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Editor: Professor John Pickford of the WEDC Centre, Loughborough
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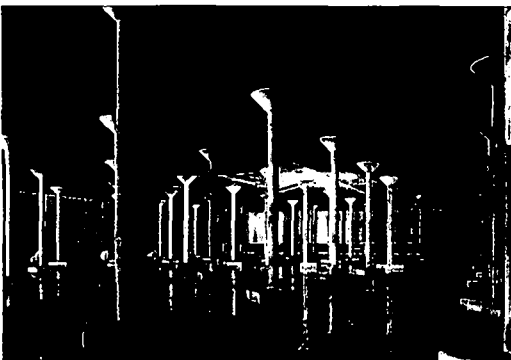
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INTRODUCTION

The Water, Engineering and Development Centre (WEDC) at Loughborough University of Technology has been pleased to associate again with Grosvenor Press International in the preparation of this fifth volume of Developing World Water.

It comes at a time when the International Drinking Water Supply and Sanitation Decade (1981-1990) is drawing to a close. Much remains to be done, so we look forward in the 1990s to further progress in providing water supplies and adequate sanitation for those in greatest need. Our objective now is 'Health for all by the year 2000'.

Volume 5 of *Developing World Water* continues the pattern of Volume 4. There are far fewer editorial articles than in the first editions. Emphasis is given to information about manufacturers and suppliers of equipment and services related to water. We hope that this information will prove useful to engineers and administrators in developing countries who are responsible for purchase.

Good clean drinking water is essential for health. Water that is near at hand and available for agriculture and industry is an important basis for development. So in this volume attention is

given to water for domestic use and also for irrigation and industrial activity. We have tried to cover the whole range of water use, including the need to deal with water after it has been used. Adequate treatment of wastewater is essential to maintain quality so that any downstream users are protected to the greatest possible extent.

Protection of the environment is vital for the health and well-being of all the people of developed and developing countries, and for the health and well-being of our planet as a whole. This has led to the concern of environmental groups and 'green' political activity with waste water.

The International Drinking Water Supply and Sanitation Decade has given particular attention to the needs of rural areas. In developing countries the the majority of the population is still rural. In many countries rural people are amongst the poorest. Their poverty



ABOVE: John Pickford

can be measured in terms of cash available and also in terms of basic amenities, in education, communications, housing and health care.

Good quality, easily available, safe water makes a tremendous difference to the 'quality of life'. However, as we approach the 21st Century there is greater awareness that the trend towards urbanization is posing ever increasing problems. More and more people are living in towns and cities. Their rate of population growth exceeds that of rural areas in almost every country. In the slums and derelict areas of old cities and in the sprawling peri-urban fringe areas of towns and cities hundreds of millions of men, women and children exist with inadequate water supplies and sanitation. More attention, more planning, more money, more and better equipment, better operation and maintenance and better management are all desperately needed to secure

improvements to their water supplies and waste disposal.

To help cope with this situation WEDC is giving more attention to the whole gambit of urban needs in developing countries. WEDC is particularly concerned with training of engineers, scientists and managers from developing countries. The expertise built up over many years is also used for research and is available for consultancy. Our involvement in preparation of *Developing World Water* is one way in which WEDC seeks to disseminate relevant and appropriate information and ideas.

John Pickford

Editor-in-Chief: Professor John Pickford, OBE
Water, Engineering and Development Centre
(WEDC)

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Leicestershire LE11 3TU England

WEDC

The Water, Engineering and Development Centre is a financially independent unit within Loughborough University of Technology, England. It is devoted to research, training, consultancy and other activities related to the planning, provision, operation and maintenance of water supplies, sanitation, urban engineering and rural development in the Third World.

WEDC is active in Africa, Asia and Central America.



WEDC is particularly concerned with:

- Site preparation, water supply, disposal of liquid and solid waste, roads and communications, buildings and other services that improve the health and well-being of people living in towns and cities;
- Small-scale irrigation, rural water supply and sanitation, and other facilities for the economic and social development of rural areas;
- Refugees and the relief of natural and man-made disasters;
- Appropriate technology, cost-effective design and construction, sustainability through good operation and maintenance, the optimisation of institutional support, and health education, mobilisation and participation of communities;
- The integration of technological, social and management inputs for development.

The WEDC team consists of professional staff engaged in research, teaching and consultancy related to developing countries, supported by information, research, publicity and secretarial assistants. Members of the team have considerable experience of developing countries, which is continually updated by work in the field for government departments, local government, international agencies, non-government organisations and consultants.

Current WEDC research includes an investigation of reduced cost sewerage, with field studies in Africa, Asia and Latin America. Various

aspects of irrigation are being studied in Bangladesh, Morocco and Zimbabwe. Infrastructure for housing for low-income communities, management of municipal services and disposal of septic tank effluents are amongst other projects in hand.

CONSULTANCY:

WEDC staff undertake assignments that are often specialist inputs to projects by consulting firms. In



RIGHT: An African engineer on a practical WEDC course.



ABOVE: Students involved in a simulation game during a WEDC course at Loughborough.

In addition, WEDC undertakes contracts for small studies where the special expertise of staff can be utilised.

WEDC conferences are held alternately in Africa and Asia. African venues have been Zaria and Kano in Nigeria, Harare in Zimbabwe, Dar es Salaam in Tanzania and Lilongwe in Malawi. In Asia conferences have been in Calcutta and Madras in India, and at Kuala Lumpur (Malaysia) and Singapore.

WEDC has a range of courses at Loughborough for experienced professionals. Most of those attending come from developing countries, although there are always a few participants from industrialised countries – people who have worked, or who intend to work, in the Third World. Courses held each year include MSc courses and courses leading to a Diploma of Loughborough University of Technology.

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BELOW: WEDC staff are particularly concerned with the socio-economics of low-income communities in their research and consultancy in developing countries.



professionals involved in providing, operating and maintaining services in cities and towns.

- Urban engineering for developing countries – which is particularly suitable for municipal and government engineers working in small and medium size towns.

- Water and waste engineering for developing countries – includes water resources, urban and rural water supply, wastewater, solid waste management, project preparation and contract management, irrigation and design practice – for engineers with good honours degrees.

- Lecturers' programme – for university and college lecturers.

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ABOVE: A group of participants at the 15th WEDC Conference at Kano in Nigeria.

- Community technology for rural development;
- Community water supply and sanitation;
- Groundwater development;
- Infrastructure for low-income urban housing;
- Irrigation and water resources;
- Management of municipal services;
- Project preparation for environmental engineers;
- Solid waste management and environmental health;
- Urban water supply;
- Water analysis and quality.

WEDC regular annual courses also include a 9-month pre-MSc course, a 7-month diploma course in water engineering and a 6-week certificate course in practical water supply and sanitation.

For further details contact Professor John Pickford or Mrs Rowena Steele, WEDC, Loughborough University of Technology, Leicestershire LE11 3TU, England. Tel: +44-509 222390. Telex: 34319 UNITEC G. Fax: +44-509 210231.

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WATER RESOURCES

DEVELOPING RESOURCES – A GROWING CHALLENGE

by Dr K Jayaraman, University of Zimbabwe

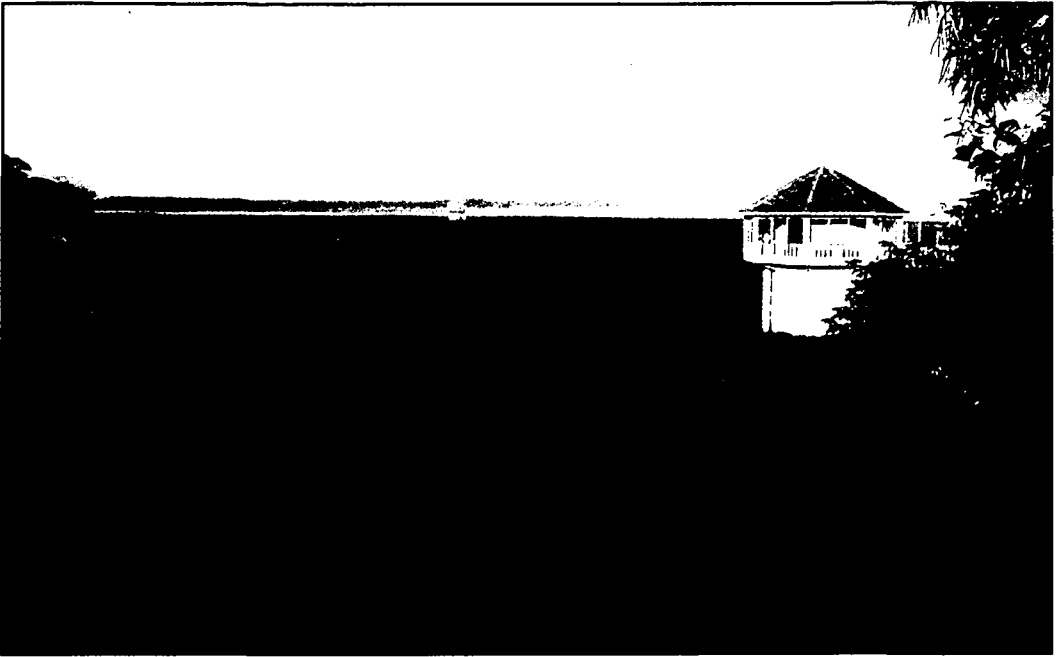
Protecting the precious water resources from pollution and providing potable water have generated a world-wide action on a scale never witnessed before. But is it adequate and appropriate?

Water is vital to the health, safety and socio-economic development of man. Water resources management has played a crucial role in the development of the earliest civilisations in the valleys of Tigris and Euphrates, Nile, Indus and Yellow River. But, in the past, water has been regarded as an unlimited resource and little consideration was given to problems and impacts associated with water consumption. Population growth, advances in agriculture, urbanization and industrialisation made water pollution a 'sudden interest' subject of the mid-20th Century, and along with it came into the limelight a considerable segment of the world's population, especially in the Third World, which has long been denied an easy access to potable water – a minimum basic need.

Many parts of the world face such a scarcity of water that they now recognize that water resources development ought to be an inherent part of the socio-economic development process. Though the endeavours of the past – as exemplified in Iran where the existence of more than 50,000 hand-excavated underground tunnels (ghanat) with a length of up to 70km and a depth of up to 300m – symbolize the struggle and perseverance of the countries in quest of water, women and children of today's Third World spend considerable

time and energy in collecting the minimum required quantities of water from sources at considerable distances from home. In many parts of the world, women spend about four to eight hours a day drawing and carrying water. There is little doubt that a number of areas in the world will increasingly face a water crisis in the near future. In Africa nearly 50 per cent of the total surface water sources are in one single river basin, that of Congo. Nearly 75 per cent of Africa's total water resources are in eight major river basins – Congo, Niger, Ogoone (Gabon), Zambezi, Nile, Sanega (Cameroon), Chari-Lagone (Lake Chad Basin), and Volta. In mid-1984, no less than 24 countries in the world were described by FAO as being seriously affected by the drought which has existed for several years. Lack of water is the single greatest barrier to development in the developing countries of the world.

Where water is readily available as in surface sources of rivers and lakes, man has been exploiting this precious resource without any consideration to its impact on the water quality or on the ecological equilibrium. The great lakes bordering eight states of the United States and the province of Ontario in Canada, which contain approximately one-fifth of the world's fresh surface water supply and provide drinking water



ABOVE: *Water hyacinth in Lake Mcllweyn in Zimbabwe*

to more than 20 million people, is now exposed to toxic pollution and accelerated eutrophication. In England and Wales, where 34 per cent of public water supply depended on river sources, approximately 12,000 pollution incidents were reported in 1983. These incidents cause about 100 intake closures per year. In 1986, China produced more than 36 billion metric tonnes of domestic and industrial wastewaters most of which goes straight into rivers, lakes and estuaries without any treatment. 85 per cent of the river waters in China has quality indices below minimum drinking water standards.

In many areas, lakes not only serve themselves as a source of drinking water, but also influence the water quality in rivers, eg water quality in the River Nile is highly dependent on the water quality of the upper Nile lake system – Lake Victoria, Lake Kyoga, and Lake Mabuto Sese Seko. Many lakes face the danger of growth of floating, submerged and marginal aquatic plants which harbour disease vectors like snails, accelerate water losses through transpiration and interfere with navigation and other uses of water. The water fern in Lake Kariba and water hyacinth in Lake Mcllweyn in Zimbabwe are typical examples. Water hyacinth is also a major problem in many

impoundments in tropical and sub-tropical areas of Asia and South America as well as in the United States. While the rivers in the industrialised countries have already been adequately harnessed for navigation and energy, the Third World will have more large dams built in the ensuing decades to exploit their enormous energy potential. The eutrophication which used to be a problem only in lakes and reservoirs is now appearing even in many stretches of rivers in Europe. The European rivers have the highest average nutrient levels – about 45 times higher than the natural background.

Public water supply in many parts of the world is largely based on groundwater abstraction, the percentage varying from 99 per cent in countries like Denmark and Austria to 65 per cent in the Netherlands. About one-half of the total population in the United States relies on groundwater for their domestic water supply. Flushing of the polluted aquifers is not possible thus necessitating effective preventive measures for groundwater protection.

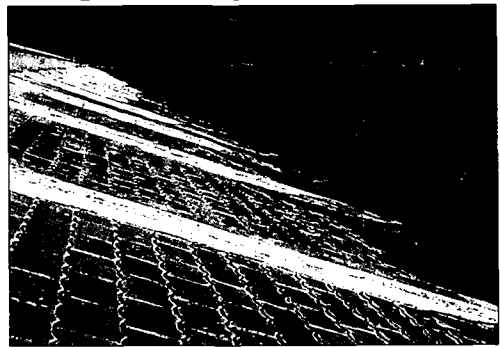
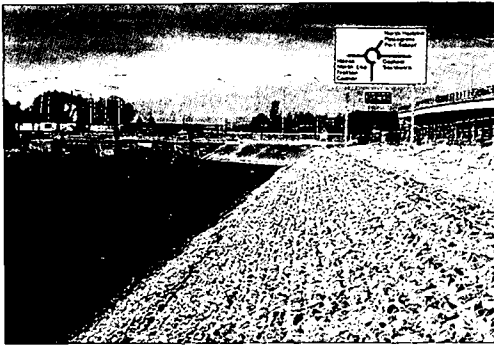
Water is our greatest single vital natural resource, which the developing world cannot afford to misuse. It will continue to be a renewable resource only as long as its use is well regulated for various aspects of human life. There

is an urgent necessity for sustainable water development which would ensure optimal utilisation of available waters as well as maintenance of its quality. Conservation, management and quality maintenance of water is of equal significance to urban and rural regions alike. The ability to provide drinking water for people will clearly be tied to our ability to manage this resource for all our needs. Implementing conservation measures, preventing pollution from domestic, industrial and agricultural activities, and avoiding over-exploitation for any particular purpose should be given serious consideration. There is no doubt that water pollution control efforts which have been under way for some years in some countries have already borne some fruit as reflected in their more efficient wastewater treatment facilities for the municipalities and industries as well as in the improved conditions of their rivers. Nevertheless the problems that are confronted are getting more complex and more severe than hitherto. Also in many countries the regulations have not been able to catch up with the problem. Reducing wastewater

loads and also water demands, improved water-use habits and community education are areas which need more attention in many parts of the world.

A strategy for an efficient water resource management should have its basis on a national, and in many cases international, water use policy which must be fair and comprehensive. Sincere commitment at a national level, dedicated work of all the professionals charged with administering the programme, and public understanding and support for the water conservation and pollution control efforts are indispensable if our water resources are to be managed for the maximum benefit of the society. As we are all ignorant – of course, about different things – a coordinated and cooperative approach on a community or watershed basis is a prerequisite for protecting this vital resource. This issue of efficient water resources management must be settled now for the benefit of not only this generation but for untold generations to come. It is time we 'really know' if we are doing 'enough' of what we 'really want' to do of what we should actually be doing.

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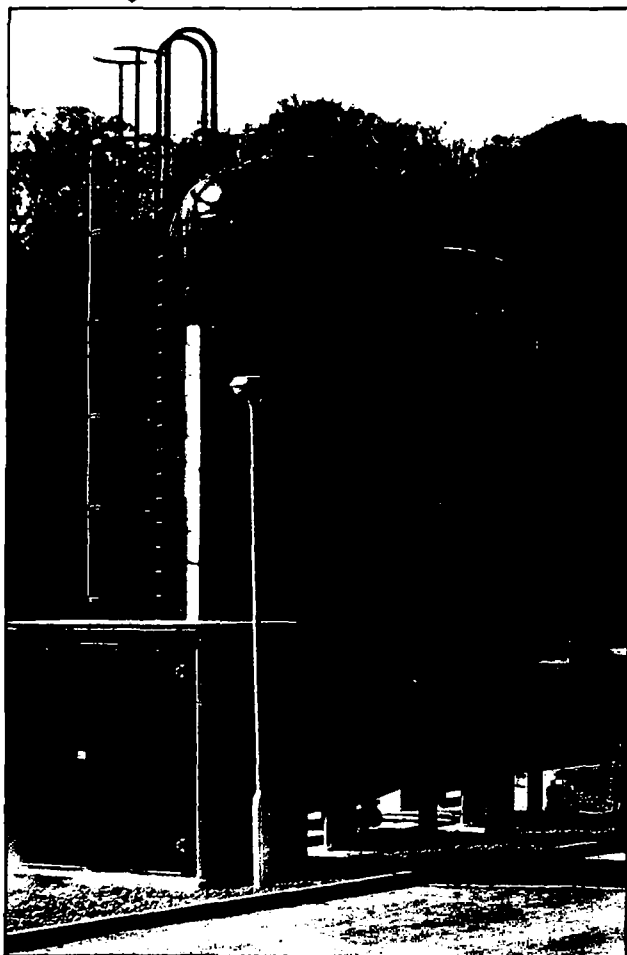
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Vigano Brianzo 2, Via G. Galilei, Como 22060. Italy. Tel: +39-39-949 471. Telex: 335301. Fax: +39-39-955 853. Tenax is the trade mark throughout the world of a wide range of extruded nets made totally of plastic material. In particular Guigher Spa produce tubular nets specially for the cultivation of mussels in sea water. Tenax nets do not deteriorate and their original properties and strength are not affected in salt water conditions. In addition to the Tenax structures for growing mussels, there are other nets suitable for packing, dispatch and sale of mussels and also oyster bags.

MARSUN BROSYSTEM,

PO Box 154, Halnstad 30103. Sweden. Tel: +46-35-109 670. Fax: +46-35-11 1194. Specialised in water treatment

for aquaculture farming of fish and crustacean. Oxygenation, nitrification, aeration, filtration and heat exchange.

REDPORT NET CO LTD,

94 East St, Brixport, Dorset DT6 3LL. UK. Tel: +44-308 22592. Fax: +44-308 27934. Manufactures and makes up of all types of materials, webbing and netting for use in many fields, especially angling, fish farming and pisciculture. Netting machines that are suitable for filtration purposes, to that used for deep sea fishing.

TIFA (CI) LTD,

50 Division Avenue, Millington, NJ 07946. USA. Tel: +1-201-647 4570. Fax: +1-201-647 2517/7338. Fishery chemicals.

WEBER SENSORTECHNIK GMBH, 2201 Kollmar. West Germany. Tel: +49-04128 591.

Telex: 218326. Fax: +49-04128 593. Flow-captor flow switches and meters provide reliable and accurate control of water systems and operate with high repeatability. Combined with the flow-captor Eurocard system complete measurement systems can be installed to provide central adjustment and panelling of measuring points for eg re-circulated water systems in pisciculture. Vent-captor switches and meters for air and gaseous media provide reliable monitoring of air circulatory systems and ventilating in fish farming plants.

WESTMOOR LTD,

3452 North Knox Avenue, Chicago, IL 60641. USA. Tel: +1-312-282 2237. Fax: +1-312-282 4954. Manufacture rotary vane, positive displacement air blowers used for aeration. Products include pumps and pump units plus aeration kits. Aeration systems by Westmoor are used in waste water facilities, lake management and aquaculture, where conventional blowers are unable to overcome the static pressure of greater than 3ft of water.

YSI INC,

YSI Scientific Ltd, Lysons Avenue, Ash Vale, Aldershot, Hants GU12 5QR. UK. Tel: +44-252 513006. Telex: 858210 INSTCOG. Fax: +44-252 511855. YSI dissolved oxygen and conductivity instruments monitor wastewater treatment and provide environmental control and enforcement. Other YSI systems help maintain pure water supplies by measuring temperature, pH, conductivity and ORP in surface water and groundwater as it's pumped from test wells. YSI instruments

BANK PROTECTION, RIVER TRAINING & CANALS

assure healthy crops of fish and shellfish in hatcheries and on fish farms.

BANK PROTECTION, RIVER TRAINING & CANALS

AQUATICS UNLIMITED,

2150 Franklin Canyon Rd, Martinez, CA, 94553. USA.
Tel: +1-415-370 9175. Fax: +1-415-370 9179.

Manufacturer of Aquamog - a multi purpose marine maintenance vessel with many easily interchangeable attachments. Aquamog cuts aquatic weeds deep and fast, rotates hydrosol, removes rooted vegetation. Aquamog is a powerful suction dredge and bucket dredge. Self propelled, eliminates cables, reduces downtime, reaches under piers, inside boat slips, close to shore and cleans waterways.

CONCRETE ARMOR SYSTEMS,

3 Garmany Place, Yonkers, NY 10710. USA. Tel: +1-914-779 5858. Research and development of concrete shapes for bank stabilisation and flood walls. Designed products for river and coastal protective works.

DE HOORN/NEDERHEMERT BV,

PO Box 1, de Uiterwaard 3, 5317 ZG Nederhemert. Holland. Tel: +31-04185 433. Telex: 50517. Fax: +31-04185 863. Manufacturer of the BASALTON and the BETOMAT systems. The BASALTON-system consists of concrete units which provide a hard durable armouring, whilst remaining both flexible and permeable. The units are placed mechanically and in polygon bond. Different heights and/or weights can be delivered to any wave climate. The BETOMAT system, a concrete blockmat system, is an extremely economic solution for the protection of banks and slopes. Quick to lay, even underwater, and with a maximum resistance to erosion and wave action.

DE LANGE PLASTIC LININGS,

Neptunusweg 4, 8939 AA Leeuwarden. Holland. Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

GOMACO INTERNATIONAL LTD,

769 Buckingham Avenue Trading Estate, Slough, Berks SL1

4NL. UK. Tel: +44-753 821926. Telex: 847243

GOMACO G. Fax: +44-753 693093. Concrete lining and finishing for canals.

GRASS CONCRETE LTD,

22 Bond St, Wakefield, West Yorks. UK. Tel: +44-924

374818/375997. Telex: 51458. Fax: +44-924

290289. Grass Concrete provides a range of concrete surfacing, for spillways, embankment stabilising, service access etc. The range of products includes reinforced, insitu concrete blocks.

HYPOFORS VOF,

Velperweg 76, Postbus 9300, Arnhem 6800 SB. The

Netherlands. Tel: +31-85-664593. Telex: 44-45204. Fax:

+31-85-662070. Hypofors is a prefab, flexible, 5m wide

reinforced bituminous liner. The membranes are manufactured on rolls in lengths up to 80m. Because of its sturdiness, dimensional stability and easy maintenance, Hypofors is highly suitable for the repair of damaged concrete lined irrigation canals.

MARSON BROSYSTEM,

PO Box 154, Halmstad 30103. Sweden. Tel: +46-35-109

670. Fax: +46-35-11 1194. Specialised in water treatment for aquaculture farming of fish and crustacean.

Oxygenation, nitrification, aeration, filtration and heat exchange.

NETLON LTD,

Kelly St, Blackburn, Lancs BB2 4PJ. UK. Tel: +44-254

62431. Telex: 63313. Fax: +44-254 680008. Tensor

Mat is an effective and permanent method of controlling the erosion of wet or dry slopes, and Tensor or Netlon gabions provide effective and non-corrodible erosion control structures. Netlon drainage pipes have high flow capacities and provide fast and effective irrigation and drainage. Netlon drainage nets are high profile structures used in the construction of lagoons and similar structures.

OFFICINE MACCAFERRI SPA,

PO Box 396, Via Begli-Agresti No 6, Bologna 40123.

Italy. Tel: +39-51-234503. Telex: 510649. Fax: +39-51-

236507. Maccaferri gabions, reno mattresses and rockfall netting for training and hydraulic protection structures, soil protection and soil conservation. Stabilisation of roads, railroads and airports. Protection of residential and industrial installations, linings of dams and water courses. Lake and coastal protection works.

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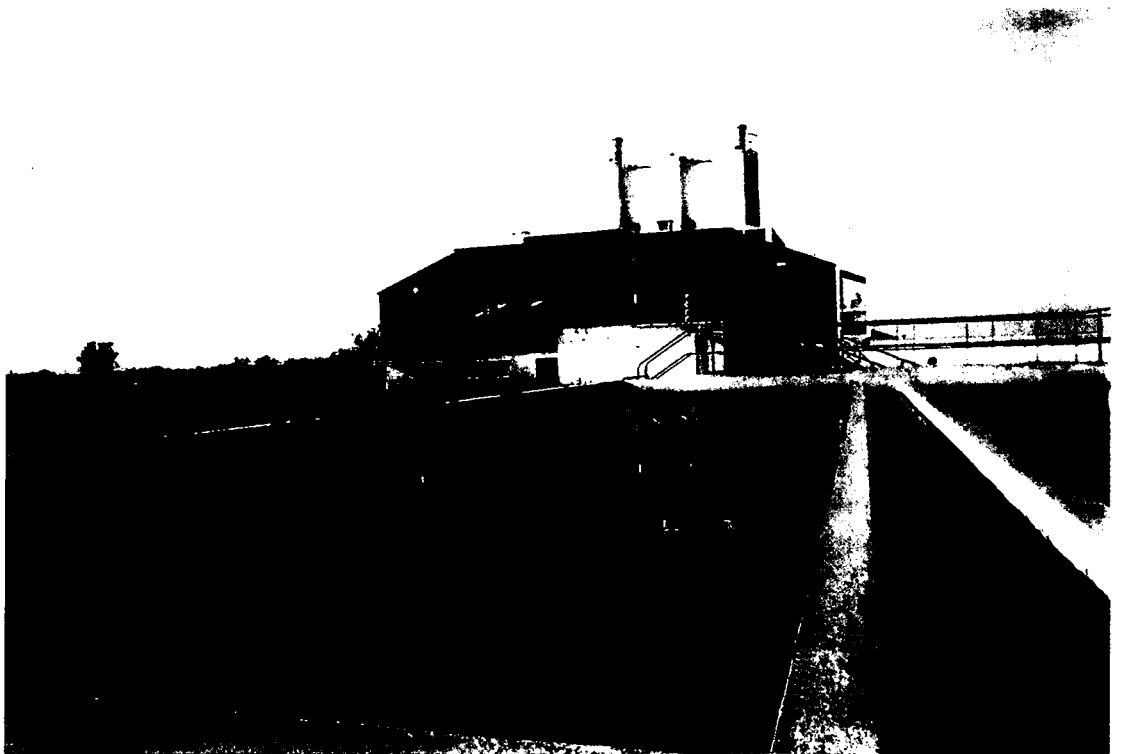
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Telex: 689 292 SAUR F. Fax: +1-33-30-60-27-89.

SAUR is the third largest water treatment and supply group in France where it serves 5,500 local authorities. It also handles waste water collection and treatment for 1.6 million people and collects and processes refuse from one-and-a-half million inhabitants. SAUR ensures the design and the execution of the plants necessary for the treatment of water and refuse (2,000 building references). The international activity of SAUR represents 38 per cent of the global activity. SAUR is present in Europe (Great Britain, Spain, Italy), in Canada and in Africa (15 countries) and serves 16 million people throughout the world.

SOYUZGIPROVODKHOZ,

Water Resources & Research Institute, 2 Yeniseiskaya St, 129344 Moscow. USSR. Tel: +1892196. Telex: 412198 INWOD SU. Fax: +1892355.

It is a major Soviet organisation in surveys, planning and studies relating to land reclamation and water management. It offers: engineering services, know-how, ready-to-use engineering and process developments, training of personnel, joint activities in design and construction on a turnkey basis operation and maintenance of water-resources and irrigation projects.

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131. Manufactures an extensive range of precast concrete products and systems for the water and allied industries. Including precast concrete chambers designed to meet all the needs of the water industry and used extensively throughout the UK. A comprehensive range of concrete revetment systems pioneered and developed by the Company to meet the diverse needs of erosion control engineering.

TERRA AQUA GABIONS,

4930 Energy Way, PO Box 7546, Reno, Nevada 89510, USA. Tel: +1-702-329 6262. Fax: +1-702-329 7530.

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Destructifiers for lakes, ponds or reservoirs to improve water quality and to reduce the cost of chemicals needed to treat finished water.

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31995. Land reclamation and levelling; laser controlled, dam building and irrigation.

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Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

GALLIFORD SPECIALIST SERVICES LTD,

PO Box 33, Milton Masor, Northampton, NN7 3AD. UK.

Tel: +44-604 858031. Fax: +44-604 858561. Undertake

specialist repairs to water towers, underground reservoirs and general water retaining structures, ie concrete repairs, crack sealing, internal lining and external waterproofing, joint renewal and epoxy paint applications.

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+925-11-31. Telex: 875540. Fax: +41-1-923-62-45.

Suppliers of equipment for dam construction: grouting equipment and grouting systems.

LOSINGER LTD,

Koenizstrasse 74, CH-3001 Berne. Tel: +41-31-664444.

Telex: 912212. Fax: +41-31-664400. Contact Name:

Peter Comiotto - Vice President. Dam and reservoir linings.

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Curved steel sections open up new scope for economic shaft and cofferdam design. Universal columns curved about the major axis form high modulus curved walings and shaft rings

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236507. Maccaferri gabions, reno mattresses and rockfall
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roads and airports. Protection of residential and industrial
installations, linings of dams and water courses, lake and
coastal protection works. Rockfall and security netting.

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98 Telex: 57400 Rund-Stahl-Bau is engaged in the
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Manufacturers and suppliers of dam instrumentation, incli-
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SOIL INSTRUMENTS LTD,
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5044. Telex: 95123 SO.IN. Fax: +44-825 61740. Soil
Instruments Ltd is a leading manufacturer of geotechnical
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Foundation engineering specialists; boring and grouting for
dams and reservoirs

VERBUND-PLAN GMBH,
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0222-53113 4800. Telex: 115978 VPLWN A. Fax:
+43-1-0222-53113 4848. Verbund-Plan has more
than 30 years experience in providing consultancy
services for dams and reservoirs in the Austrian Alps
as well all over the world. The services include feasi-
bility studies, hydrological studies, detail design,
construction supervision, detail design and monitoring
of all types of large dams (height up to 200m).**

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**AGRU ALOIS GRUBER & SOHN
EHG,**
Grunburger Strasse 41, Baa Hall A-4540 Austria. Telex:
28151 GRUBER A. Fax: 43-7258-21-72-74. Gruber a
Agru sealing systems of polyethylene (HDPE) are used for the
bottom and top sealing of domestic and special waste tips,
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extruded widths of 5m and thicknesses of 1.5 to 5mm, stan-
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weather-resistant and rotproof and thanks to their physical,
chemical and biological properties ensure reliable sealing of
refuse dumps and full ground water protection

**AKZO-FIBRES & POLYMERS
DIVISION CIVIL ENGINEERING
& INDUSTRIAL SYSTEMS,**
PO Box 9300, Arnhem 6800 SB, The Netherlands. Tel:
+31-85-664593. Telex: 45204. Fax: +31-85-663727.
Civil Engineering & Industrial Systems Division of Akzo is
active in agriculture, the building industry, environmental pro-
tection, erosion control, geotechnics, hydraulic engineering
and industry. The activities range from consulting during the
design stage to assisting with the realisation of projects

ALBERS BV,
Nude 37b, Postbus 44, Wageningen 6700 AA. The

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Netherlands. Tel: +31-8370 20464. Telex: 45793.

Alligator lining membranes are durable, flexible and impermeable. Albers BV use the most up to date technologies in the prefabrication and installation of these membranes. By virtue of a professional approach, sound engineering and the know-how of experienced personnel, Albers BV are capable of providing an economical solution to practically any sealing problem.

ALLEN PLASTICS (SITE LINING) LTD,

Edison Rd, Church Fields Industrial Estate, Salisbury, Wilts SP2 7NU. UK. Tel: +44-722 28873. Fax: +44-722 26799
Allen Plastics (Site Lining) supply and install lining membranes for all types of liquid retaining projects. They are able to fabricate large sections of flexible linings in their factory, transport them to any site, joint by welding, to produce any size.

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Kostverlorenhof 2, Amstelveen 1183 HE. The Netherlands. Tel: +31-20438901. Telex: 14577. Fax: +31-20459887.
Manufacturers of a full range of woven and non-woven geotextiles for use in waterworks construction and reinforcement applications.

ANAPLAST LTD,

Lundholm Rd, Stevenston, Ayrshire KA20 3NQ. UK. Tel: +44-294 605111. Telex: 778185. Fax: +44-294 601125. Manufacturers of heavy duty polythene sheeting for reservoirs.

BRITISH VISQUEEN LTD,

Yarm Rd, Stockton-on-Tees, Cleveland TS18 3RD. UK. Tel: +44-642 672288. Telex: 58509. Fax: +44-642 677599. Manufacturers of reservoir linings and geomembranes (including polytarp).

BURKE RUBBER CO,

2250 South Tenth St, San Jose, CA 95112. USA. Tel: +1-800-669 7010. Fax: +1-408-280 0699. Burke Rubber Co is the world's leading and oldest manufacturer and supplier of flexible membrane liners and floating covers made with Dupont Hypalon® CSPE. Applications for Burke liners and covers are found in each of the following industries: potable water, wastewater, sewage treatment, chemical, oil and gas, mining, pulp and paper utilities and methane production facilities. Burke provides complete engineering and design assistance in the selection and specification of the proper material construction and details for installation.

BUTEK LTD,

11 Radford Crescent, Billericay, Essex CM12 0DW. UK. Tel: +44-277 653281. Telex: 99270. Fax: +44-277 657921. Fabrication and installation of synthetic rubber and plastic membranes for water storage, oil pollution, effluent, lagoons, reservoir roofs and other specialised applications. Also manufacture water tanks.

DE LANGE PLASTIC LININGS,

Neptunusweg 4, 8939 AA Leeuwarden, Holland. Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

ECC NV,

Terbekehoofdreef 50/52, Wilrijk 2610. Belgium. Tel: +32-3-828 9495. Telex: 73332 ECC. Fax: +32-3-830 2769.
Synthetic resins - epoxy, acrylic and polyurethane based; geomembranes - bentonite and HDPE, special techniques for watertightness, solidification of waste sediments, hydroseeding and other environmental techniques.

ESMERY CARON,

20 Avenue du Maine, Paris 75015. France. Tel: +33-1-45442490. Fax: +33-1-2002070. Manufacturers of geotextiles and geomembranes.

FOSS EUROPE LTD,

Marbury, Whitchurch, Shrops SY13 4LN. UK. Tel: +44-948 5406. Fax: +44-948 5406. Foss Mfg Co Inc, USA. Telex: 953053. Foss Geomat® - manufactured nonwoven needle punched geotextiles for use in a wide variety of applications, including geomembrane protection. Thick and permeable, Geomat® provides an excellent filter media for lateral water flow and gasses in addition to cushioning of flexible membrane liners. Produced by Foss Mfg Co Inc, USA.

GENAP BV,

PO Box 27, 7040 AA S-Heerenberg, The Netherlands. Tel: +31-8346 61644. Telex: 45586. Fax: +31-8346 62137. Contact Name: Mr Fred Verschoor. Genap BV specialises in the manufacturing and installation of PVC membranes up to 2.00mm, HDPE up to 3.00mm etc. Qualified production and installation staff, coupled with the latest equipment ensure the perfect solution for any sealing problem. Experience in many European countries plus Africa, and the Middle East.

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Velperweg 76, Postbus 9300, Arnhem 6800 SB. The Netherlands. Tel: +31-85-664593. Telex: 44-45204. Fax: +31-85-662070. Hypofors is a prefab, flexible, 5m wide reinforced bituminous liner. A thin bi laterally drawn polyester film incorporated in the membrane prevents the penetration by roots and plants. The type of reinforcement (non woven, fabric) determines the mechanical properties. The composition of the bituminous mass can be chosen to fulfil the local requirements of the project.

ICI FIBRES GEOTEXTILE GROUP.
Pontypool, Gwent NP4 0YD. UK. Tel: +44-4955 57722. Telex: 498 208 ICI FPP. Fax: +44-4957 62772. Manufacturers of geotextiles for the construction industry including filters, laminated filter drains and high strength products under the trade names Terram, Filtram and Paraproducts.

MECAROUTE.
36 Rue de Sully, Boulogne-Bilancourt 92100. France. Tel: +33-1-46043300. Telex: 200080. Fax: +33-1-46042350. Products for hydraulic works, embankment, civil engineering and road works; geotextiles (woven and non-woven); manufacturers of bags and geotextiles clothes; geomembranes (bitumen and polymer); geosynthetics and biodegradable textiles.

MEMPERTECH MARKETING.
2019 West County Rd C, Roseville, MN 55113. USA. Tel: +1-612-631 1145. Distributor of components to manufacturers of membrane processing equipment of all sizes. Included are RO membrane elements, pumps, housings, pre-treatment and post-treatment equipment.

MONARFLEX LTD.
Lyon Way, St Albans, Herts AL4 0LQ. UK. Tel: +44-727 307 16. Telex: 826542. Fax: +44-727 68045. Monarflex Geomembrane Lining System has been installed throughout

the world for a wide variety of applications which include: seeping and leaking reservoirs, root zone sewage treatment, slurry lagoons, methane gas barriers, water landscaping and water containment. Monarflex have a worldwide supply and installation service and have completed huge projects in many countries of the world. As manufacturer and installer, Monarflex offer sole responsibility on all contracts undertaken by their own installation engineers.

NAUE - FASERTECHNIK GMBH.
Gewebesrasse 2, Espelkamp D-4992. West Germany. Tel: +49-5743 410. Telex: 972178. Fax: +49-5743 4133. Manufacturers of a complete range of geotextiles, especially non-woven types.

NIEDERBERG CHEMIE.
PO Box 1163, Neukirchen-Vluyn D-4133. West Germany. Tel: +49-2845 8080. Telex: 8121138. Carbofol pioneers new approaches to hydraulic engineering construction. The technologies rendered possible by Carbofol linings eliminate the possibility of water loss through seepage while at the same time reducing installation costs.

NORTH AMERICAN GREEN.
PO Box 66, Ingfield, IN 47618. USA. Tel: +1-812-867 6632. Fax: +1-812-867 6632. Manufacturers of a variety of erosion control blankets. The blankets have been certified by laboratory testing and field evaluations to quantify erosion control effectiveness. The blankets are constructed of all natural materials.

OFFICINE MACCAFERRI SPA.
PO Box 396, Via Begli Agrestii No 6, Bologna 40123. Italy. Tel: +39-51-234503. Telex: 510649. Fax: +39-51-236507. Maccaferri gabions, Reno mattresses and rockfall netting for training and hydraulic protection structures, soil protection and soil conservation. Stabilisation of roads, railroads and airports. Protection of residential and industrial installations, linings of dams and water courses. Lake and coastal protection works. Rockfall and security netting.

PRESTON PRODUCTS INC.
PO Box 2399, Appleton, WI 54913. USA. Tel: +1-414-739 9471. Telex: 887187. Fax: +1-414-738 1496. The geosystems division of Presto Manufacture have two primary systems - geoweb and geoblock. Geoweb applications include erosion control, low water crossings, shoreline protection, retaining walls, spillways and pavement construction.

PURO, BELGIUM,

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PO Box 511, Industrial Rd, Old Hickory, TN 37138, USA. Tel: +1-615-847 7132. Fax: +1-615-847 7068. Manufacturer of nonwoven spunbonded polyester and polypropylene fabrics for agricultural, apparel, furniture and bedding, filtration, geotextiles and construction fabrics applications.

S ROBB & SON,

Unit 3c Cromwell Business Park, New Rd, Stives, Combs PE17 4BG, UK. Tel: +44 480 62150. Suppliers and installers of flexible liners for water storage and landfill sites, also offering an advisory service prior to installation. Work includes ornamental ponds and lakes, storage lagoons and reservoirs in sizes from garden ponds up to 35 acres.

SCHLEGEL LINING TECHNOLOGY GMBH,

Bredowstrasse 33, Hamburg 74 D-2000, West Germany. Tel: +49-40-733290. Telex: 2163748 SLT D. For many years Schlegel Lining Technology has been known as the manufacturer and installer of a highly qualified liner – the Schlegel sheet. Schlegel sheet was developed to meet the exacting requirements of large area sealing applications such as waste disposals, water reservoirs, canal linings etc. Schlegel sheet, being manufactured by a purpose designed patented process in rolls 10m wide, and depending on thickness, up to 200m long, has become the key element of present day waste disposal.

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16945 Northchase, Suite 1750, Houston, Texas 77060, USA. Tel: +1-713-874 250. Fax: +1-713-874 2168. SLT is known as a world leader in the design, manufacture and installation of high-quality HDPE geomembrane systems. SLT products are premium grade and intended for the exacting

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DEVELOPING WORLD W A T E R

Entries ending in WT are taken from Water Technology Magazine's Planning & Purchasing Handbook. The subscription Magazine, 13 Century Hill Dr, Latham, NY 12110, USA. Telephone (518) 783-1281.

GIORGIO ARMANI

EFFICIENT WATER WELLS

by Bill Moffat

The design of any water borehole should ensure that the installation will provide clean potable water for the whole of the planned design life. The secret of a long life borehole is not in the drilling but in the development of the bore and the design of the permanent installation

Modern rigs can drill almost any rock type fast and efficiently. Choice of rigs include percussion, mud and air flush rotary and down-the-hole hammer drills. In selecting drilling equipment for a developing country it is important to choose the correct drilling method to suit the rock types which are expected, to select the machine that is of a suitable size and manoeuvrability so it is able to reach all the borehole sites easily, and one that can be maintained with the resources that are readily available.

This frequently means that a compromise is necessary. Generally the large and more technically developed the drilling equipment the faster it will produce footage but the maintenance will be more complex. This probably means that repairs and maintenance will be dependent on imported spares and the resulting drain on foreign exchange.

It may be prudent to select a smaller and simpler drilling rig which will produce boreholes at a slightly slower rate with a smaller demand on scarce foreign exchange. The largest high speed rigs are often able to drill at least a borehole a day and it requires a very efficient organisation to supply screen, casing and pump at a similar rate. If the finishing of the installations fall well behind, drilling money is being used inefficiently in high speed drilling, since the bores will remain unused

for a period and possibly become vandalised.

Local criticism will also be engendered and complaints will follow on the slowness of pump installation. In the most efficient schemes, drilling speeds and pumping speeds are integrated so a continuous flow of well designed boreholes are produced and local enthusiasm and co-operation is enhanced.

Consideration should perhaps be given to using a special rig for test pumping the completed bore since this releases the drilling rig earlier. Atlas Capco have developed the TPC-02 for such work and when used in conjunction with their Well Monitor computer system very efficient testing is possible.

The Well Monitor system records the well drawdown during step pumping by means of a transducer and data logger, and the integrated computer program performs the test pumping calculations in the field. The system claims that a complete well evaluation can be obtained in the field within one hour of the pumping test being completed.

The system also has the added advantage that the test data is held on a 3.5ins floppy disk and is fully available for later analysis or comparison with other boreholes.

Development is the most important factor to ensure that a water borehole will produce the maximum yield that the aquifer will allow. For this

to happen all the fine material generated by the drilling process must be removed from the borehole walls, and especially from the invasion zone where the material has been forced into the pore spaces and cracks in the aquifer. This removal process is difficult since it must be done after the screen and gravel pack, if required, have been installed, ie the fine material cannot be reached other than through the screen and pack.

Rotary drilling using mud is usually considered to produce the greatest problem to efficient development. Percussion drilling and air drilling, which use no mud, can still generate an invasion zone in the wall rocks of the borehole and so boreholes drilled by these methods still require development.

Bentonite was once the usual drilling mud for water boreholes but it is now almost wholly replaced by organic and polymer muds. They have the ability to break down their cohesive structure on demand and so 'fall off' the borehole walls and flow more easily from within the invasion zone. Remains of bentonite mud cake have been located in boreholes that have been in use for many years. It is doubtful if a borehole drilled using bentonite mud ever reaches its full potential due to mud retention. The new drilling additions are expected to produce much cleaner boreholes which can reach their full potential yield. This does not mean, however, that development is no longer required, and that all the cleaning can be 'left to the mud'. The fact is that much shorter development times should be needed to produce clean efficient boreholes.

Having the correct screen available when needed is always a problem in developing countries where delivery times may be protracted. The rapidly developing use of filter sleeves such as Terrafilter 110 by Demco are allowing the correct screen slot width to be more readily available by reducing cost of purchase, storage and transport.

These filter sleeves are made to fit over the commonly available sizes of slotted PVC pipe sandwiched between a water conducting sleeve and a protective sleeve. The water conducting sleeve allows free movement of water from all areas of the screen into the slots and the outer protective sleeve protects the filter material from damage during insertion and transportation.

Filters down to an equivalent slot width of 200 microns are available.

Numerous boreholes fail early in life due to the screen or pump not being selected to deal with corrosion or encrusting properties of the water. Cheaper first cost mild steel or galvanised iron screens or casing will soon fail if the groundwater is at all corrosive. It is thus prudent to check water quality by laboratory or field tests before screen selection is made. Stainless steel or thermo plastics of various types are corrosion resistant. Brass is much used in some areas as a corrosion resistant material. Care must always be taken to ensure that the brass is of good quality – poor quality products will corrode.

In some parts of the world rounded gravel of the correct gradings for gravel packs are difficult to find without transporting material in from long distances. The temptation may be to use other material such as crushed rock or other angular material easily available. This should be resisted since angular material under the vibration produced by the flow of water into the well will compact and so ultimately restrict, or even prevent, the free flow of water. Preformed screens when a slotted pipe is surrounded by resin bonded sand is also a possible alternative. They have the physical disadvantages of being heavy and some types are fragile and so require very careful transportation.

If finance is limited it is false economy to attempt to save money by skimping the development and completion of a bore. It is much more advantageous to ensure that development and completion are done to the best possible technical standards. In this way fewer bores will be required to meet the total demand so the finance available will be spent on long life boreholes rather than on more numerous bores which will fail within a few years.



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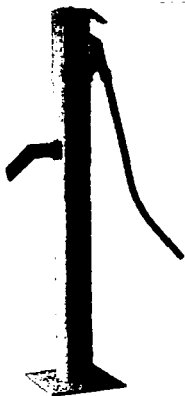
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ZI De Quincieux, 69650 St Germain Au Mont D'or. France. Tel: +33-1-78911900. Telex: 330420 Attn STI. Fax: +33-1-78911998. Contact Name: Tubafor International. Part of Tubafor Group, this company manufactures PVC casing and screens.

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PO Box 85, Zillmere, Queensland 4034. Australia. Tel: +61-7-265 5555. Fax: +61-7-265 2768. Surescreen Mfg Co Pty are leading manufacturers of continuous slot welded profile wire screens. Production comprises diameters from 0.5in to 65ins. Surescreen has total inhouse manufacturing facilities including drawing and shaping machine centres etc. Industries served are: well drilling, water treatment and others.

TUBAFOR,

BP 96, ZI Martinoire, 59393 Wattrelos Cedex. France. Tel: +33-1-20262432. Telex: 160620. Fax: +33-1-20272792. Contact Name: R Dewavrin. The factory, located in North of France, manufactures carbon steel and stainless steel casings and screens (especially bridge slotted screens). Also exclusive distributor for French market manufacturers of drilling equipment.

TUBAFOR INTERNATIONAL,

39 Champs Élysées, Paris 75008. France. Tel: +33-1-42259342. Telex: 280888 F. Fax: +33-1-4563408. Casing water well screens - bridge slotted screens, continuous slot screens and PVC screens.

TUBAFOR MAROC,

Km 4, Route de Casablanca, Rabat. Morocco. Tel: +212-7-94-865. Telex: 31694. Fax: +212-7-94-516. Contact Name: F Lardennois. Manufacture steel and stainless steel screens and perforated plates, especially for North African markets.

VAN REEKUM MATERIALS BV, PO Box 98, Apeldoorn, AB 7300. The Netherlands. Tel: +31-55-213283. Telex: 36316 VRMAP. Hand and foot pumps suitable for depths of up to 100m, cylinders and riser/rod combinations of corrosion resistant materials. Survey and construction equipment for hand drilled wells, complete with casing, tripod and hand winches. PVC casing and screens for shallow and deep wells, with several types of connections. Soil sampling equipment and acoustic sounding line measurement system. Well pointing materials with cardan quick couplings.

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PO Box 27, AA Zevenhuizen, ZH 2760. The Netherlands. Tel: +31-1802 2744. Telex: 26642 BOODE NL. Fax: +31-1802 3090. Water well casing systems. Water well

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CAPITAL ENGINEERING SERVICES,

Unit D4, Mailmech Industrial Estate, 83 Coeeth Cope Rd, Beckenham, Kent. UK. Tel: +44-1-658 2243. Capital Engineering produce a full range of pumps, both manually operated and mechanical, ranging from 0.5 horse power to 1000s of horse power for drawing water from wells and bore holes etc.

CLIMAX PUMPS,

Wildon Engineering Ltd, White Ladies Close, Little London, Worcs WR1 1PZ. UK. Tel: +44-905 22014. Telex: 337300 TAYLEY G. Fax: +44-905 723828. Contact Name: Mr T Oakley. Manufacturers of bore-hole pumps, hand operated to VLOM design, also flywheel hand driven pumps, depths to 80 metres. Handpumps can also lift above ground for storage in overhead tanks. Diesel, petrol, electric driven bore-hole pumps up to 200 metres depth, flows to 20,000 litres per hour. Climax products have a proven reliable track record.

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DEMPSTER INDUSTRIES INC,

711 South Sixth St, Beatrice, NB 68310. USA. Tel: +1-402-223 4026. Telex: 701447. Fax: +1-402-228 4389. Manufacturers of pumps, water pumping windmills, hand pumps, (including the Mark II pump) pump cylinders and pump rods.

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Ave de Maire 28, Tournai B-7500. Belgium. Tel: +32-69228152. Telex: 57399. Fax: +32-69212764.

Hand-operated pumps for deep wells also export industrial pumps. Specialise in special pumps and accessories in small quantities to clients requirements. Also pumps for all kinds of industry-chemicals, food etc.

DEPLECHIN POMPES SA,

Ave de Maire 28, Tournai B-7500. Belgium. Tel: +32-69228152. Telex: 57399. Fax: +32-69212764.

Hand-operated pumps for deep wells also export industrial pumps. Specialise in special pumps and accessories in small quantities to clients requirements. Also pumps for all kinds of industry-chemicals, food etc.

DUBA SA,

Kasteeldreef 1, Wetteren 9200. Belgium. Tel: +32-91693496. Fax: +32-91695752. Company specialised in rural water supply. Manufacture and distribution of deep-well handpumps, pumps for solar (photovoltaic) energy, all kinds of irrigation pumps as well as reciprocating pumps for water boosters and small scale distribution.

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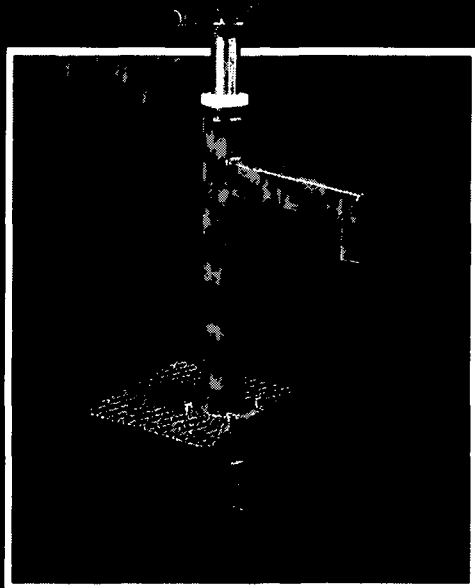
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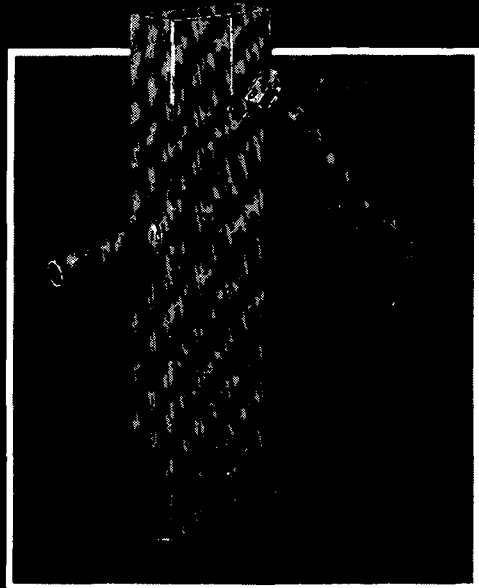
Via Genova 8, 58100. Italy. Tel: +39-564451272. Telex: 322458 IKRANE I. Fax: +39-564454237. Pulsa Systems water oscillation or spring rebound inertia hand pumps, the world's best pumping technology, presented and studied world wide for their scientific and technological interest. have revolutionised rural water supply in developing countries. Post-VLOM and Post-Plastic, they have no working parts below ground level, are entirely in stainless steel and rust and abrasion resistant, with one single length of flexible polyethylene feed pipe per pump, working vertically and/or horizontally, up to three pumps in on 110mm internal diameter bore-hole, from an actual water level of up to 80m+.

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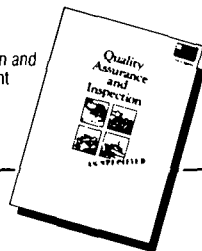
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400 Orange St, Ashland, Ohio 44805-2285. USA. Tel: +1-419-289 1144. Telex: 987443. Fax: +1-419-289 6658. Manufacturers of a complete range of pumps for all aspects of the water industry.

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Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

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PO Box 51066, Kifissia GR-145 10. Greece. Tel: +30-1-8161712/8161702. Telex: 215870. Fax: +30-1-8161018. Handpumps and deep well vertical pumps with lineshaft accessories.

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PO Box 54, SF-38201 Vammala. Finland. Tel: +358-32-12667. Telex: 22661 NIRA SF. Fax: +358-32-43134. Vammalan Konepaja Inc, is the man-

ufacturer of NIRA handpumps since 1920s. Good quality handpump models available for shallow wells and deep wells. The NIRA AF-85 direct-action shallow well handpump is internationally acknowledged to be the best choice for shallow well applications at village-level (max 22 mts). NIRA AF-2000 deep well handpump is a combination of high technology and high quality fitted to the original VLOM requirements (max 65 mts). Small NIRA handpumps like NIRA 6b and NIRA 9 available for small-scale irrigation and pumping water for rooftanks. Also NIRA Waste-Not-Taps for urban and rural water standposts.

VAN REEKUM MATERIALS BV,
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Manufacturers of submersible electropumps for 4ins-6ins-8ins wells.

BIZZI & TEDESCHI SNC,

Via Brodolini 35A, Campegine, RE 42040. Italy. Tel: +39-522 677209 67257. Fax: +39-522 677633.

Manufacturers of submersible electropumps for 4ins-6ins-8ins wells.

BOODE BV,

PO Box 27, AA Zevenhuizen, ZH 2760. The Netherlands. Tel: +31-1802 2744. Telex: 26642 BOODE NL. Fax: +31-1802 3090. Water well casing systems. Water well screen systems: standard range vertical slots, B & BR (ribbed) (din 4925) range horizontal slots, type '2000' continuous slots and BOODEPAC dual wall screen. Wellpoints for dewatering, dewatering equipment, casing/screen accessories, drilling fluids, water well consultancy, pumps and hand pumps.

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DUBA SA,

Kasteeldreef 1, Wetteren 9200. Belgium. Tel: +32-91693496. Fax: +32-91695752. Company specialised in rural water supply. Manufacture and distribution of deep-well handpumps, pumps for solar (photovoltaic) energy, all kinds of irrigation pumps.

EFIMEX SA SITINDUSTRIE GROUP,

8 Rue du 31 Decembre, 1207 Geneva. Switzerland. Tel/Fax: +41227366610. Telex: 289392 EFST. EFIMEX is dedicated to oil and water well equipment since 1974 as part of the SITindustrie group it constitutes a major manufacturing source for: - pump riser pipes in stainless steel, carbon steel supplied with flanges or threaded connectors - well heads in stainless steel - stainless steel fittings, tees and elbows.

EMMANUEL N KAZIS SA,

PO Box 51066, /GR-145, 10 Kifissia. Greece. Tel: +30-1816712/8161702. Telex: 215870 EMKAGR. Fax: +30-8161018. Manufacturing all types of pumps: 'Torrent' deep well vertical pumps with lineshaft, 'Torrent' submersible electric pumps, 'Torrent' mixed and axial flow vertical pumps, Centrifugal surface pumps, 'STAR-RITE/KAXIS' submersible pumps, power panels, pump accessories, handpumps, special purpose pumps.

EMW-SWEDE PUMP,

Oringvagen 1, 44500 Hunkedal. Sweden. Tel: +46-52-712820. Fax: +46-52-411279. EMW-SWEDE PUMP is selling and producing quality hand pumps and tube-clamps for standpipe installations. We provide highest Swedish quality and use only first class material.

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Tel: +1-617-769 7600. Groundwater clean-up, services and equipment.

GRUNDFOS INTERNATIONAL A/S,

P D Jensensvej 7, Bjerringbro 8850. Denmark. Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. Grundfos stainless steel submersible pumps and turbine pumps types SP and BP designed for general water supply, irrigation and industrial applications. Capacity range: Q up to 280 cbm/h. H up to 500m.

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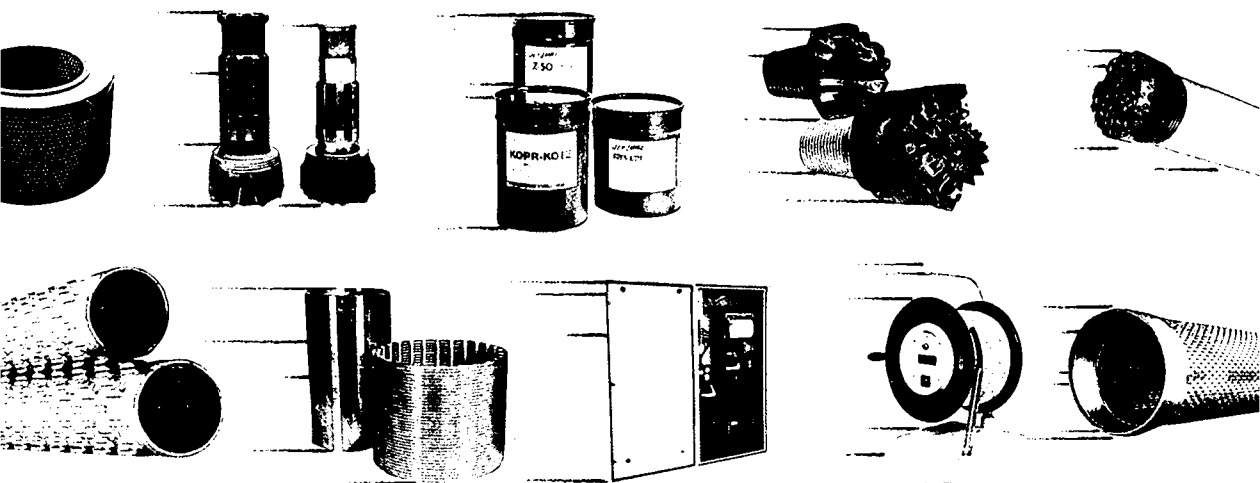
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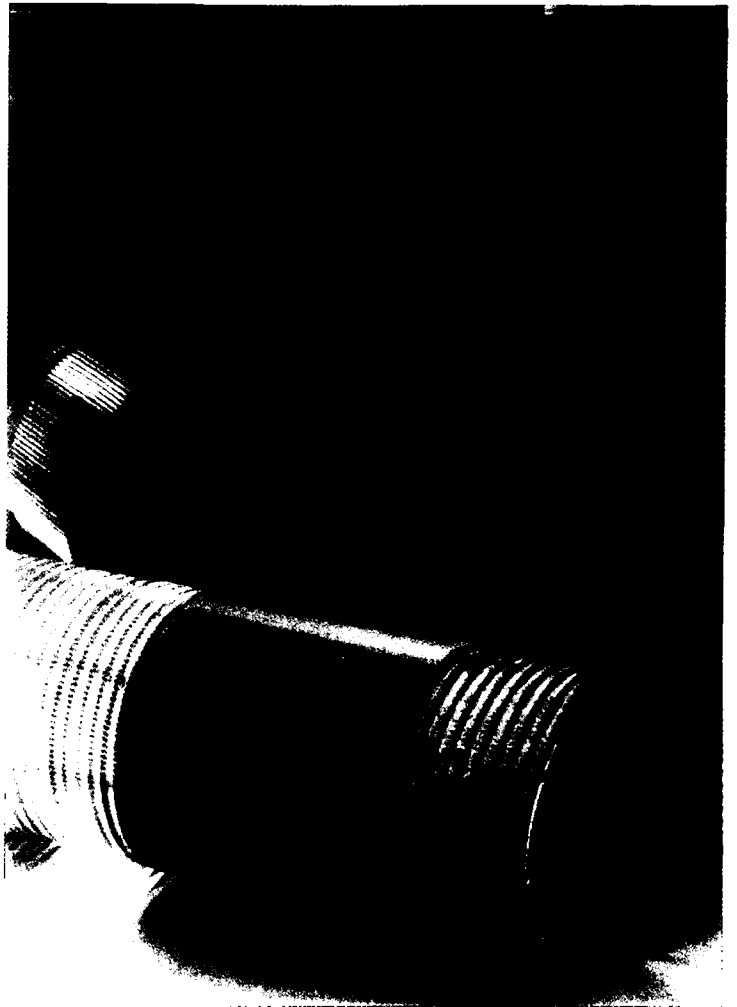
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Intersigma Company Limited was established on the 22nd of December 1989, to promote fast and effective increases of business activity based on the new economic principles. Its main stock holders became foreign trade organizations, FINOP and SIGMA Concern. On establishing general assembly, Jiri Kocher was elected as the chairman and Josef Vymazal as general manager of joint-stock enterprise.

The new Company Limited, profits from the experience gained during twenty years of activity as intercessor between manufacturers and international markets.

The subjects of interest of the joint-stock enterprises are:

- Export and import of products, equipment, parts, components and materials of water installations, chemical industry, energetics and building industry and ecological systems:

- Providing service for foreign subjects and receiving service from foreign subjects in the form of:
 - engineering
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 - investment and engineering activities
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within the frame of products and equipment mentioned above.

- Promotion of entire foreign trade activity.

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The aim of the joint-stock enterprise is to create better conditions for the export and import of products, and mainly for providing foreign, as well as domestic customers with a complex service covering marketing, advertising, engineering, supervision and transport.

The management committee of **Intersigma Company Limited** is formed by prominent experts of the decisive stock holders, who ensure important parts of deliveries for the main branches of national industry i.e. energetics, mining industry, building industry, agriculture, etc. Skilled personnel, existing trading network abroad, long term commercial experience and reliable manufacturing sphere with skilled engineering and labour staff give sufficient guarantee for satisfaction of all existing and future customers and suppliers.

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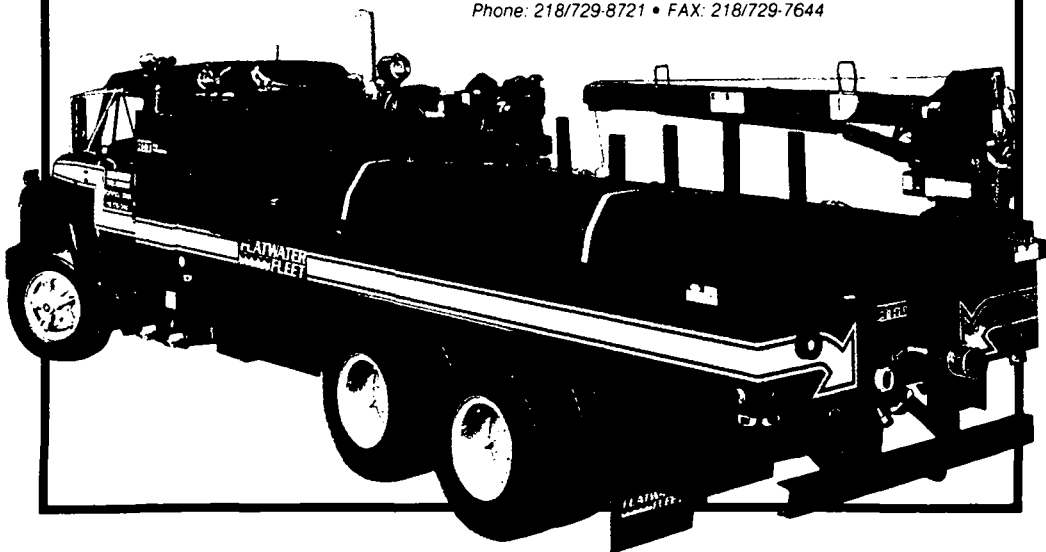
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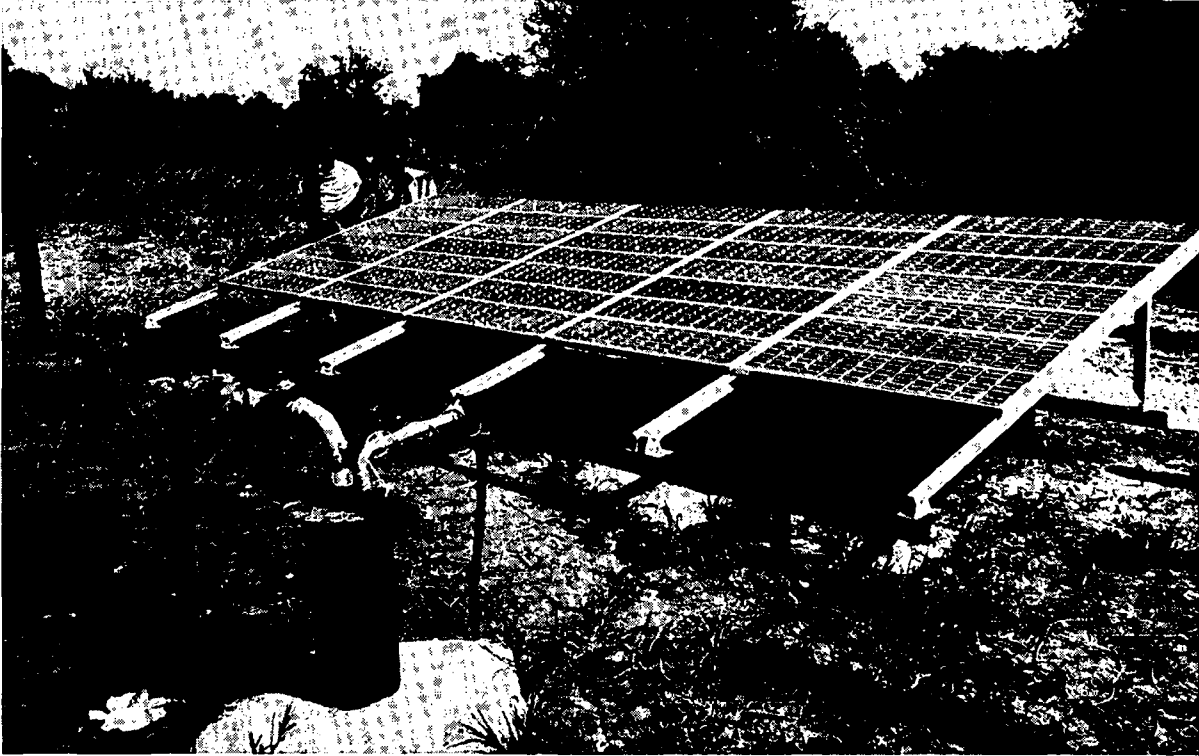
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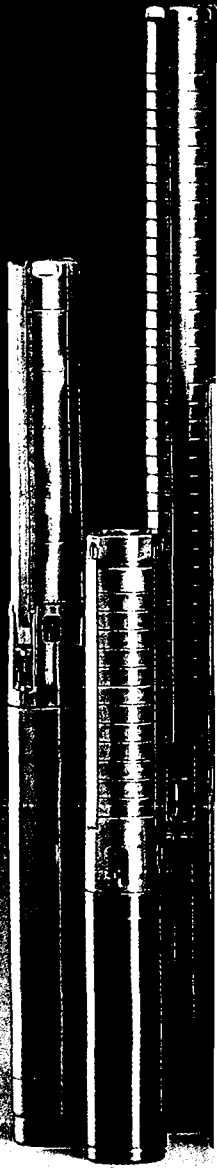
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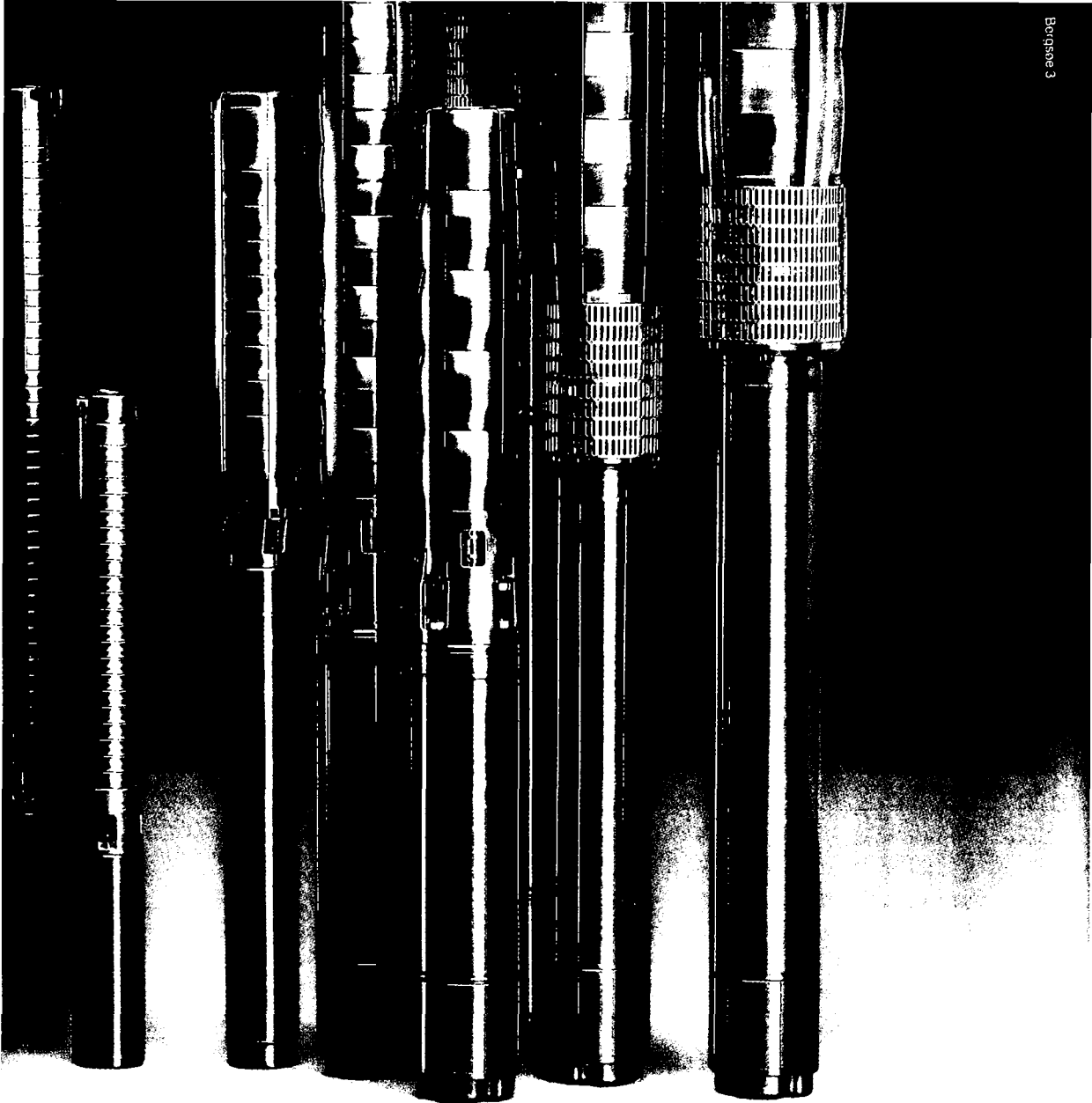
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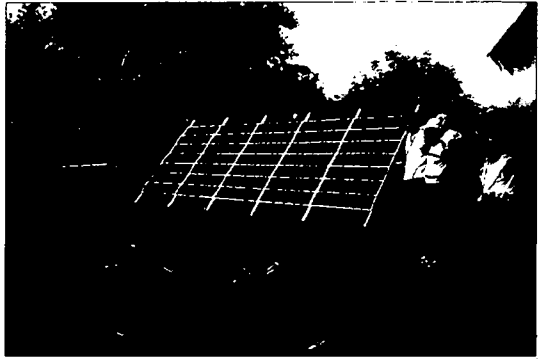
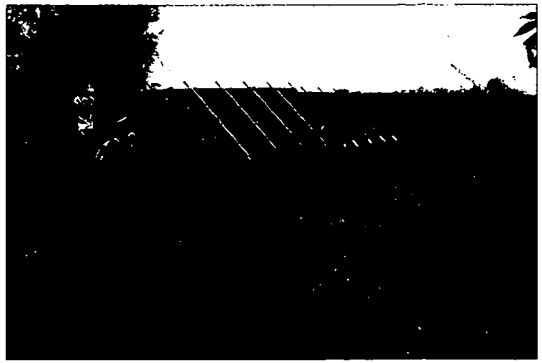
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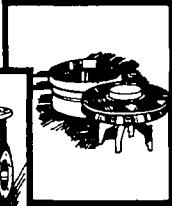
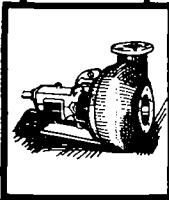
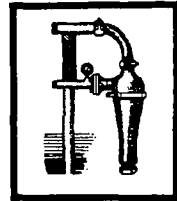
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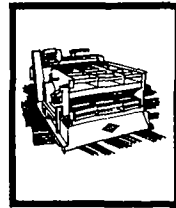
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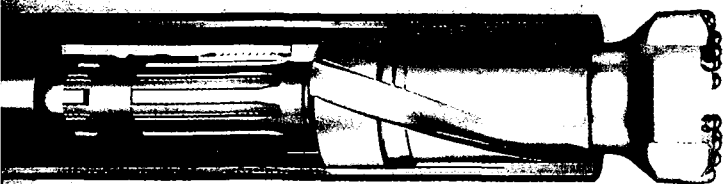


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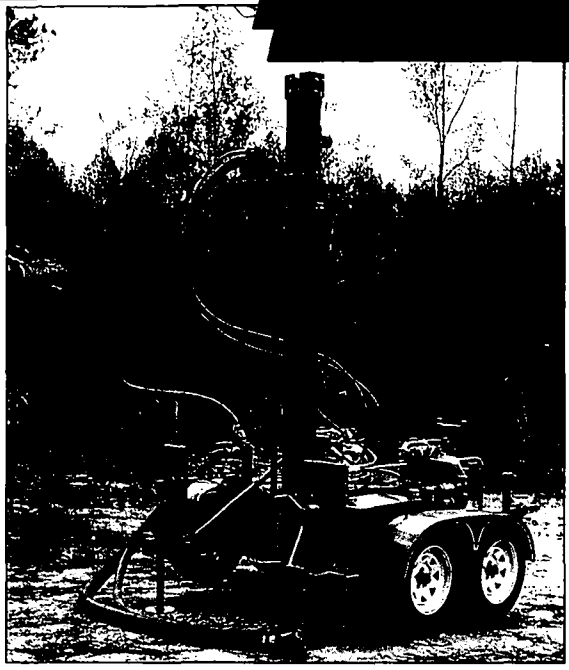
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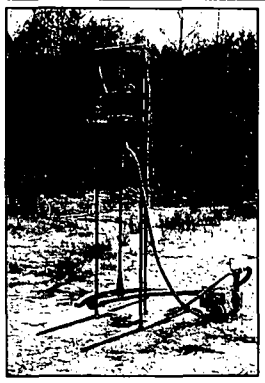
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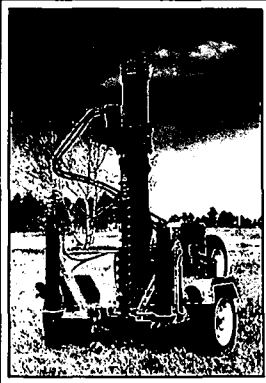
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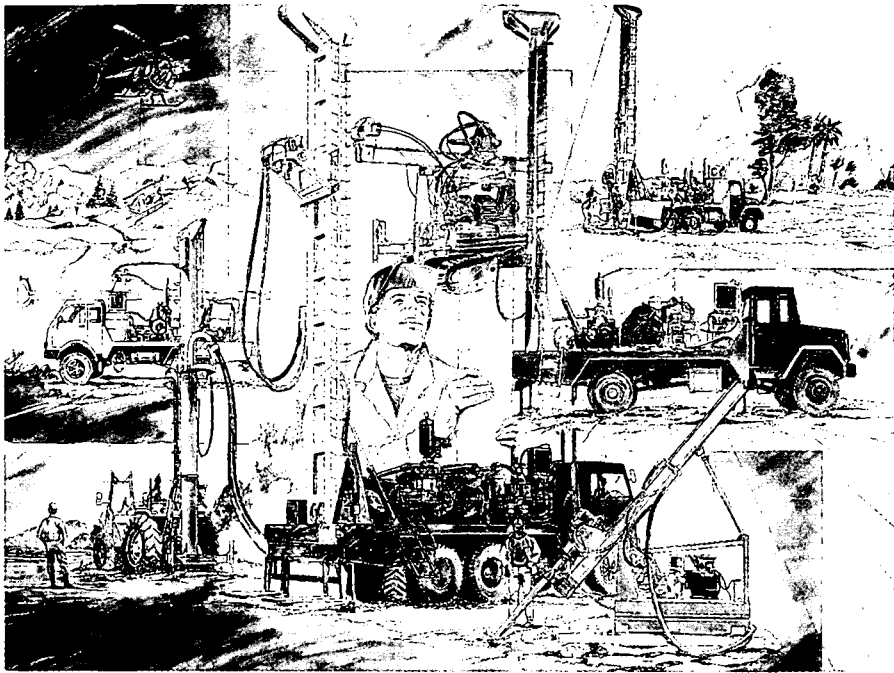
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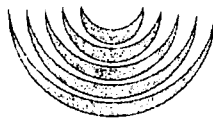


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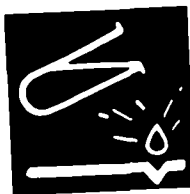
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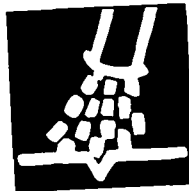
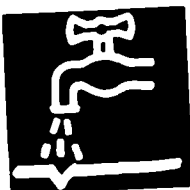


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SEWERAGE FOR THE URBAN POOR

by Bob Reed, Water Waste and Development Centre (WEDC)

By the year 2000 it is estimated that nearly half of the worlds population will be living in cities and between 30 per cent and 50 per cent of those people will be living in low income housing areas.

The provision of services for such low income areas is going to be one of the main challenges facing engineers and managers in the next decade. The problem is that services, as presently perceived, cost far more than the recipients are able to pay. Failure to attack the problem however will lead to increasing incidents of disease and political and social unrest.

One of the most important (and expensive) services is the disposal of human wastes. Conventional wisdom recommends the installation of piped sewerage schemes as the best approach but such systems in low income areas have a poor success rate. Firstly there is the problem of cost. Not only are such schemes very expensive to construct they are also very expensive to connect to. Whilst the communal pipes laid in the public highway are often funded or heavily subsidised by the government or an international donor, the household fixtures and fittings must almost always be paid for by the individual. The cost of such fittings usually far exceeds the individuals ability to pay. This leads to the all too common site of expensive sewerage with few connections.

The second problem is that of water. Sewerage schemes require large volumes of water to carry solids through the pipes to prevent blockages. A minimum of 100 litres per person per day is often considered necessary. Such high water usage is

rare in low income housing areas. Many communities rely on communal water points and those that have house connections often only receive water for limited periods of the day or week.

The obvious alternative to conventional sewerage is an on-site system such as pit latrines. Compared with sewerage, pit latrines are considerably cheaper particularly when the cost of treatment is included. They are also easier to construct and simpler to maintain. Unfortunately pit latrines too are not universally appropriate.

BELOW: Providing good sanitation for high density housing areas such as these will be a major challenge in the coming decade.





ABOVE: Frequently on-site sanitation such as the offset pour flush latrine shown here will be the most appropriate solution.

High density, multi-story buildings, high ground water levels or poor soil conditions may all preclude the use of pits but probably the main constraint is the water consumption.

As soon as water consumption exceeds the bare minimum, facilities will be needed to dispose of sullage. Small amounts may be disposed of in the pit or by soakage into the ground on the plot, but in general some form of sullage drain network will be necessary. Sullage drains are notoriously difficult to maintain. They frequently become blocked by food waste or refuse and act as breeding grounds for flies and mosquitoes. If their construction and maintenance cost is added to that of the pit latrine it may considerably reduce their financial advantage over conventional sewerage.

Finally there is the problem of upgradeability. As communities develop and become more established their standard of living tends to increase. In time the community may well reach the stage where it can afford and need conventional sewerage. On-site sanitation systems

and sullage drains are not easy to upgrade and usually very little of such a system can be incorporated into a higher quality scheme.

It can be seen therefore that there are many communities where neither conventional sewerage or on-site sanitation are appropriate and some other system must be found. One possible solution is a system called reduced cost sewerage.

THE ALTERNATIVE

Reduced cost sewerage systems are based on two different principles. The first type, often known as 'shallow sewer systems', are designed to transport faeces and liquids in the same way that conventional sewerage does. Savings are made by a relaxation of technical specifications, careful location of the sewers and appropriate implementation techniques.

The second type includes some form of solids interceptor tank through which all excreta and sullage pass. The tank is designed to collect gross solids so that the sewer can be designed to carry



ABOVE: *As water consumption increases the poor containment of sullage may become a major health hazard.*

only liquid and small solids.

Research at WEDC has shown that the two systems share many of the cost saving modifications, therefore rather than try to look at the two systems separately, individual components will be considered.

SOLIDS INTERCEPTOR TANK

Tanks of various sizes have been used ranging from 120 litres to 5850 litres. Many of the larger tanks were designed as septic tanks or aqua privies thus contributing to the treatment process. Such tanks are expensive to construct and probably only viable where the tanks were already in existence prior to the start of the sewerage scheme.

Smaller tanks are intended to collect gross solids and allow time for them to liquefy before being washed into the pipes. In theory such systems should rarely need emptying but in practice they do, particularly where solid objects are used for anal cleansing.

All tanks will eventually require emptying and the method of emptying and ultimate disposal of the sludge should receive careful consideration.

PIPES AND FITTINGS

The diameter of pipes, particularly at the heads of sewers is often set more on the basis of ease of cleaning and prevention of blocking by bulky solids than by technical design. Accurate assessment of wastewater flow rates, particularly where interceptor tanks are fitted, often leads to smaller pipes at shallower gradients. Pipes as small as 50mm have been used and there is some evidence to suggest that they are less prone to blockage than larger diameter pipes. Because of the curvature of the pipe, smaller diameter pipes will produce higher hydrostatic heads behind any blockage thus helping to force its removal.

On flat sites the gradient of the sewer becomes critical in that it effects the depth of excavation and hence cost. Reduced cost sewerage schemes have been built with gradients as shallow as 1/167 without causing excessive blocking; however the community used water for anal cleansing and that may be significant. Since interceptor systems do not carry large solids the velocity of flow is not critical. This means that sewers can follow the

ground profile thus keeping excavation costs to a minimum.

Up to 45 per cent of a sewerage scheme can be the cost of access points. Replacing manholes with rodding eyes or increasing the spacing can considerably reduce the cost.

LAYOUT

Considerable savings can be made by modifying the sewer layout. Laying sewers along the back of houses close to the fixtures they serve rather than in the highway with individual house connections can reduce the overall pipe length by as much as 50 per cent. In addition, sewers laid at the backs of houses do not have to withstand traffic loads therefore they can be laid at a shallow depth (as little as 300mm).

Overall site layout also has its part to play. Architects and planners often lay out sites with the houses in clusters. This may have social and aesthetic benefits but it considerably adds to the cost of all services. From a purely cost point of view, house plots laid out in rectangular blocks are usually the most cost effective.

COMMUNITY INVOLVEMENT

Most successful reduced cost sewerage schemes to date have relied heavily on the involvement of the community in their construction and maintenance. Such involvement not only reduces cost (10 – 15 per cent) but optimises the health benefits and consolidates community groups. If allowed complete control however it may lead to the use of sub standard materials and poor workmanship.

The size of community group must also be considered. Projects based at lane or cluster level seem to be more successful than those based on larger groups. This has implications for design. Often the communities are easily persuaded to be involved in the disposal system that passes directly in front of their property but as the distance from the property increases the individuals interest declines rapidly. In one scheme this has led to individual street sewers discharging directly into open drains at the end of the road.

IMPLEMENTING INSTITUTIONS

No matter how much of the scheme is managed and funded by the community there is still a need

BELOW: A reduced cost sewerage scheme funded and constructed by the community may lead to improvements to the environment locally but produce additional hazards for others.



for a well organised and committed institution. Institutions are required to offer advice on management, design and construction. They must be able to fund and maintain all of the communal parts of the system such as the trunk sewers and the treatment plants. They may also have to supply appropriate financing arrangements for the community to overcome their lack of working capital.

An interceptor tank scheme in Nigeria has failed primarily because of poor institutional support. Most families appear to have maintained their own latrines and tanks adequately but a lack of funds and confusion over institutional responsibility has led to almost no maintenance being carried out on the scheme in 20 years.

LEGISLATION

In many countries local rules and regulations are a major obstacle to the introduction of unconventional forms of excreta disposal. Specially funded projects can often get a dispensation from the most confining rules but until political will allows the relaxation to be applied to all schemes changes in approach will not happen. In many parts of Brazil building regulations have been changed and reduced cost sewerage has become almost the norm.

LEVEL OF SERVICE

Some of the existing schemes save money by only constructing a partial system. As mentioned before schemes in Pakistan have lane sewers discharging into open drains. Should such schemes be approved of? It is hard to say. The environment around the houses is improved and the scheme is affordable by very poor communities with no subsidy. On the other hand untreated faecal waste is discharged into public drains where it can create problems for other communities. It is the authors opinion that it is better to build half a system than no system at all on the grounds that at least some people will benefit and the scheme can always be improved at a later date.

Most communities improve with time and it is likely that the types and numbers of fittings on a property and the volume of wastewater generated will increase. Can reduced cost sewerage schemes cope with higher levels of service? The answer is not clear. The main problems are likely to be the

sizes of the pipes used and the gradients at which they are laid. The author is currently investigating existing reduced cost sewerage schemes partially in order to answer this question.

CONCLUSIONS

Providing adequate sanitation for the urban poor is one of the major challenges facing engineers and planners in the coming decades. Existing approaches to the problem such as conventional sewerage or on-site sanitation are not going to be appropriate in many situations. One possible alternative is reduced cost sewerage. Unfortunately there is still very little hard evidence particularly related to affordability and operation and maintenance to be able to say conclusively that such systems are viable long term. It is hoped the research currently underway here at WEDC will discover if such systems are viable and if so how they should be designed.

ACKNOWLEDGEMENTS

This article is based on research carried out at WEDC funded by the British Overseas Development Administration. The author would like to acknowledge their support.

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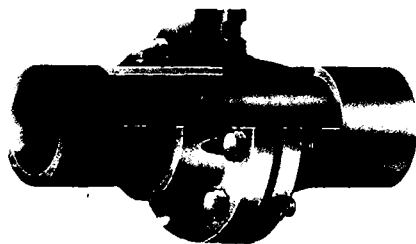
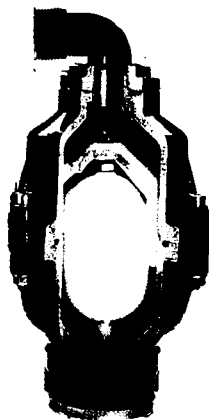
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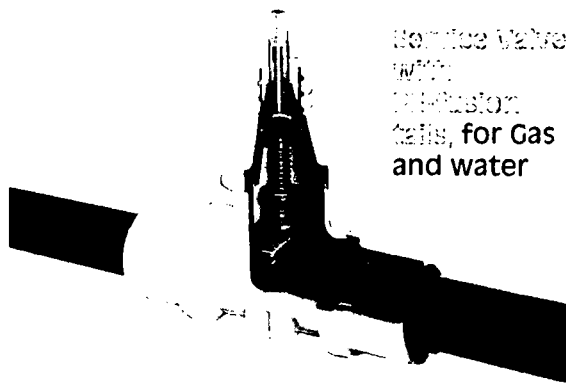
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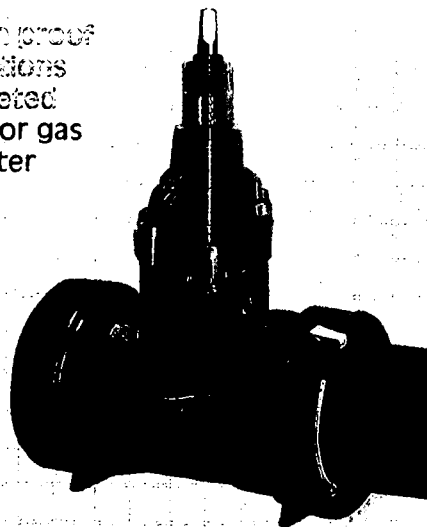


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6100 Oak Tree Boulevard, Cleveland, OH 44131. USA. Manufacturer of deposit control additives and corrosion inhibitors used as components of water treatment formulations for cooling, boiler and process water applications.

HARCO TECHNOLOGIES CORP,
1090 Enterprise Drive, Medina, OH 44256. USA. Tel: +1-216-725 6681. Telex: 196184. Fax: +1-216-723 0244. Provide cathodic protection for submerged or buried metallic structures. Also engineering, materials, design, installation and service.

HERBERTS HEAVY DUTY COATINGS,
Freshwater Rd, Dagenham, Essex RM8 1RU. UK. Tel: +44-1-590 6030. Telex: 24317. Fax: +44-1-599 3527. Technical specification and application checking service for new construction and maintenance, with a comprehensive range of coating systems for the protection of steel and concrete from corrosion, abrasion and fire.

IMPALLOY LTD,
Alloys House, Willenhall Lane, Bloxwich, Walsall WS3 2XW. UK. Tel: +44-922 408444. Telex: 338270. Fax: +44-922 710043. Designers and suppliers of cathodic protection and electrolytic anti-fouling equipment.

JEROME INSTRUMENT CORP,
Old High School Highway 89a, Jerome, AZ 86331. USA. Tel: +1-602-634 4263. Manufacturer of Gold Film Hydrogen Sulphide and Mercury Instrumentation. Hazardous waste and corrosion control monitoring; water purity testing.

KEMTUNE INC,
PO Box 11325, South Calhoun St, Fort Wayne, IN 46857. USA. Tel: +1-219-456 3596. Telex: 232639. Fax: +1-219-456 3598. Kemtune manufacture and distribute non-chemical water treatment equipment for limescale and corrosion control in boilers, cooling towers, heat pumps, heat exchangers, water heaters and many other applications worldwide.

KING LEE CHEMICAL CO,
PO Box 146, Del Mar, California 92014. USA. Tel/Fax: 1-619-693 1358. King Lee offers advanced chemicals for the economical, safe, and efficient control/prevention of corrosion and scale in piping systems and water treatment equipment. Products offered are available in powder and liquid formulations. They are added at low dosage levels for optimum protection. Products are safe to ship, handle, and store for extended periods of time without loss of performance. Distributor inquiries are welcome.

KNAPP POLLY PIG INC,
1209 Hardy St, Houston, Texas 77020. USA. Tel: +1-713-222 0146. Fax: +1-713-222 7403. Contact Name: Gary Smith. The original manufacturer of Polly Pig Internal Pipe Cleaners - Polly Pigs are used to clean water piping systems in applications such as irrigation, raw, potable and wastewater. The cleaners will remove debris such as scale and sludge which

CORROSION, SCALE PROTECTION CONTROL

has accumulated in the pipe. Polly Pigs can be used with any type of pipe material and can negotiate bends, tees, valves and reductions in pipe size. Proper maintenance of any piping system with Polly Pigs can restore the pipeline to maximum flow capability, reduce pumping costs and pressure requirements. Knapp Polly Pigs are made from flexible urethane foam and are available to fit all pipe sizes. For information, contact Knapp at the above address.

LIFESOURCE WATER SYSTEMS,
5235 South Fair Oaks, Pasadena, California 91105.
USA. Tel: +1-818-792 9996. Suppliers of a bi-polar energy cell – no magnets or metal bars, salt free, chemical free and eliminates scale and corrosion. Natural minerals remain, reduced evaporation when applied in irrigation, soap and chemical use reduced dramatically, water boils faster. Actual chemical bond broken apart.

LITHGOW - SAEKAPHEN LTD,
Buckley, Clwyd CH7 3PQ. UK. Tel: +44-244 542501.
Telex: 61367 CALSAK. Fax: +44-244 548738.
Manufacturers of anti-abrasive and anti-corrosive coatings and linings. Metal and concrete refurbishment specialists.

MAINLINING SERVICE INC,
PO Box 96, 555 Pound Rd, Elma, New York 14059. USA.
Tel: +1-716-652 3700. Fax: +1-716-652 9234. Water main cleaning and/or cement lining of water mains in place by the originators of the centrifugal (Perkins) pipe lining process. Range of capability from 4ins to over 12ft diameter – over 40 years experience in equipment design, manufacture and field use.

MET-PRO CORPORATION,
PO Box 144, 160 Cassell Rd, Harleysville, PA 19438.
USA. Tel: +1-215-723 6751. Telex: 244-903. Fax: +1-215-723 6758. Stiles-Kem Division manufactures water treatment chemicals for the control of scale and corrosion.

MICROPAX LTD,
Southgate Chambers, 37-39 Southgate St, Winchester, Hants SO23 9EH. UK. Tel: +44-962 733242. Telex: 477152. Fax: +44-962 62288. Cathodic protection services allied to sacrificial anode and impressed current systems, including: consultancy, design, survey, inspection, installation, maintenance and material supply. Distributors for insulating joints, anodes, reference electrodes, monitoring systems etc.

MITCO WATER TREATMENT LTD,
Unit 4, Hancocks Industrial Estate, London Rd, Loudwater, High Wycombe, Bucks HP10 9RE. UK. Tel: +44-494 671600. Fax: +44-494 677398. Provide technical field service for industrial water systems analysis. Supply chemical additives for control of scale, corrosion and bacteria contamination. Supply pre-treatment equipment. Supply maintenance for de-alkalisation and demineralisation plant.

NUTEK,
PO Box 1, Amston, CT 06231. USA. Tel: +1-203-537 2387. Telex: 710-420-0430. Produce chemicals for scale and corrosion inhibition and removal. Able to remove calcium sulphate, barium sulphate, iron oxides and most difficult scales.

PFIZER WATER TREATMENT PRODUCTS,
235 East 42nd St, New York, NY 10017. USA. Tel: +1-212-573 2531. Fax: +1-212-573 1166. Pfizer Water Treatment Products Group, a unit of the Pfizer Inc Pharmaceutical Corporation, manufactures the 'Flocon' line of antiscalants specifically designed to inhibit scale formation in reverse osmosis desalination units. Pfizer also sells and distributes the 'Floclean' cleaners for reverse osmosis membranes and provides a variety of services to the industry including water analysis, membrane autopsies and computerised dosing programmes.

PLASTIC COATINGS LTD,
Woodbridge Industrial Estate, Guildford, Surrey GU1 1BG. UK. Tel: +44-483 31155. Telex: 859237. Fax: 44-483 33534. PCL offer a comprehensive coating service to industry using a very wide range of materials including thermoplastic, thermosets, and fluoropolymers. Licenced applicators for Du Pont and Whitford PTFE range of non-stick materials. Specialist applicators of materials approved by the Petrochemical and North Sea Oil and Gas industries. Suppliers of factory applied coatings suitable for use in contact with potable water and listed by the UK Water Fittings Bylaws scheme.

THE PQ CORP,
PO Box 840, Valley Forge, PA 19482. USA. Tel: +1-215-293 7305. Fax: +1-215-688 3835. Supply sodium silicates for the stabilization of dissolved iron and manganese and inhibition of corrosion in water storage and distribution systems. Also used as coagulant aids for raw and wastewater treatment.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00

PRODORITE LTD,
 Leabrook, Wednesbury, West Midlands WS10 7LT. UK. Tel: +44-21-556 1821. Prodorite are recognised as the foremost company in Britain, specialising in the formulation and manufacture of a formidable range of anti-corrosive, abrasion-resistant protective systems, aimed specifically at the developing world water market.

PSG CORROSION ENGINEERING INC,
 7807 Convo Court, Suite 110, San Diego, CA 92111-1293. USA. Tel: +1-619-565 6580. Designs sacrificial and impressed current cathodic protection systems for mitigating pipeline, tank and treatment plant corrosion, internal-external corrosion and investigation and coating specifications.

ROBAN DUCTILE WELDING LTD,
Fairsharm Industrial Estate, Evelyn Drive, Leicester LE3 2BU. UK. Tel: +44-533 891363. Fax: +44-533 823225. Roban provide a comprehensive range of petrolatum grease based tapes, mastics and primers. Their system is used to protect all types of ferrous pipes and fittings from corrosion caused by ground-water, salts and acids, and is used worldwide by the Water, Gas and Petrochem industries. Roban also undertake the supply and coating of pipelines to customers specific requirements. (Please see Roban's advertisement on page 000).

SALAMANDER ENGINEERING LTD,
 Unit 1A, Reddicap Trading Estate, Sutton Coldfield, West Midlands B75 7BU. UK. Tel: +44-21-378 4508. Telex: 3351676. Manufacturers of 'Scalemaster' - a simple and easily fitted unit which inhibits scale formation, with no running or maintenance costs.

SCHILLING-CHEMIE GMBH,
 PO Box 11 36, Freiberg D-7149. West Germany. Tel: +49-7141 7030. Fax: +49-7141 703178. Acitol chemicals and decalcification pumps for the removal of scale, corrosion and organic deposits in industrial water systems.

SERVICISED LTD,
 Ajax Avenue, Slough, Berks SL1 4BH. UK. Tel: +44-753

33771. Telex: 846966. Fax: +44-753 691623. Expansion jointing and structural waterproofing. Pipeline protection systems.

SIEMENS SOLAR GMBH,
 Buchenallee 3, Bergisch Gladbach 1, D-5060. West Germany. Tel: +49-2204 4060. Telex: 884891 SSO. Fax: +44-2204 40666. Converting light directly into electric energy enables the use of solar powered cathodic protection even in remote areas. In competition with other energy sources - diesel, distant power lines etc - solar power has proved itself time and again to be the best solution due to its numerous advantages.

STILES-KEM DIV MET-PRO CORP,
 3301 South Sheridan Rd, Zion, IL 60099. USA. Tel: +1-312-746 8334. Manufacture water treatment chemicals for control of scale, red water and corrosion in municipal, industrial, commercial and domestic water systems to prolong life of water using equipment and distribution systems.

SUPERIOR WATER SERVICES INC,
 4509 Pine St, Smyrna, GA 30080. USA. Tel: +1-404-433 0805. Provides corrosion and scale inhibition and algae control to cooling towers, boilers, closed systems and domestic water systems.

UNIVERSAL PIPE COATERS LTD,
 Manby Rd, Immingham, South Humberside DN40 3EF. UK. Tel: +44-469 72311. Applicator of anti-corrosion coatings to mild steel pipes of all diameters, and the application of concrete weight coating for offshore lines, in accordance with the latest industry standards and specifications.

UNIVERSAL SOLUTIONS INC,
 12416 North, 28th Drive Ste 18-252, Phoenix, AZ 85029. USA. Tel: +1-602-371 0797. Manufacturing water treatment and scale removing chemicals. Custom design of chemicals.

WAYNE CONSULTANTS INC,
 N16 W22040 Jericho Drive, Waukesha, WI 53186. USA. Tel: +1-414-547 5300. Marketing full line of proprietary chemicals to prevent scale and corrosion in industrial boilers and cooling towers.

WINN & COALES (DENSO) LTD,
 Denso House, Chapel Rd, West Norwood, London SE27 0TR. UK. Tel: +44-81-670 7511. Telex: 946175. Fax:

LOCATION & INSPECTION UNDERGROUND SERVICES

+44-81-761 2456. Comprehensive range of anti-corrosion tapes, mastics and coatings for pipeline, pipe fittings, tanks and steelwork in all environments. Sealants for precast concrete pipe joints.

THE WISEMAN GROUP,

PO Box 58, High St, Ingatestone, Essex. UK. Tel: +44-277 353330. The Wiseman Group develop and manufacture chemical products for the international plumbing industry. Their principal brands are Everflux and Fingertip self-cleaning plumbing fluxes and the Radtect range of anti-corrosion water treatments.

LOCATION AND INSPECTION UNDERGROUND SERVICES

ALPER SYSTEMS LTD,

Cambridge Science Park, Milton Rd, Cambridge CB4 4FQ. UK Tel: +44-223 862464. Fax: +44-223 861324. Alper Systems Ltd specialises in computerised mapping and geographical information systems. 'Alper Records' captures, displays and interrogates mains and sewer data overlaid onto a maintained vector or raster scanned map background.

BODDINGTONS LTD,

Unit 10, Dunmow Industrial Estate, Chelmsford Rd, Great Dunmow, Essex CM6 1HF. UK. Tel: +44-371 5101. Telex: 81233 BODTON G. Fax: +44-371 4906. Boddingtons Warning Tapes are laid above a buried water pipe, sewer pipe or irrigation pipe, so as to warn other excavators of the buried service. Detectable Warning Tapes with a tracer foil are used where plastic pipelines are concerned. Boddingtons electrical products specialise in energy monitoring equipment notably power factor correction control relays and maximum demand load shedding equipment.

BORETECH DIVISION OF CCV,

5748 East Shields Avenue, Fresno, CA 93727 USA. Tel: +1-209-291 0383. Fax: +1-209-291 0463. Manufacturer of downhole CCD TV cameras for vertical and horizontal shafts. (ie water wells and sewer pipes).

CHICAGO STEEL TAPE CO,

450 CIPS St, PO Box 359, Watseka, IL 60970. USA. Tel: +1-815-432 5237. Fax: +1-815-432 2417. Chicago Steel Tape manufactures ferrous metal locators. Its two units, the ft-50 Pin Finder and the ft-60 Ferro Trak, are unsurpassed

in locating buried ferrous metals like septic tanks, cast-iron pipes, manhole covers, valve boxes etc. These instruments are currently being used by waterworks professionals in the US, Canada, England, Sweden, Finland, New Zealand, Australia, Italy, Switzerland, UAE and Israel etc.

DRAGERWERK AKTIENE- SELLSCHAFT,

Moislinger Allee 53-55, D-2400 Lubeck 1.

Germany. Tel: +49-451 8820 Telex: 268070.

Fax: +49-451-882 2080. Gas Analysis Division.

In order to reduce the number of potentially hazardous situations at the workplace and minimise any damage resulting from these hazards, many different gases, vapours, and aerosols must be monitored. For that purpose Drager offers easy-to-handle and economical measuring systems. With more than 200 different Drager-Tubes, over 350 separate hazards can be determined in air, soil and water samples.

GOLDAK/UDSEC,

547 West Arden Avenue, Glendale, CA 91203 USA. Tel: +1-818-240 2666. Fax: +1-818-244 6818. Designer, developers and manufacturers of portable electric detection instruments since 1933. Specialised instruments for the water industry include pipe locators, valve locators, leak detectors and pipe tracers for sewer pipe, both cast iron and non-metallic. Locators also have the capability of locating Septic tanks and tracing telephone and electrical cables.

GULECTRON BV,

Mevr v d Meystraat 22, Geulle, AP 6243. The Netherlands. Tel: +31-43-649081, 043-641343. Telex: 56786 GULEC NL. Television inspection in pipe lines.

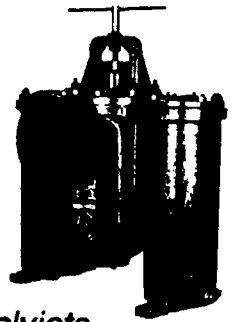
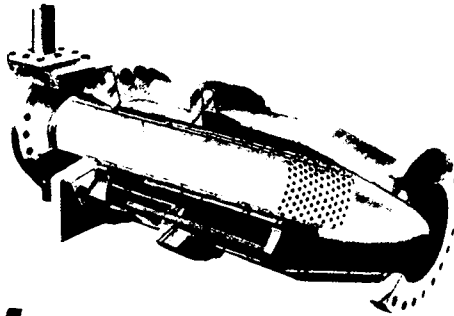
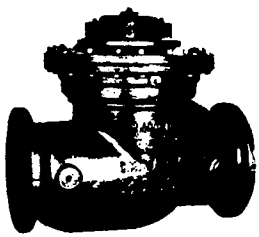
HEATH CONSULTANTS INC,

PO Box CS-200, 100 Tosca Drive, Dept AWWA, Stoughton, Mass 02072-1591. USA. Tel: +1-617-344 1400. Telex: 924486. Fax: +1-617-341 4359. Leakage detection - manufacture of equipment and training. Also pipe and cable locators.

INSIGHT VISION SYSTEMS LTD,

Unit 1, Merebrook, Hanley Rd, Donemoor, Malvern, Worcs W13 6NP. UK. Tel: +44-684 310001. Telex: 334480. Fax: +44-684 310510. Designers and manufacturers of closed circuit television systems for inspection of pipes in hostile environments.

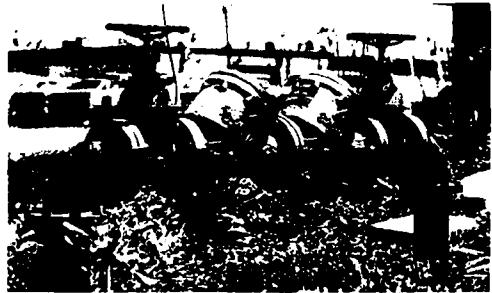
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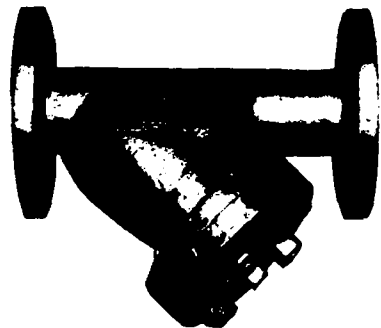
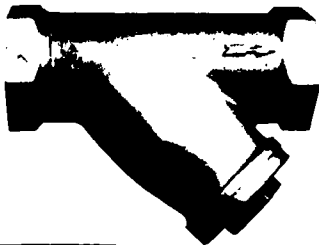
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Backflow Prevention Devices

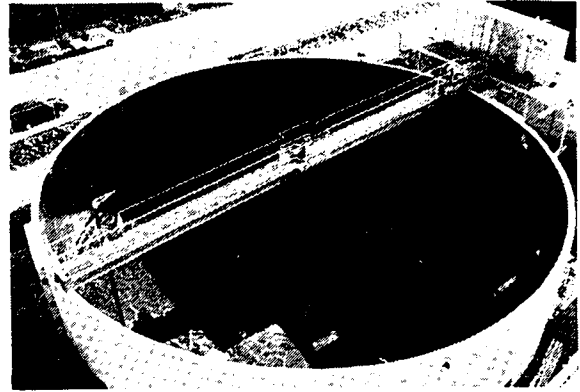
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"Y"-Type Strainers

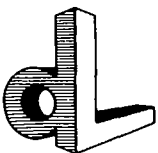
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- **AGRU® PE-HD-sheets for tank farms, waste water and manure reservoirs, waste tips, earth- and sludge-depots.**
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- **Lining with T-profile for concrete protection in PE-HD and PE-LD.**
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- **CKW tight sheets -PE-HD/AL/PEMD for the protection of concrete and the environment.**
- **Renovation-lining for corroded concrete and steel.**
- **PE-HD and PP drainage systems, pipes and shafts.**
- **Vertical drainage.**
- **Supply, assembly, testing, certification and delivery,**

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LANKA CARBONS (43% OWNED),
Guest St, Leigh, Lancs WN7 2HE. UK. Tel: +44-942
672101. Telex: 67555. Fax: +44-942 677136.
Manufacturers activated carbon in Sri Lanka which is
marketed wholly by Sutcliffe.

MCCULLOUGH/LEAKTEK INC.,
1165 Park Avenue, Murfreesboro, TN 37130. USA. Tel:
+1-615-890 9030. Full service offering: water distribution
system analysis (water audits); meter testing; leak detection
surveys; C factor tests; pipe location; underwater pipe
inspection and leak location; sub-surface mapping. Services
provided for municipalities, manufacturers, colleges, contrac-
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work guaranteed.

METROTECH CORPORATION,
670 National Avenue, Mt View, CA 94061. USA. Tel: +1-
415-940 4900. Telex: 6502726454 MCI UW. Fax:
+1-415-962 9527. Metrotech Corporation designs, manu-
factures and sells advanced electronic underground utility
locating instruments: pipe and cable (including fiber optic)
locators and tracers, 50/60Hz, iron and steel, valve
box/pedestal and water leak locators. The high radio fre-
quency Model 810 operates from an upright standing
position, features a visual and audible left/right guidance
system, a simultaneous signal strength (LCD) readout, a push
button depth indicator (inches/centimeters) switch and an
automatic sensitivity control.

**PALMER ENVIRONMENTAL SER-
VICES,**
6 Knightwood Court, Gapton Hall Industrial Estate, Great
Yarmouth, Norfolk NR31 0NG. UK. Tel: +44-493
600563. Telex: 975313. Fax: +44-493 653427.
Manufacturers of a leak noise correlator - for the detection
of leaks in underground water pipes. Also offer pipe & cable
location equipment and a leak detection, mapping and con-
sultancy service.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.

PROTOVALE OXFORD LTD,
Unit 511, Rectory Lane, Kingston Bagpuize, Abingdon,
Oxon. UK. Tel: +44-865 821277. Fax: +44-865
820573. Manufacture metal detectors, their application in

this field being for the location of stop box covers etc which
have been obscured along pipelines. Although the com-
pany's interests are mainly based in the UK and Europe, they
would be interested in any inquiries from further afield.

RADIO DETECTION LTD,
Western Drive, Hengrove Park Industrial Estate, Bristol, Avon
BS14 0AZ. UK. Tel: +44-272 839581. Telex: 44806.
Fax: +44-272 891505. Radio Detection specialise in 'infor-
mation from underground', supplying hand held equipment
for the detection of underground pipes and cables.

ROBAN DUCTILE WELDING LTD,
Fairsham Industrial Estate, Evelyn Drive, Leicester LE3
2BU. UK. Tel: +44-533 891363. Fax: +44-533
823225. Roban offers a comprehensive range of
equipment for locating underground services includ-
ing live cable locators which not only detect, but also
determine depth; and metal detectors for identifying
underground metallic pipes and services. At the top of
the range, sophisticated combined pipe and cable
locators are available. (Please see Roban's advertise-
ment on page 000).

SCHONSTEDT INSTRUMENT CO,
1775 Wiehle Avenue, Reston, Virginia 22090. USA. Tel:
+1-703-471 1050. Telex: 710-833-9880. Fax: +1-703-
471 1795. Offer magnetic and cable locators that will
detect ferrous metallic objects under the ground as well as
underground metallic utilities.

SEBA DYNATRONIC,
Industriestrasse 6, Baunach D-86111. West Germany. Tel:
+49-9544 680. Fax: +49-9544-2273. Instruments for leak
detection, water loss analysis, cable fault location and con-
sultancy. Especially: locators for metallic and non metallic
pipes, leak detectors, correlators, pressure and flow meters.

TELESPEC LTD,
Tannery House, Tannery Lane, Send, Woking, Surrey GU23
7HB. UK. Tel: +44-483 222061. Telex: 859270. Fax:
+44-483 223329. Telespec offer a new quality 'look see'
system for inspection of all types of pipework, sewers and
bore holes. The equipment is available with 10 view heads
with remote control focus, waterproof to 250m and able to
inspect 80-1000mm pipes.

TINKER & RASOR,
PO Box 281, San Gabriel, CA 91778. USA. Tel: +1-818-

LAYING OF PIPE LINE (INCLUDING TRENCH EXCU

287 5259. Fax: +1-818-287 0132. Tinker & Rasor manufactures leak detectors and Detectron Model 505-Gofer pipe and cable locators. When it comes to tracing distance, depth penetration and sensitivity, the Model 505-Gofer rivals all other pipe and cable locators on the market.

LAYING OF PIPE LINES (INCLUDING TRENCH EXCAVATIONS)

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Porte Marsh Rd, Calne, Wilts SN11 9BW, UK. Tel: +44-249 816420. Telex: 444355. Specialists in pipeline installation world wide.

BERGSOE ANTI CORROSION (BAC) AB,

PO Box 214, Landskrona S-261 23, Sweden. Tel: +46-418 16165. Fax: +46-418 27722. BAC supply and install pipelines and storage tanks - structures in soil and water, also cables, piles and sheet piling, as well as water towers and water treatment plants.

CHERNE INDUSTRIES INC,

**5700 Lincoln Drive, Minneapolis, Minnesota 55436.
USA. Tel: +1-612-933 5501. Fax: +1-612-938 6601.**

Cherne Industries manufactures and distributes products for the plugging, testing and repair of plumbing through municipal size pipeline. Specifically the company makes both mechanical and pneumatic pipeline plugs, by-pass plugs, plug accessory items, pipeline air-testing equipment, manhole vacuum testing equipment, plastic pipe deflection gauges, large diameter joint testing and sealing equipment and portable grouting equipment. Many of the two dozen styles of pipeline plugs are available in chemical or petroleum resistant materials. Cherne Industries has been manufacturing products for the plumbing and municipal pipeline industries for 36 years and is recognised as the leader in air-testing and pneumatic plugs.

DUAL MANUFACTURING CO,

1000 West Cherokee, Sioux Falls, South Dakota 57117 5041. USA. Tel: +1-605-336 3860. Telex: 437040. Three models of backhoes, digging from 7ft 6ins to 12ft 9ins. Two models of trenchers for hydrostatic or Deer driven tractors.

ESSENER HOCHDRUK - ROHRLEITUNGSBAU,

PO Box 120124, Essen 12, D-4300, West Germany. Tel: +49-201 349-25. Fax: +49-201 351423. Supply, construction and complete engineering of pipeline systems of all sizes and for all media, including pertaining facilities such as pumping and compressor stations, terminals, telecom and SCADA systems and all utilities. Further, complete interconnecting piping systems for industrial plants etc.

ESSIG (UK) LTD,

Unit 5, Mill Hall Business Estate, Aylesford, Maidstone, Kent ME20 7JZ UK. Tel: +44-622 76562/3. Telex: 966102 ESSIG G. Impact boring equipment (moles). Bore sizes from 45mm to 1.5m can be obtained with our wide range of machines. Pipe punching machines, cast iron crackers, slag gas crackers and venturi water pump.

GRESSBACH WINDEN - UND MASCHINENBAU GMBH,

PO Box 6, Obernburg D-8753, West Germany. Tel: +49-6022 31047. Telex: 4-188-132 GRES D. Fax: +49-6022 31050. Gressbach Winden - und Maschinenbau GmbH was founded in 1816. Manufacturing and marketing of WIMAG equipment: lifting gear and construction equipment, especially for underground engineering, pipe handling equipment, cranes and special constructions.

HYDRO ENGINEERING SDN BHD,

15a Jalan Bachang Batu 2, 1-4 off Jalan Ipoh, Kuala Lumpur 51200, Malaysia. Tel: +60-3-2987814/2920935. Fax: +60-2432223. Established in 1981, Hydro is involved in pipe-laying for local authorities and public work department agencies in Malaysia. Currently expanding and hope to have dealings in overseas markets.

JOHNSTON ARMALINE,

Johnston House, Hatchlands Rd, Redhill, Surrey RH1 1BG, UK. Tel: +44-737 242466. Fax: +44-737 249730. Provide specialist staff and equipment to contractors for pipe-jacking. Also have considerable expertise in a variety of sewer lining techniques, including installation of small diameter pipes and connections by remote control.

J MASTENBROEK & CO LTD,

83 Swineshead Rd, Wyperton Fen, Boston, Lincs PE21 7JG, UK. Tel: +44-205 65459. Telex: 377296. Fax: +44-205 310016. Manufacture trenching machines and equipment for laying pipes and cables. Also ditch maintenance equipment.



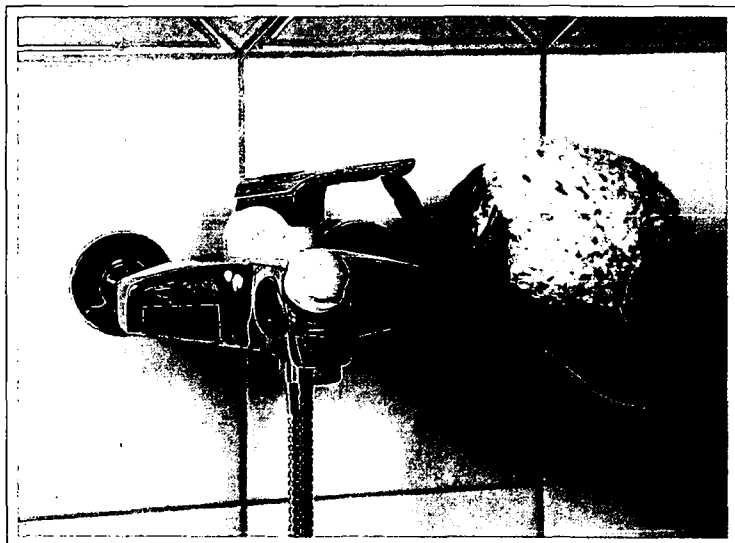
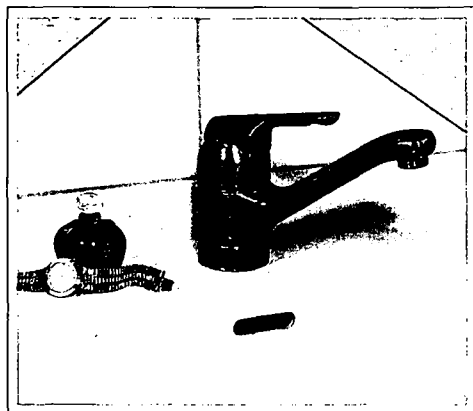
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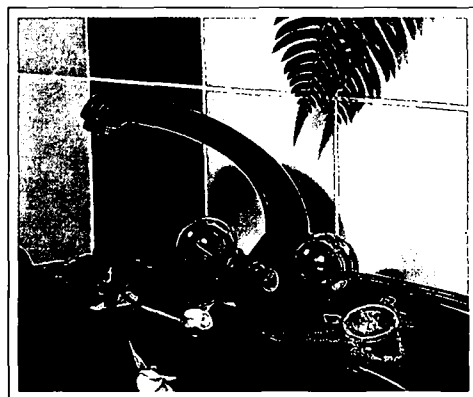
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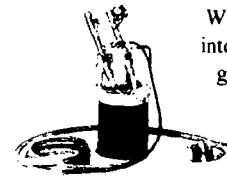
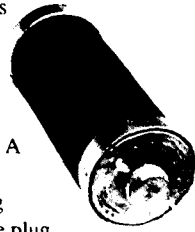
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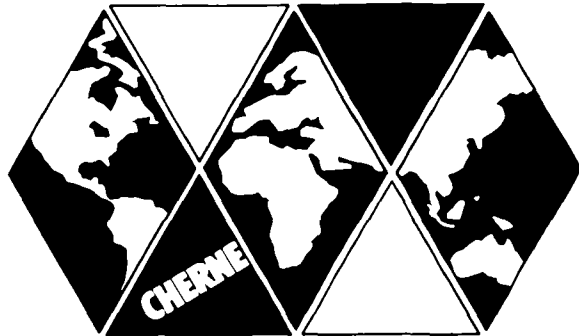


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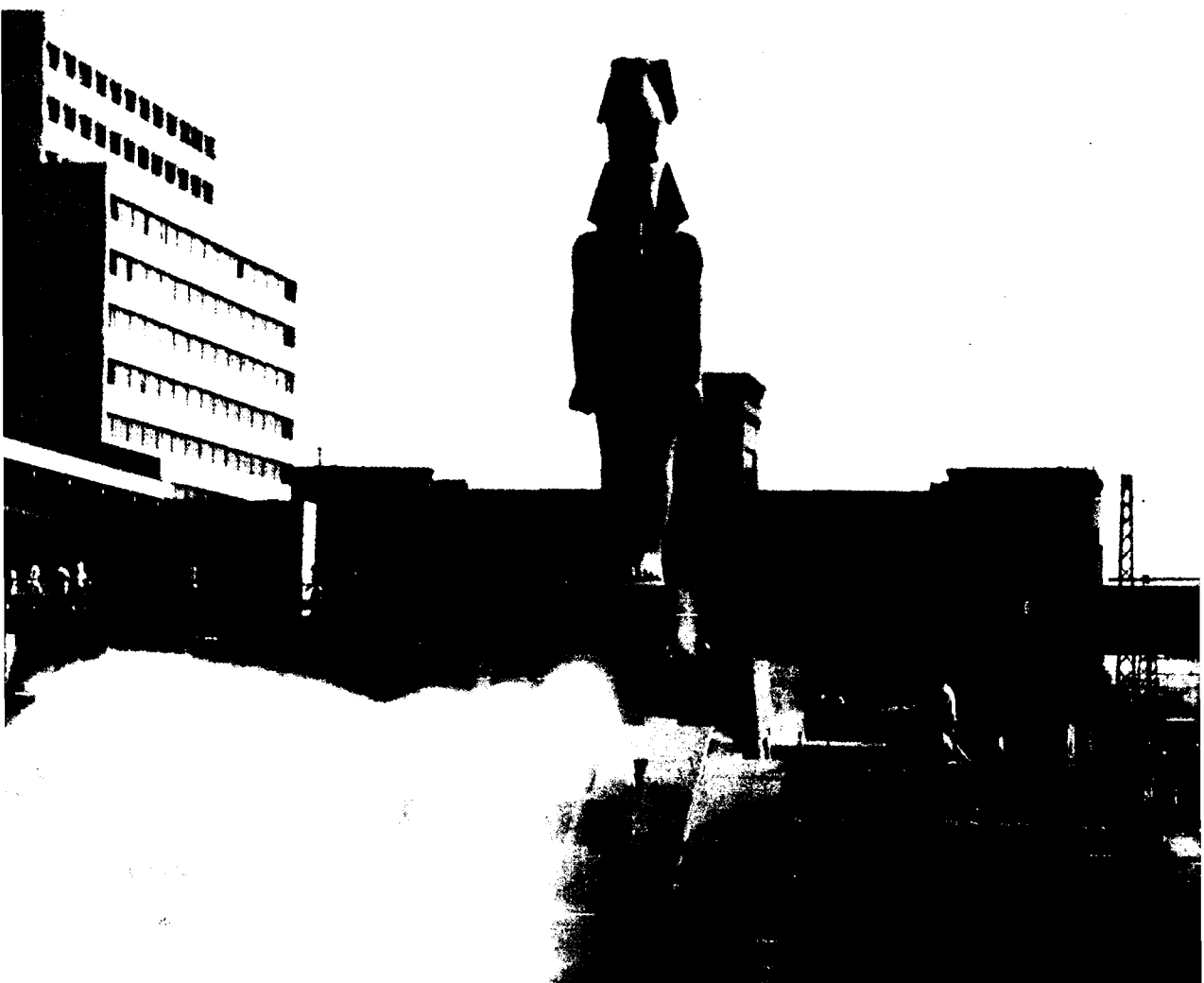


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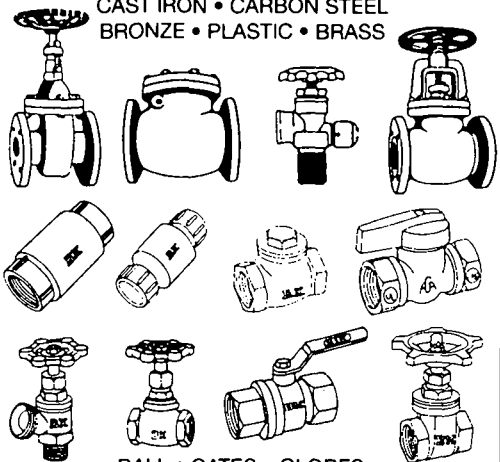


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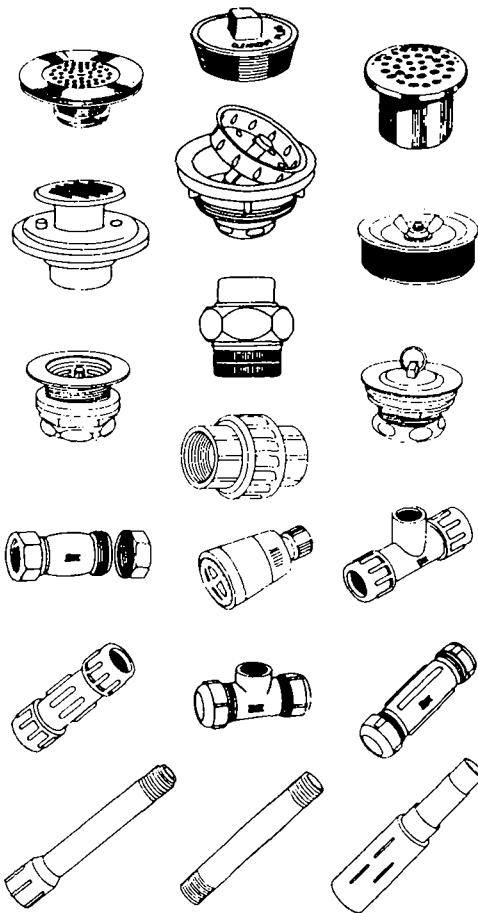
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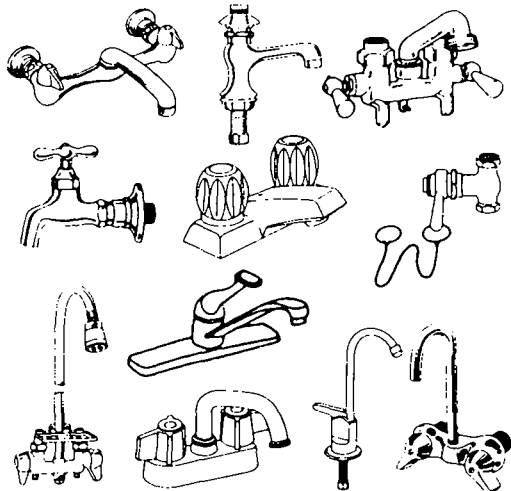
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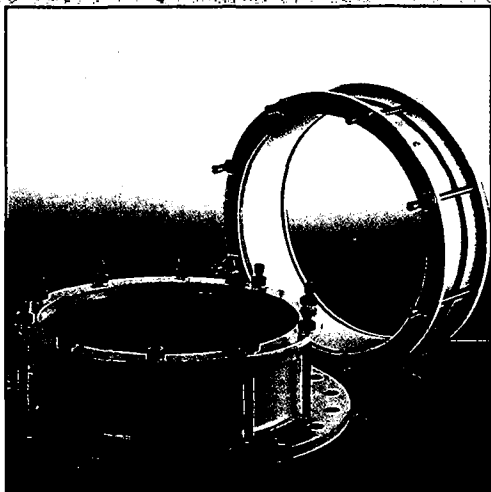


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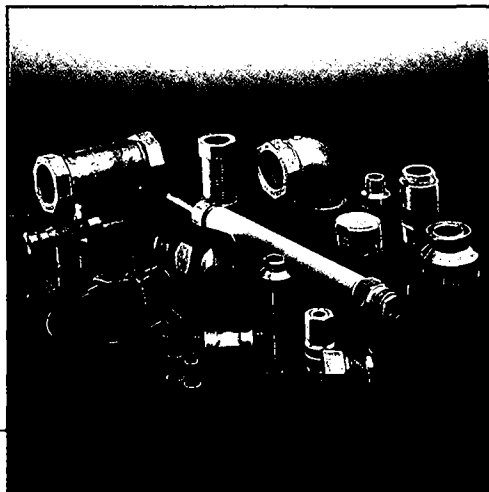
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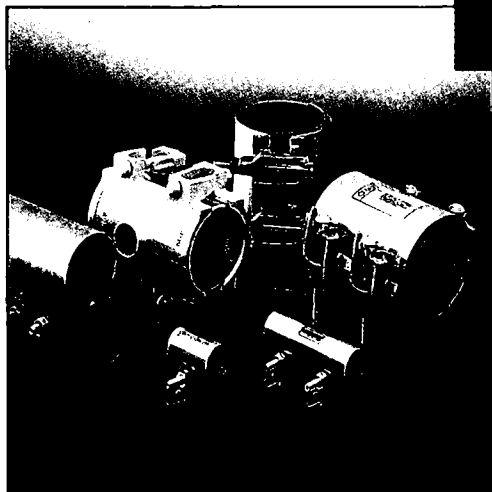
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Birkby Lodge Works, Birkby Lodge Rd, Huddersfield, West Yorks HD2 2BG. UK. Tel: +44-484 510421. Telex: 51513. Fax: +44-484 510421. Autotork electric actuators are suitable for any make, type and size of valve, penstock or sluice. Types include on-off/regulating and modulating with rotary, linear or partturn outputs. Control systems and panels also supplied.

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PO Box 816, 655 Wheat Lane, Wood Dale, Illinois 60191. USA. Tel: +1-708-773 8585. Fax: +1-708-773 0330. B & K Industries is a quality distributor of a wide variety of plumbing valves and specialities for industrial, commercial and residential applications. Valves are available in brass, bronze, cast iron, carbon steel and plastic. Other products include compression repair fittings, PVC nipples, a variety of faucets and various other plumbing specialities. Contact our sales department for specific information on all of our quality products.

BAILEY DIV OF CMB IND,

PO Box 8070, Fresno, CA. USA. Tel: +1-209-252 0791. Telex: 33-7616 CMB FSO. Fax: +1-209-453 9030. Bailey, division of CMB Industries has more than 60 years of

PIPES & PIPE FITTINGS

control valve manufacturing experience and has a complete line of control valves 1/25in-60ins to meet any water control need. Diaphragm actuated and pilot operated, Bailey's pressure reducing, rate of flow, pressure relief, float valves, altitude valves, pump control valves and surge articulator valves are available in a variety of materials and end connections.

C BANCROFT PIPELINE LTD,
Pellon Lane, Halifax, West Yorks HX1 5BG. UK. Tel: +44-422 64121. Telex: 517743. Fax: +44-422 53513.
Bancroft Pipeline are distributors of pipeline equipment to water authorities and industrial users both in the UK and overseas. Their range includes: pumps, valves, control equipment and pipework in various materials.

EDWARD BARBER & CO LTD,
Paxton Rd, London N17 0BS. UK. Tel: +44-81-808 5161. Telex: 299410. Fax: +44-81-801 5718. Edward Barber (UK) Ltd manufacture a comprehensive range of brass and gunmetal/merer valve units, stopvalves, mains tapping ferrules, saddle/ferrule straps, service line couplings and adaptors. Trade name - EBCO.

BARFLO LTD,
56 Cavendish Place, Eastbourne, East Sussex BN21 3RN. UK. Tel: +44-323 27877. Fax: +44-323 411952. Barflo supply equipment for water conservation and control. Also distributors of PVC and polyethylene piping. Barflo is a subsidiary of 'Wolsey Centres Ltd'.

BASIO DI SALERI & FIGLI,
25067 Lumezzane SA, Via Cristoforo-Colombo, Brescia 63. Italy. Tel: +39-30-82-73-55. Telex: 301243. Fax: +39-30-827-355. Stainless steel and carbon steel two, three and four way ball and special valves for a variety of industrial applications.

BATLEY VALVE CO LTD,
Longlands Industrial Estate, Wakefield Rd, Ossett, West Yorks. UK. Tel: +44-924 275931. Fax: +44-924 280026. Manufacturers of butterfly control valves operated manually, electrically or pneumatically in any material.

BECKEL- EDELSTAHL,
PO Box 97, Bad Ischl A-4820. Austria. Tel: +43-6132-33-77-0. Telex: 68138. Beckel-Edelstahl supplies stainless steel equipment for water supply and sewage disposal. The line-up embraces: components for tanks, eg pressure doors, feed and delivery pipes (to give uniform spiral or parallel flow),

extraction turbines, pipe fittings and complete pipe installations, double-walled doors, ventilation louvers of fixed and moveable design, manhole components, eg manhole covers, ventilation shafts, well heads and risers, niche strainers, components for sewers and sewage treatment plants, eg wall entrances, bulkheads, slide valves, overflows, ground water and backwash traps etc.

BELZONA MOLECULAR LTD,
Claro Rd, Harrogate, North Yorks HG1 4AY. UK. Tel: +44-423 67641. Telex: 629497. Fax: +44-423 505967.
Maintenance product and services for the repair and refurbishment of pumps, valves and associated equipment. Accepted supplier of coatings and systems for protection against corrosion and chemical attack on concrete.

ISAAC BENTLEY & CO LTD,
Hylo House, Cale Lane, New Springs, Wigan, Lancs WN2 1JR. UK. Tel: +44-942 824242. Telex: 67230. Fax: +44-942 826653. Leading European company in the manufacture of pipe joint lubricants for rubber ring joints under the trade name Vinoleo. These products are supplied to most pipe manufacturers in Europe in Own label packaging. Also supply solvent cement and solvent cleaners used in the jointing of plastic pipes. A lubricant for valve and tap lubrication and silicone grease for pipe fitting use.

ISAAC BENTLEY & CO LTD,
Naylor St, Liverpool L3 6DS. UK. Tel: +44-51-236 8901. Telex: 629497. Manufacturers of pipe jointing lubricants which are supplied to the major pipe manufacturers in the UK, Europe and Saudi-Arabia. All approved by UK, German and Dutch authorities.

OLAF P BERG AB,
PO Box 13095, Gotenborg S-40252. Sweden. Tel: +46-31-250175. Telex: 20620. Fax: +46-31 253640.
Suppliers of ductile iron pipes, malleable iron pipe fittings and gate valves.

BERMAD,
Kibbutz Evron, M P Ashrat. Israel. Tel: +972-4-929241. Telex: 471606. Fax: +972-4-929-46. A complete range of valves for all applications in water supply and irrigation. Automatic valves, air release valves, pressure reducing and sustaining valves etc.

BERMAD,
4070 Leaberton Court, Anaheim, CA 92807. USA. Tel:

+1-412-429 0247. Fax: +1-714-666 2533.

Manufacturers of valves for application in the water industry: control valves, pressure reducing valves, pressure relief valves and pump control valves.

BESTOBELL - VALVE & STEAM PRODUCTS,

Greasbrough Rd, Rotherham, South Yorks S60 1RE. UK. Tel: +44-709 828 80. Telex: 54268. Fax: +44-709 828327. Manufacturers and suppliers of valves and related fluid controls. We manufacture our own range of water authority approved butterfly valves of the replaceable rubber seal type and are exclusive agents and distributors of the GR SAPAG range of rubber lined butterfly valves. Metal seated valves are available for high pressure work.

BIG 'O' INC,

PO Box 970, Exeter, Ontario, Canada. Tel: +1-519-235 0870. Telex: 0645659. Fax: +1-519-235 2144.

BIWATER PENSTOCKS LTD,

Clay Lane, Oscibury, Warley, West Midlands B69 4TF. UK. Tel: +44-21-511 1740. Telex: 339795. Design, manufacture, install and commission penstocks for water and effluent control. Full range of materials, cast iron, stainless steel, aluminium and plastic construction - with sizes to meet every requirement. Ancillary equipment including flap valves, hydrants, draw-offs, sludge valves, surface boxes.

BIWATER PIPES & CASTINGS LTD,

Clay Cross, Chesterfield, Derby S45 9NG. UK. Tel: +44-246 250740. Telex: 54301/547903. Fax: +44-246 250741. Manufacturers of ductile iron pipes and pipe fittings to BS4772 for the water, sewage and drainage industries.

BIWATER VALVES,

PO Box 3, Kilmarnock KA1 3XH. UK. Tel: +44-563 21150. Telex: 77258. Fax: +44-563 41013. Manufacturers of valves (gate, butterfly, air, check and control types) for water, sewage, hydro-electrical and industrial applications.

BOODE BV,

PO Box 27, AA Zevenhuizen ZH2760. The Netherlands. Tel: +31-1802 2744. Telex: 26642. Fax: +31-1802 3090. Manufacture water valves, screen and casing for drinking water for rural and urban areas.

BORANEX SA,

BP 66, 15 Rue Fauchier, Marseille Coeox 2, 13203. France. Tel: +33-91-91-92-50. Telex: 440674 ROBC.. Fax: +33-91-56-1463. Specialise in the supply of cast iron pipes and fittings, cement/asbestos, PVC, polyethylene pipes and various accessories. This material is used in the supply of drinkable water and also for sewage application. Also valves and all equipment for hydrant material.

WILLIAM BRADY & SONS LTD,

English St, Hull, North Humberside HU3 2OL. UK. Tel: +44-482 29894. Telex: 592466. Fax: +44-482 228065. Manufacturers of pressure reducing, pressure sustaining and relief valves. Products can be tailored to clients own specifications.

BRITISH FLUIDICS & CONTROLS LTD,

Forest Rd, Hainault, Ilford, Essex IG6 3HJ. UK. Tel: +44-1-500 3300. Suppliers of pneumatic control components and systems (pneumatic control valves and solenoid operated control valves).

BROKS & WALKER LTD,

Iycoot Grove, East Dulwich, London SE22 8QL. UK. Tel: +44-81-693 3311. Telex: 264691. Fax: +44-81-299 0152. Distributors of valves, actuators, filters, tubes and fittings.

BROOKLYNS LTD,

Sanford Lane, Wareham, Dorset BH20 4DY. UK. Tel: +44-9295 6656. Fax: +44-9295 54169. Manufacture a wide range of precast concrete products for the water industry, including underground and above ground chambers and kiosks for stop cocks, valves, meters and hydrants, sewage treatment products and revetment systems. Also metal products - covers and frames, indicators and marker posts for pipelines etc.

BSS,

Fleet House, Lee Circle, Leicester LE1 3QQ. UK. Tel: +44-533 23232. Telex: 342761. A national company supplying pipeline and mechanical services equipment through a network of over thirty depots throughout the UK. Each depot maintains comprehensive stocks to provide a local service for the day-to-day requirements of industries in the area.

PIPES & PIPE FITTINGS

BTR SILVERTOWN LTD,

Horninglow Rd, Burton-on-Trent, Staffs DE13 0SN. UK. Tel: +44-283 510510. Telex: 344119. Fax: +44-283 510052. Manufacturers of lined pipes, pumps, purpose mouldings and pipe repair kits. The company has water board approval for pipe seas.

BUTLER INC,

7846 Alabama Avenue, Canoga Park, CA 91304. USA. Tel: +1-818-888 3089. Offers an extensive line of single and multi-port diverter valves for counter top filters of all types. The faucet line includes atmosphere and air gap as well as the common ledge type dispensing faucet. A wide selection of dispensing spouts available.

BV MACHINEFABRIEK EN IJZ- ERGIETERIJ,

V/H Rogier, Nerinx, Richter Waltweg 3, Postbus 40, Bergen oo Zoom 4600 AA. The Netherlands. Tel: +31-6140 33050. Telex: 78228. Fax: +31-640 57536. Manufacturer of cast iron fittings for water and gas pipelines to be used for cast iron, asbestos-cement and PVC pipes. Also couplings for pipelines.

CAMBRIAN-PLASTICS LTD,

Litchard Industrial Estate, Bridgend, Mid Glamorgan. UK. Tel: +44-656 57482. Fax: +44-656 767127. Tanks, pipes and cylindrical products. The tanks can hold water effluent, fertilisers and chemicals.

CANBAR INC,

PO Box 280, 1 Canbar St, Waterloo, Ontario N2J 4A7. Canada. Tel: +1-519-886 2880. Telex: 069-55255. Fax: +1-519-886 5546. Manufacturers of tanks and pipelines from wood, fibreglass and moulded polyethylene, of wood stave penstocks and pipelines for irrigation supply and hydro-power installations and chemical storage tanks for the water treatment industry.

CENTRAL SUPPLY INC,

31-a Makaala St, Hilo 96720. Hawaii. Tel: +1-808-961 5855. Central supply is in the supply house industry currently distributing industrial piping and supply, plumbing accessories, irrigation pipes and supply irrigation systems design and sewer/drain pipes & fittings. Primarily wholesale.

CERTAINTED CORPORATION,

Box 860, Valley Forge, Pennsylvania 19482. USA. Tel: +1-

215-341 7000. Fax: +1-215-341 6837. Manufacturers of PVC municipal water pipe, water transmission pipe and PVC fittings for sewerage applications.

CHEMICAL PIPE & VESSEL CO LTD,

104 The Borough, Downion, Salisbury, Wilts SP5 3LY. UK. Tel: +44-725 2144. Telex: 477818. Fax: +44-725 22135. Manufacturers of plastic corrosion-resistant pipe systems

CHERNE INDUSTRIES INC,

5701 South County Rd 18, Minneapolis, Minnesota 55436. USA. Tel: +1-612-933 5501. Fax: +1-612-938 6601. Cherne Industries manufactures and distributes products for the plugging, testing and repair of plumbing through municipal size pipeline. Specifically the company makes both mechanical and pneumatic pipeline plugs, by-pass plugs, plug accessory items, pipeline air-testing equipment, manhole vacuum testing equipment, plastic pipe deflection gauges, large diameter joint testing and sealing equipment and portable grouting equipment. Many of the two dozen style of pipeline plugs are available in chemical or petroleum resistant materials.

CHIMMASHEXPORT,

25 Bezbozhny Per, Moscow 129869. USSR. Tel: +7-288-36-90. Telex: 411032. Soviet Foreign Trade Association Chimmashexport was established in 1987 as the sole supplier of machinery and equipment for the chemical and petrochemical industry. Exports plant and equipment, oil, petrochemical, pulp and paper industries, cryogenic plant, air and gas compressors, pumps, industrial valves and fittings.

CLA-VAL CANADA LTD,

PO Box 10, 2 Christie Drive, Beamsville, Ontario L0R 1B0. Canada. Tel: +1-416-563 4963. Telex: 061-5135. Fax: +1-416-563 4040. Manufacturers of automatic pressure reducing control valves and pressure relief systems for pump stations and reservoirs.

CMB INDUSTRIES,

PO Box 8070, 1550 North Peach Avenue, Fresno, California 93747. USA. Tel: +1-209-252 0791. Fax: +1-209-453 9030. CMB Industries has two divisions which manufacture quality lines of water control valves and backflow prevention valves. The Bailey division manufactures water control valves for water

pressure and flow control applications. Bailey also designs and manufactures the patented Polyjet Sleeve valve used in applications where high head pressure must be reduced without valve cavitation. The Febco division manufactures a superior line of backflow prevention devices used to protect potable water from contamination in irrigation, residential, fire sprinkler and plumbing applications.

COMPRESSION SYSTEMS HOLLAND B V,

PO Box 65, Nieuwkoop, AB 2420. The Netherlands. Tel: +31-1725 9218. Telex: 39528. Fax: +31-1725 3695. Manufacturers of sludge pumps (duplex and triplex) to customer specifications, steel and cast-iron piping with coatings suited to customers' requirements. Manufacturers of pipe coating machinery.

CONCRETE PIPE ASSOCIATION,

60 Charles St, Leicester LE1 1FB. UK. Tel: +44-533 536161. Fax: +44-533 514568. Promotion, development and advisory service for design, specifications and construction of pipelines for sewage; service water, highway and agricultural drainage; consisting of precast concrete pipes, bends and junctions, pipes for jacking manholes, soak-aways and road gulleys.

CONLEY CORP,

2795 East 91st, Tulsa, OK 74137. USA. Manufacture fiber-glass pipe, valve and fittings from 0.5ins through 20ins.

COOKSON INDUSTRIAL MATERIALS LTD,

leadworks lane, Chester CH1 3BS. UK. Tel: +44-244 21022. Telex: 61178. Fax: +44-244 315041. A subsidiary of the international company, Cookson, with a turnover in excess of one billion pounds a year. Manufacture a range of specialised lead-based products including lead wool, lead pipes and pipeline pressure testing equipment.

COOPER INDUSTRIES WKM PRODUCTS, FLOW CONTROL DIVISION,

PO Box 2117, Houston, Texas 77252. USA. Tel: +1-713-499 8511. Telex: 166282. Fax: +1-713-499 5211. Manufacturers of large and small gate valves, ball valves and butterfly valves for all conditions including harsh environments.

CORROCOAT SERVICES,

Forster St, Leeds, West Yorks LS10 1PW. UK. Tel: +44-532 760760. Telex: 557243. Fax: +44-532 760700. Manufacturers and applications of high technology coatings including the Fluidglide system for the improvement of pumping efficiency. Corrosion engineers specialising in the overhaul and protection of pumps, valves, and pipework. Also treatment of steel and concrete tankage.

COSMOPLAST INDUSTRIAL CO,

PO Box 6032, Sharjah, United Arab Emirates. Tel: +971-6-331264. Telex: 68578 COPOL EM. Fax: +971-6-331917. Contact Name: Ron Clayton. Pipes for Potable Water Supply, Land Drainage and Sewerage to all recognised international standards made in Sharjah under close technical supervision. An output of eight metric tonnes a week means large stocks are readily available for export. Ask Ron Clayton for more details.

COWELLS INTERNATIONAL LTD,

Rackheath, Norwich, Norfolk NR13 6LF. UK. Tel: +44-603 720611. Telex: 97256. Fax: +44-603 721355. Manufacturers of a vacuum sewerage system. Distributors of pipes, sewerage pipes and pipe fittings.

CRANE BVMI,

Shaw Rd, Bushbury, Wolverhampton, West Midlands WV10 9NN. UK. Tel: +44-902 20496. Telex: 338171. Fax: +44-902 27167. Manufacturers of strainers (forged or cast), pumps-vertical in line, vertical spindle, end suction and valves - bellows sealed design, globe or gate. All available in standard or exotic materials and of assured quality conforming to most specified requirements. BS5882, BS570 parts 1,2,3, and MOD Aqap Series.

W S CRASTER (PV) LTD,

Engineers & Founders, PO Box 336 Harare. Zimbabwe. Tel: +263-4-67676/7/8. Telex: 22547 CRASTR ZW. Fax: +263-4-66697. Manufacturers of Castermatic swimming pool filtration units. High pressure sand filters Caster Compact water treatment plants for drinking water, industrial effluent treatment, swedge treatment, valve industries, pumps, mining equipment.

CROSS MARINE SERVICES INC,

565 West 2000 South, Orem, Utah 84058. USA. Tel: +1-801-225 8355. Fax: +1-801-226 4108. Equipment erection, turbines and generators. Manufacturers of gates

PIPES & PIPE FITTINGS

and valves, seals and gaskets. Complete range of services in construction engineering (including underwater).

CROSS WEIR LTD,

Unit 4, Station Industrial Estate, Fleet, Hants GU13 8QY.
UK. Tel: +44-252 628121. Telex: 858470. Fax: +44-252 626574. Distributors and stockists of valves and hydrants for the water and fire protection industries to awwa, cipa, u/f/m, fcc and BS. Motorised, fire-locking keys, backflow prevention pressure reducing and special valves.

MIKE CROSSLEY & ASSOCIATES,

22a Guildford Rd, St Albans, Herts AL1 5JG. UK. Tel: +44-727 64459. Fax: +44-727 39939. Manufacturers of external de-becding tools for water pipes.

CSR - HUMES PTY LTD,

PO Box 31, World Trade Centre, Melbourne, Victoria 3005. Australia. Tel: +61-3611 3311. Telex: 38015. Fax: +61-3614 6347. Humes Pipe Systems, steel reinforced concrete ranging in size from 100mm to 3,600mm, are produced for a wide variety of applications such as stormwater drainage, road culverts, sewerage and irrigation. Precast concrete products are available for a wide variety of applications both urban and rural. Humes Plastiline protects concrete pipes and structures from corrosion and renovation systems, these include Humes Duraliner and Spray Applied Linings (SAL) For soil stabilisation, they offer a range of ProPex Geotextiles or engineering fabrics for road construction, railway and drainage projects. Humes Concrete is Australia's leading producer of concrete and a significant contributor to the nation's construction. Ever expanding, Humes has become involved with the Advance Australia Award winning Envirocycle, a compact and inexpensive alternative to domestic sewerage, septic tank and pump-out systems.

CT (LONDON) LTD,

Westfield House, Westfield Rd, Guildford, Surrey GU1 1EJ.
UK. Tel: +44-71-483 502020. Telex: 859284. Fax: +44-71-483 502953. CT (London), long established in fluids handling, can offer a variety of valves, pumps, pipe supports, gauges, chemical dosing and spray equipment to solve your water handling problems. Call us!

DE LANGE PLASTIC LININGS,

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with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

DEAN REELS LTD,

Colt Hill Works, London Rd, Oditham, Hants RG25 1AN.
UK. Tel: +44-25-671 2822. Telex: 858893. Hose reel manufacturers for hose size up to 4ins dia bore - hand, spring and power operated. Pressures up to 15,000 psi for water, chemicals and fuels.

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10020 Big Berd Boulevard, St Louis, MO 63122. USA.
Tel: +1-314-966 3533. Fax: +1-314-966 2532. Dema Engineering Co offers a wide selection of dispersing equipment used to meter and proportion cleaning and sanitising products. Proportioners, injectors, foamers and spray clean equipment mix chemical with water and air to provide a cleaning solution.

DESBORDES (ETSA),

56 Rue Massena, Lyon Cedex 06. 69451 France. Tel: +33-7852-2946. Telex: 900443 F DESBOLY. Fax: +33 72-74-9499. Desbordes manufacture bronze waiger pressure reducing valves for water higher than three bars, ie buildings, mountainous areas etc. They are unaffected by scale impurities.

DEUTSCHE FIBERCAST GMBH,

Postfach 1410, Feldeneud, Eschweiler D-5180. West Germany. Tel: +49-2403 7020. Telex: 832195. Fax: +49-2403 702151. Provide gro pipes and fittings.

DEZURIK INTERNATIONAL LTD,

Nelson Way, Nelson Industrial Estate, Cramlington, Northumberland NE23 9BJ. UK. Tel: +44-670 714111. Telex: 537198. Fax: +44-670 737813. A comprehensive range of valves and valve construction materials. Valve sizes up to 1,850mm, pressures up to 140 barg. Dezurik also make a consistency transmitter and have a variety of actuators.

D R A L L I M ,

Brett Drive, Bexhill-on-Sea, East Sussex TN40 2JR, UK. Tel: +44-424 216611. Telex: 95285. Fax: +44-424 21663. Drain Controls manufacture pneumatic hand valves to suit the most exacting requirements, incorporating electrical pole switches to EEX standards giving unrivalled flexibility in instrument circuit design. The product portfolio is complemented by brass s/s and plastic fittings.

D R E S S E R E U R O P E S A ,

PO Box 7036, Panningen, AA 5980, The Netherlands. Tel: +31-4760 72929. Telex: 58181 DESANI. Fax: +31-4760 73367. Dresser Europe SA, part of Dresser Industries, which is one of the world's leading suppliers of technology products and services to energy, natural resources and industrial markets, is situated in Panningen, Holland. Piping specialties, manufactured at our plant in Holland, include the famous Dresser coupling, which has been installed in millions since its conception more than one century ago. A product range including flange adapters, step couplings, repair clamps and sleeves, self-tapping service connectors, expansion joints and fittings find application in all civil works involving the extraction, supply, and distribution.

D U V A L C O B V ,

Kamerlingh Onnesweg 10, Dordrecht, GL 3316, The Netherlands. Tel: +31-78-180522. Telex: 29035. Fax: +31-78-510591. Manufacturer of a wide range of rubber-lined Butterfly valves. Valve size ranges from 1in to 100ins. Also a complete repair service for all various types and makes. Makers of rubber-lined seatings and of course hydraulic service-engineers available for world-wide services.

D U R A P I P E G L Y N W E D T U B E S & F I T T I N G S L T D ,

Walsall Rd, Norton Cones, Cannock, Staffs WS11 3NS, UK. Tel: +44-543 79909. Telex: 339745. Fax: +44-543 79450. Glynwed's aim is to extend the use of thermoplastic pressure pipe and fittings to a wider base by the development of products for specific activities aimed at satisfying the individual requirements of the water and waste water industries. Currently, we are manufacturing thermoplastic pressure pipework systems in ABS, PVC, polyethylenes, and polypropylene. These systems comprise pipes, fittings and valves.

D Y K A (U K) L T D ,

65-69 Ellingham Way, Ashford, Kent TN23 2JU, UK. Tel:

+1-233 34438/9. Telex: 966671 DYKALK. Fax: +1-233 42755. Dyka manufacture full ranges of imperial and metric pipe systems for pressure and sewer application in both uPVC and polyethylene materials. The full range of peripheral products is also available.

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191 East North Avenue, Caro, Stream, Illinois 60188, USA. Tel: +1-312-260 3034. Telex: 722434. Fax: +1-312-260 4150. Manufacturers and suppliers of pressure compensating flow regulators coping with 1/16 gallon per minute to 90 gallons per minute.

E I S E N W E R K E F W D U E K E R ,

PO Box 20, D-8752 Laufach, Bayern D-8752, Germany. Tel: +49-06093 870. Fax: +49-06093 87246. Ductile iron fittings and valves for water supply systems.

E M C O L I N T E R N A T I O N A L L T D ,

Royal London Buildings, 42 Baldwin St, Bristol, Avon BS1 1PN, UK. Tel: +44-272 290161. Telex: 4473. Fax: +44-272 873503. Manufacturers and suppliers of a wide range of repair and maintenance materials. Main product is rapid epocrete, widely used for underground fast curving and providing a safe pipe jointing in confined spaces.

E N O L G A S B O N O M I S A S ,

Via Europa 227, Concesio 25062, Italy. Tel: +39-30-2752361. Fax: +39-30-2752493. Specialises in the manufacturing of ball valves, ball bib cocks, check valves and fittings in brass.

E R I E C O N T R O L S E U R O P E N V ,

Industriepark Wolfstee, Herentals B-2410, Belgium. Tel: +32-14-214095. Fax: +32-14-214881. Manufacturer of valves and steering systems for domestic and commercial water treatment.

E R I E M A N U F A C T U R I N G C O ,

4000 South 13th St, Milwaukee, WI 53221, USA. Tel: +1-414-483 0524. Telex: 2-6867. Fax: +1-414-483 6610. Manufacturers of automatic water softener and filters control valves. These valves are available with electro/mechanical and electronic timers.

E S S E B I P L A S T I C S R L ,

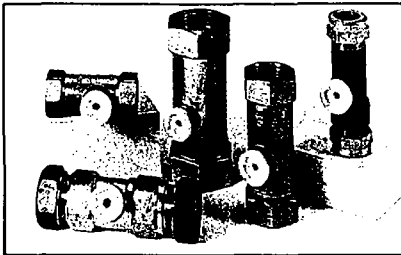
Via La Forma 1, Sirolo (Ancona) 60020, Italy. Tel: +39-71-73600145. Telex: 560606 MARRA I. Fax:

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SOCLA have been instrumental in the development of many protective devices designed to prevent contamination of drinking water caused by backflow or backsiphonage.

Today, SOCLA offer the most comprehensive range of check valves, foot valves and backflow prevention devices available from one source anywhere in the world — as befits the market leaders.

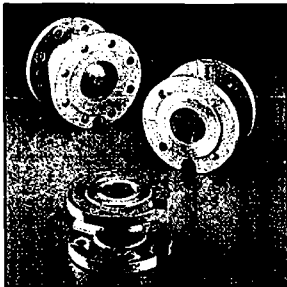
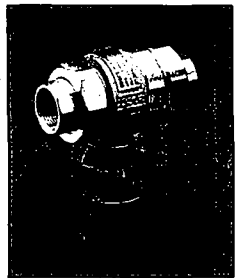


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For low/medium risk areas. For numerous hot & cold water applications. WRC Approved. UKWFBS Listed. PN10. Sizes: 15mm to 28mm dia. (compression ends). ½" to 2" dia (BSP screwed ends).

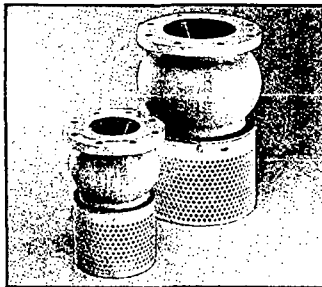
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For areas at high/medium risk e.g. laboratory & hospital equipment, dairy equipment, cattle troughs, washers etc. Sizes: ½" & ¾" dia. PN10.



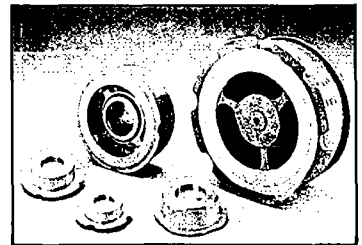
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WRC Approved. UKWFBS Listed. Excellent hydraulic performance. For water distribution, irrigation, pumping & sea applications. Sizes: 50mm to 350mm dia. PN16.



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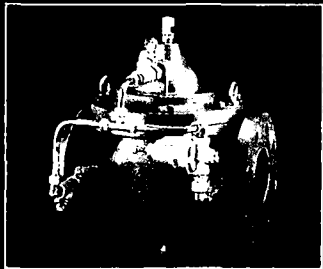
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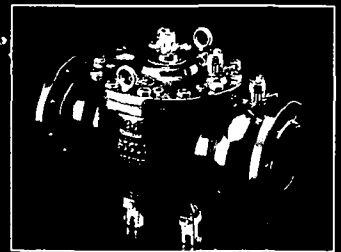
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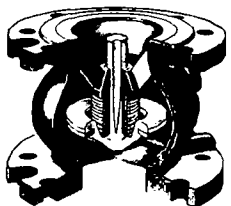
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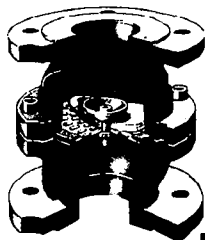
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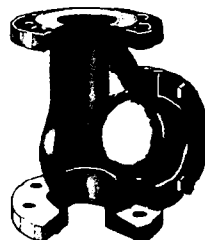
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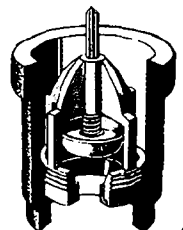
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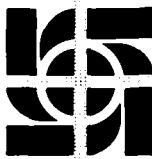
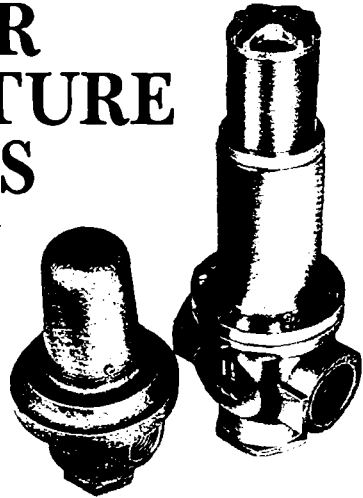
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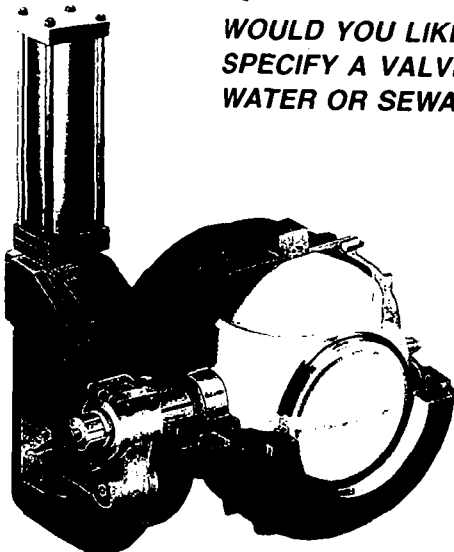
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91 Meiklewood Rd, Drumoyne, Glasgow G51 4DU. UK. Tel: +44-41-810 3121. Telex: 779541. Fax: +44-41-810 4724. Keystone is the world's largest speciality valve flow control company in the UK, Keystone has manufacturing plants in Glasgow and Manchester producing butterfly valves, actuators, process control systems, power safety and instrumentation products.

KINETROL LTD,
Trading Estate, Farnham, Surrey GU9 9NU. UK. Tel: +44-252 723688. Telex: 858-567. Fax: +44-252 713042. 0.25 turn pneumatic and electric actuators and add-on control units for automatic operation of all 0.25 turn valves.

RICH KLINGER AKTIENGESELLSCHAFT,
A-2352 Gumpoldskirchen, PO Box 19. Austria. Tel: +43-2252-62406. Telex: 14430 KIGTG A. Klinger are engaged in the production of industrial fittings. One of the main items in the line-up are the Ballstar Ball Cocks. These are available in every size from DIN 10 to 600, of cast iron, steel and acid-resistant steel, and in numerous special designs (eg for hot water up to 230°C). Other products turned out by Klinger are Klingerit sealing sheets, piston valves, meter pipe cocks and liquid level gauges.

W T KNOWLES & SONS LTD,
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KOMPOTEK,
Jillerbackel 1-7, Ban Hagen 1242. Sweden. Tel: +46-8-7491860. Fax: +46-8-66190. Valves and automatic products which consist of electro pneumatic actuator and all electric actuators.

THE KSB MANUFACTURING CO LTD,
Duke House, 6-12 Tabard St, London SE1 4JT. UK. Tel: +44-71-403 1789. Telex: 8952557. Fax: +44-71-403 2101. Centrifugal pumps for all applications across the spectrum. Also manufacture valves.

KUBOTA LTD,
11-12 Hanover St, London W1R 9HF. UK. Tel: +44-71-629 6471. Telex: 263235. Fax: +44-71-629 6915. Manufacture a very wide range of pumps, valves, ductile iron piping, pvc piping and ancillary equipment. Design, construction and equipment for water supply, irrigation and pollution control systems in many countries.

LASCO FITTINGS PHILIPS INDUSTRIES INC,
3255 East Miraloma Avenue, Anaheim, California 92806. USA. Tel: +1-714-993 1220. Fax: +1-714-524 0232. Losco Fittings, a division of a 'Fortune Manufacturing 500' firm, is a leading producer of Schedule 40 and 80 PVC pressure pipe fittings, insert fittings and PVC-DWW fittings, as well as specialised swing joints, swivel joints and repair couplings for both large-scale and small-scale turf irrigation projects, proven in worldwide installations under every climatic condition.

LEONARD VALVE CO,
1360 Elmwood Avenue, Cranston, RI 02910. USA. Tel: +1-401-461 1200. Fax: +1-401-941 5310. Manufacturer of thermostatic water mixing valves and controls.

LIMITORQUE CORPORATION,
PO Box 11318, Lynchburg, Virginia 24506. USA. Tel: +1-804-528 4400. Telex: 82-9448. Fax: +1-804-845 9736. Manufacturers of heavy duty valve actuators, also machine and ball screw jacks.

LIMITORQUE INTERNATIONAL,
Bone Lane, Newbury, Berks RG14 5EH. UK. Tel: +44-635 46999. Telex: 817214. Fax: +44-635 36034. Manufacturers of rotary and 0.25 turn pneumatic and electric valve actuators, together with a comprehensive range of manual gearboxes.

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Meer Subdivision, Postfach 365, Monchengladbach D-405. West Germany. Tel: +49-2161-350-1. Telex: 852525. Fax: +49-2191 350669. Manufacturer of non slam, low pressure loss, nozzle check valves. Made in nominal sizes from 25 to 1500mm. Pressure up to 400 bar. For all liquids and gases.

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PIPES & PIPE FITTINGS

12-12. Telex: 605928. Fax: +33-1-3-99-2704.

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MARSTON BENTLEY LTD,

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56, Boulevard Davout, Paris 75020. France. Tel: +33-1-43-48-20-09. Telex: 215-320. Fax: +33-1-43-48-78-21. Precision valves, pumps for cars and trucks. Also clutches, brakes and electronics.

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931 Summit St, Niles, OH 44446. USA. Tel: +1-216-544 4700. Fax: +1-216-544 5403. Manufacture pipe hangers and pipe support systems.

MID AMERICA WATER TREATMENT INC INTERNATIONAL,

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MIDDLE EAST TUBE CO LTD,

PO Box 788, Haifa 31007. Israel. Tel: +9724-910467. Makers of steel pipes. Akko plant: water and gas pipes 1.5in-4ins galvanised and black, line pipe 3ins-6ins, seamless pipe 1.5in-4ins. Ramat plant: line pipe 6ins-20ins longitudinal h f weld, 20ins-80ins spiral DSA welded. Corrosion protection: concrete lining, cement mortar coat

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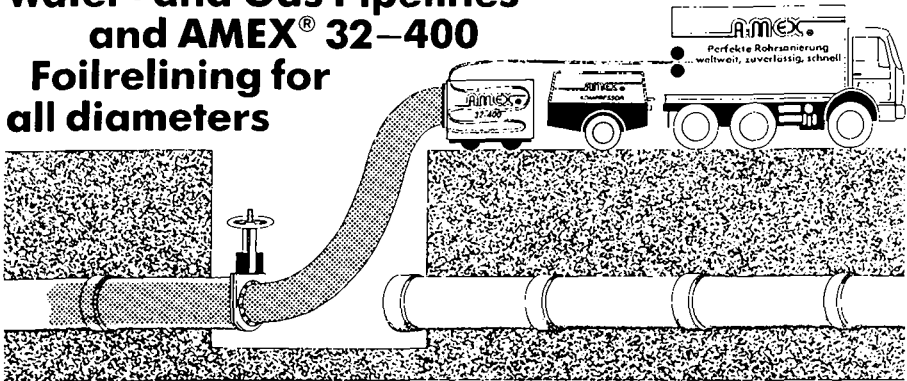
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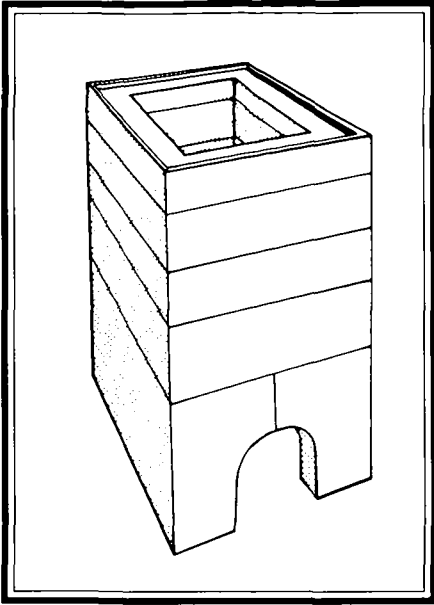
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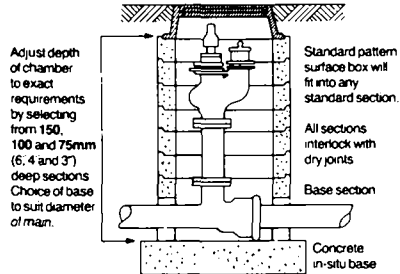
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518-274 0961. Fax: +1-518-274 0210. Manufacturers of a complete line of automatic control valves.

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Rue du Bosquet 17, Louvain la Neuve B-1348. Belgium. Tel: +32-10-45-1879. Fax: +32-10-45-1888. Plastic equipment including pipes and pumps. Also rubber lined pumps and valves and agitators.

SAUNDERS VALVE CO LTD,
Grange Rd, Cwmbran, Gwent NP44 3XX. UK. Tel: +44-633 838044. Telex: 498241. Fax: +44-633 838413. Manufacturers of diaphragm, ball, butterfly and non-return valves and actuators. Manufacturers of Saunders EVS underground stop valve system.

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2901 West Third St, Dayton, OH 45417. USA. Tel: +1-513-268 6626. Manufacturers of plastic and brass 5-cycle and 2-cycle control valves and accessories suitable for softeners and filters.

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2131 Magnolia Avenue South, PO Box 1926, Birmingham, Alabama 35201. USA. Tel: +1-205-252 6900. Telex: 501601 2966. Fax: +1-205-322 4356. Manufacturers of concrete pipes for the water industry.

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91 Rue De Faubourg, Saint-Honore, Paris 7536508. France. Tel: +33-266 9209. Fax: +33-142 660153. Bonna is a leading company in the production of large diameter pressure and non pressure concrete pipes (pre-stressed or reinforced) for potable water, wastewater, industrial water and irrigation.

SOCIETE METALLURGIQUE HAUT MARNALS,
5 Rue Mauciere, 52300 Joinville. France. Tel: +33-25-94-09-23. Fax: +33-25-94-01-94. Contact Name: J Chandesris - Sales Manager. Manufacturer and retailer of

PIPES & PIPE FITTINGS

valves, clamps, surface boxes, connection joints, fitting, pipe protection equipment, air valves, pressure reducers, stabilisers, hydrants etc.

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SOIUSTCI. Fax: +44-322 864629. Suppliers of most types of process valves and actuators, including slide, pinch, ball and butterfly valves.

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91342. USA. Tel: +818-364 1611. Fax: +818-362
1596. Manufacturer of PVC schedule 40, PVC and CPVC
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of pre cast concrete products for tunnel linings, sewers,
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5AA. UK. Tel: +44-602 322121. Telex: 37671. Fax: +44-
602 329513. Manufacturer and supplier of ductile iron

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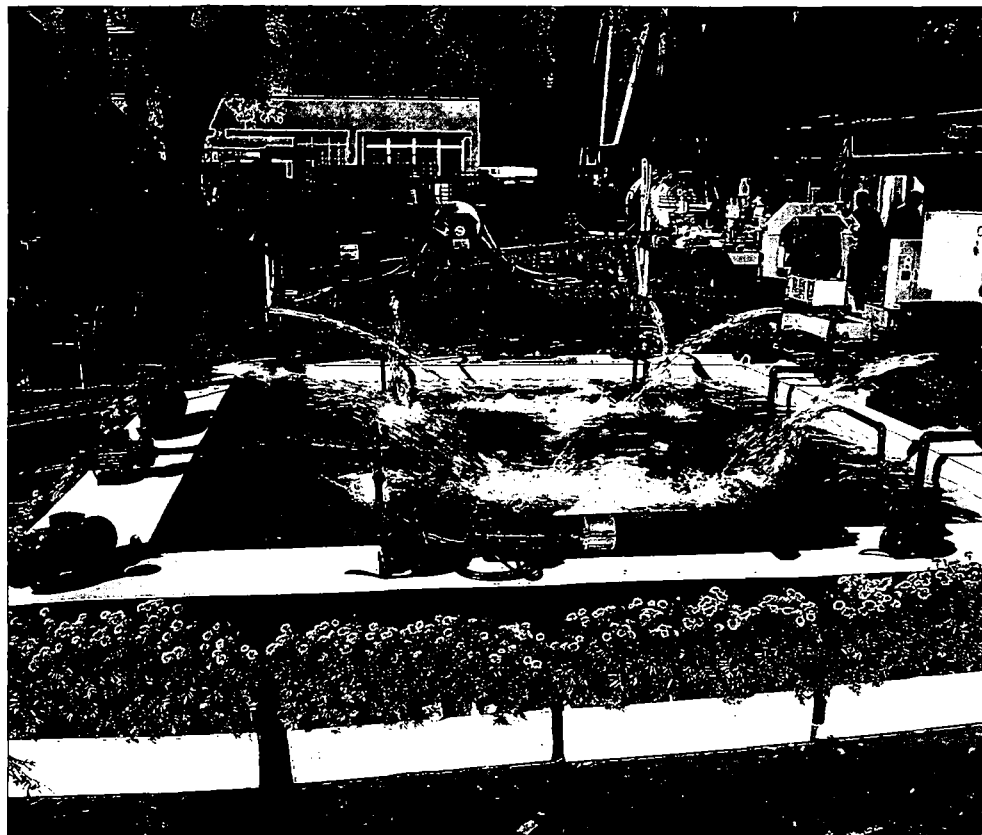
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Challenger, 1, Avenue Eugene Freyssinet, 78064 Saint Quentin Yvelnes Cedex. Tel: +1-33-30-60-22-60. Telex: 689 292 SAUR F. Fax: +1-33-30-60-27-89.
SAUR is the third largest water treatment and supply group in France where it serves 5,500 local authorities. It also handles waste water collection and treatment for 1.6 million people and collects and processes refuse from one-and-a-half million inhabitants. SAUR ensures the design and the execution of the plants necessary for the treatment of water and refuse (2,000 building references). The international activity of SAUR represents 38 per cent of the global activity. SAUR is present in Europe (Great Britain, Spain, Italy), in Canada and in Africa (15 countries) and serves 16 million people throughout the world.

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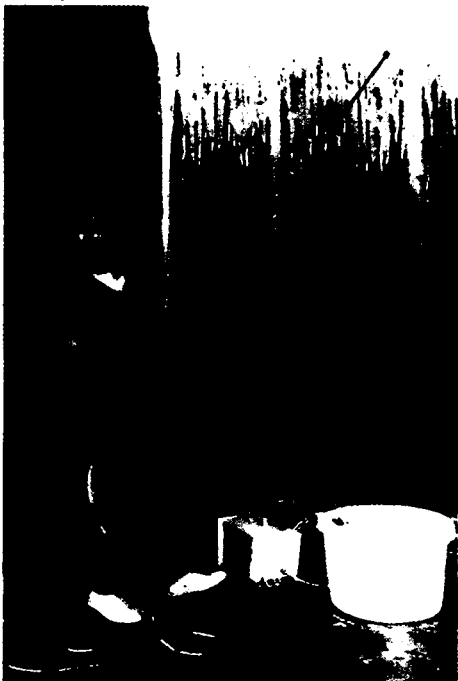
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PO Box 280, 1 Canbar St, Waterloo, Ontario N2J 4A7, Canada. Tel: +1-519-886 2880. Telex: 069-55255. Fax: +1-519-886 5546. Manufacturers of tanks and pipelines from wood, fibreglass and moulded polyethylene, of wood stave penstocks and pipelines for irrigation supply and hydro-power installations and chemical storage tanks for the water treatment industry.

CARELA,

R Späne GmbH, PO Box 11 28, 7888 Rheinfelden, West Germany. Tel: +49-7623 1084. Telex: 773444 SPAE D. Fax: +49-7623 63360. CARELA is one of the leading manufacturers of chemicals and equipment for water supply industry, well, water tank and water pipeline cleaning and disinfection. CARELA-BIO-PLUS-forte for rehabilitation of aged water wells, CARELA-BIO-PLUS for water tank cleaning / disinfection, CARELA-BIO-DES for pipeline disinfection and a range of 40 other CARELA products for industrial use. Apart from water related products, CARELA/R Späne GmbH manufactures several equipment and accessories as CARELA-WELL-MASTER for well rehabilitation of various diameters and up to 100 meters depths, through cleaning and disinfection of screen line and gravel pack by means of brushing, block surging, jetting and dosing processes.

THE CEMENT GUN GROUP LTD,

Restoration House, 61-65 Stafford Rd, Wallington, Surrey SM6 9AP. UK. Tel: +44-1-669 4011. Telex: 946707. Fax: +44-1-669 0208. Sprayed concrete repairs and overall

protective and decorative treatments to reinforced concrete structures, including water towers mostly applying proprietary materials.

CHEM-TAINER INDUSTRIES,

361 Neptune Avenue, North Babylon, NY 11704. USA.
Tel: +1-516-661 8300. Fax: +1-516-661 8209. Manufacturer of one-piece moulded polyethylene tanks. Capacity 2 gallons to 9,000 gallons. All materials food grade.

CLIMAX PUMPS,

Wildon Engineering Ltd, White Ladies Close, Little London, Worcs WR1 1PZ. UK. Tel: +44-905 22014. Telex: 337300 TAYLEY G. Fax: +44-905 723828.

Contact Name: Mr T Oakley. Manufacturers of deep well borehole units either hand, diesel, petrol or electric driven units. Pumps draw down to 200 metres deep. All pumps have lift and force facility that enables both horizontal and vertical distribution of water above ground level.

CONCEPTS IN FIBREGLASS,

6207 South McIntosh Rd, Sarasota, FL 33583. USA.
Tel: +1-813-924 9846. Fax: +1-813-378 4518. Custom fibreglass fabricator and manufacturer of indoor and outdoor aerators, commercial brine tanks, reverse osmosis storage tanks for the water treatment industry.

COOKSON & ZINN LTD,

Station Rd Works, Hadleigh, Suffolk IP7 5PN. UK. Tel: +44-473 823061. Telex: 98613. Fax: +44-473 824164. Manufacturers of storage tanks; process, pressure and surge vessels and associated pipework, all in carbon or stainless steel to BS 799, 2594, 2654, 5500 and API 620, API 650, designed and fabricated within the parameters of BS 5750.

DAVEY PRODUCTS PTY LTD,

118 Atkinson St, Oakleigh, Victoria 3166. Australia. Tel: +61-3-568 1655. Telex: AA139654. Fax: +61-3-568 4551. Manufacturers and marketers of pressure systems, end suction pumps - domestic, commercial and farm, swimming pool filters and pumps, spa bath pumps, engine driven pumps and pressure tanks.

DE JONG GORREDIJK BV,

PO Box 15, Gorredijk, AA, 8400. The Netherlands. Tel: +31-5133 1541. Fax: +31-5133 1555. De Jong

TANKS (INCLUDING PRESSURE VESSELS) & WATER TOWERS

Corredijk BV manufacture stainless steel products, such as hotwater storage tanks, filtertanks, pressure-vessels and transport containers, with a capacity of 1-1000 liters (wallthickness up to 3mm). Manufacture serial-wise and completely according to customers wishes.

DE LANGE PLASTIC LININGS,
Neptunusweg 4, 8939 AA Leeuwarden. Holland. Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

DELTA COOLING TOWERS INC,
PO Box 952, 114 Clinton Rd, Fairfield, NJ 07006. USA. Tel: +1-201-227 0300. Fax: +1-201-227 0458. Manufacture a line of factory assembled packaged cooling towers from 10 tons to 1,000 tons. We also manufacture a line of pack air strippers for removal of toxic organic contamination from water.

EMCO ENGINEERING INC,
25 North St, Canton, MA 02021. USA. Tel: +1-617-828 7340. Telex: 924326. Fax: +1-617-828 1714. The Emco group of companies is an international organisation incorporated in the state of Massachusetts, in 1974, specialising in the manufacture of water and waste treatment equipment, including: reverse osmosis, brackish and sea-water desalting plants, ultrafiltration systems, sewage treatment systems, water softeners, reclamation systems, deionisation lime treatment, swimming pool equipment and water storage tanks.

ERMCO INC,
1570 Fairview Avenue, St Louis, MO 63132. USA. Tel: +1-314-423 7711. Fax: +1-314-421 5904. Manufacturers of commercial, industrial water conditioning equipment. Industrial water softeners, pressure filter, deaerators and special tanks.

FIBAFLO REINFORCED PLASTICS LTD,
Holton Heath Industrial Estate, Holton Heath, Poole, Dorset. UK. Tel: +44-202 624141. Telex: 41175. Produce pipes, tubes and vessels in filament wound grade for the water, oil and chemical industry. Sizes from 25mm to 2.5m diameter.

FLEXCON INDUSTRIES,
300 Pond St, Randolph, MA 02368. USA. Tel: +1-617-

986 2424. Manufacturer of deep drawn steel and stainless steel diaphragm tanks for reverse osmosis systems, water wells and hydronic heating systems.

FRANKLIN HODGE INDUSTRIES LTD,

Ramsden Rd, Rotherwas Industrial Estate, Hereford HR2 6LR. UK. Tel: +44-432 269605. Telex: 35593. Fax: +44-432 277454. Franklin Hodge Industries supply high quality, reliable, economic water storage tanks, which require minimal long term maintenance. Franklin Hodge tanks have particular relevance to the storage of processed water, with no harmful or potentially polluting paint finishes, sealants of special gaskets are used inside the tanks. Over many years Franklin Hodge have built a reputation with clients worldwide, as suppliers of easily installed long life tanks for pure water storage in both urban and remote locations.

GALLIFORD PIPELINE SERVICES LTD,

PO Box 33, Milton Malsor, Northampton, Northants NN7 3AD. UK. Tel: +44-604 858031. Fax: +44-604 858561. Undertake specialist repairs to water towers, underground reservoirs and general water retaining structures, ie concrete repairs, crack sealing, internal lining & external waterproofing, joint renewal and epoxy paint applications.

GOODWIN TANKS LTD,

Pontefract St, Ascot Drive industrial Estate, Derby DE2 8JD. UK. Tel: +44-332 363112. Fax: +44-332 290397. Suppliers of glass coated (vitreous enameled) sectional steel cylindrical storage tanks for the containment of potable water and sewage processing.

H & H PRECISION PRODUCTS THERM-O-DISC INC,

1320 South Main St, Mansfield, OH 44907. USA. Tel: +1-419-756 2131. Manufacturer of bubblers, carafe fillers, water valves, flow controls, tank assemblies and custom OEM products.

HARRINGTON INDUSTRIAL PLASTICS,

14480 Yorba, Chino, CA 91710. USA. Tel: +1-714-597 8641. Specialises in ultrapure and corrosion resistant plastic liquid handling. Pipe fittings, valves, pumps, tanks, filters and instrumentation.

TANKS (INCLUDING PRESSURE VESSELS) & WATER TOWERS

HENDERSON BARWICK INC,
150 California Avenue, Brockville, Ontario K6V 5W1.
Canada. Tel: +1-613-342 8471. Telex: 066-36539. Fax:
+1-613-342 4432. Custom-made tanks, tubing, ducts, spe-
cial cabinets, mixers, conveyors and pressure vessels of all
kinds. Chiefly in stainless steel, aluminium, copper and many
special alloys including titanium, hastelloy and all nickel
alloys.

JACK F HOLT & ASSOCIATES,
3603 North Muskingum Avenue, Oaessa, TX 79762. USA.
Tel: +1-915-366 5295. Specialised in the BYOB drinking
water connection, design RO systems (from 200-10,000
gpd) pre-treatment, storage tanks, delivery and post-treatment
equipment. Complete water store, the design, construction
and marketing services.

K & M PLASTICS INC,
Elk Grove Village, Illinois 60007. USA. Tel: +1-312-439
3311. We are a manufacturer of brine tanks and brine cab-
inets. We are also a distributor for the park international
mineral tanks.

KVK,
A-8551 Wies, Austria. Te: +43-3465/25-13. Telex:
034342. The firm KVK has been engaged for years in the
production of large capacity tanks for acids, lyes and waste
water. In line with pollution control requirements it has devel-
oped a compact neutralisation plant for the treatment of used
waters and acids.

MATT-SON INC,
28 West 005 Industrial Avenue, Barrington, IL 60010.
USA. Tel: +1-312-628 8766. Design, manufacture and dis-
tribute plastic components for the water treatment industry.
Stock supplier of US water treatment.

MATT-SON INC,
28 West 005 Industrial Avenue, Barrington, IL 60010.
USA. Tel: +1-312-628 8766. Supplier, manufacturer and
distributor of plastic components. Fiberglass tanks, resins and
filtration media, brine tanks and accessories, cartridges and
filter housings, pipe and pipe fittings and a wide variety of
third faucet components including UV equipment.

**MID AMERICA WATER TREAT-
MENT INC INTERNATIONAL**
2045 Lake St, Hanover Park, IL 60103. USA. Tel: +1-312-
289 6400. Manufacturer of a complete line of residential

and commercial water conditioning equipment including soft-
eners, filters, chemicals, chemical feed pumps, RO systems
and a complete line of component parts, pressure vessels,
resin, valves, brine tanks, feeder tanks, filter housings, car-
tridges and carbon.

MONARCH WATER SYSTEMS,
245 North Valley Rd, Xenia, OH 45385. USA. Tel: +1-
513-426 7000. Manufactures pressure vessel equipment
including filters with many media from different applications,
ion exchange softeners, dealkalisers and demineralisers.
Uses standard parts which can be obtained and serviced
locally.

MORGAN MARINE LTD,
Llandybie, Ammanford, Dyfed SA18 3JA. JK. Tel: +44-269
850437. Telex: 48300. Fax: +44-269 850656. GRP
buildings, switchgear and sub-station building, pumping sta-
tions, treatment buildings, kiosks, cabinets, sound proof
buildings and enclosures, tanks, structural and cladding pan-
els, large span circular and rectangular covers and reservoir
access covers.

**MOTHERWELL NAYLER PET-
ROSEALS,**
149 Glasgow Rd, Wishaw ML2 7QG. UK. Tel: +44-698
355711. Fax: +44-698-69774. Tank covering is neatly
achieved by the Covera Dome. Using geodesic design prin-
ciples the dome can contain odours, exclude light, protect
from weather etc, while presenting a pleasing visual aspect.

NALGE CO,
PO Box 20365, Rochester, NY 14602-0365. USA. Tel:
+1-716-585 8800. Manufacture chemically and corrosion
resistant plastic tanks, 2 gal to 22,000 gal; blowers and
tubing. All used in water and waste treatment.

**NEI THOMPSON HORSELEY-
BRIDGE,**
PO Box 5, Tipton, West Midlands DY4 7LV. UK. Tel: +44-
21-557 1104. Telex: 337359. Fax: +44-21-520 7841.
NEI Thompson Horseley Bridge supply sectional water stor-
age tanks manufactured in grp and steel together with a
range of large capacity ellipsoidal tanks on towers.

NORTHANTS AFORM LTD,
Pound Lane, Thatcham, Nr Newbury, Berks RG13 4TQ.
UK. Tel: +44-635 63040. Fax: +44-635 71950.
Manufacturers of glass reinforced covers for water tanks,

TANKS (INCLUDING PRESSURE VESSELS) & WATER TOWERS

and component parts for packaged effluent treatment and anaerobic digester systems.

PAKO PLASTICS,

5370 West Highway 12, Maple Plain, MN 55359. USA. Manufacture rotational molded nylon tanks for water conditioning.

PARK INTERNATIONAL CORP,

1401 Freeman Avenue, Long Beach, CA 90804. USA. Tel: +1-213-494 7002. Manufactures thermo plastic/fiber-glass pressure vessels for water conditioning industry. 49 sizes from 18 to 37.6cu ft, capacity 150psi operating, NSF/UL approved. Tanks are suitable for all water treatment applications. Accessories include manifolds and distribution systems.

PEABODY TEC TANK,

PO Box 996, Parsons, Kansas 67357. USA. Tel: +1-316-421-0200. Telex: 910-740-1988. Manufacturers of sectionalised epoxy coated carbon steel water storage and waste treatment tanks, with capacities up to 7500 cubic meters.

PEABODY TECTANK INC,

PO Box 996, Parsons, KS 67357. USA. Tel: +1-316-421-0200. Telex: 910-740-1988. Fax: +1-316-421-9122. Peabody TecTank Inc, manufactures bolted steel tanks for export worldwide. Liquid storage tanks and standpipes for water and wastewater storage are produced with the best interior and exterior coatings in the industry. Technical and budget assistance is available, and tanks are designed to API, AWWA and customer-specified standards. Erection and construction is completed with factory crews or supervision of customer supplied labor.

PITT DES MOINES INC,

1015 Tuttle St, Des Moines, Iowa. USA. Tel: +1-515-244 6000. Telex: 86-6434. Fax: +1-515-244 2576. Manufacturers of elevated and flat-bottomed storage tanks.

PRONAL SA,

Roubaix, Cedex 1, BP 25-59051. France. Tel: +33-20-24-18-19. Fax: +33-20-27-23-10. Pronal is a family-owned company specialising in the manufacture of technical inflatable products made of rubber-coated fabric eg flexible tanks for storage and transport of liquids such as water or petroleum products, lifting bag, inflatable stoppers for pipes and various products for the industry.

QUICK TANKS INC,

545 North Krueger St, Kendallville, IN 46755. USA. Tel: +1-219-347 3850. Manufacturer of galvanised and lined non-code steel pressure tanks for water storage and treatment.

REVUL CORP,

PO Box 1357, Loveland, CO 80539-1357. USA. Tel: +1-303-663 1903. Complete service company which engineers, designs, manufactures and markets pressure vessels for water purification and liquid separation applications. Revul pressure vessels are fully engineered to meet the operation and maintenance needs of the system manufacturer and end user.

ROBAN DUCTILE WELDING LTD, Fairsham Industrial Estate, Evelyn Drive, Leicester LE3 2BU. UK. Tel: +44-533 891363. Fax: +44-533

823225. A major UK ductile iron flange pipe manufacturer with what is said to be the most modern production facility in Europe, Roban offer a complete pipeline supply service, including connection for storing tanks, and water towers. Roban also specialise in all types of valves, flange adaptors and couplings, and offer an advisory service on pipe jointing problems. (Please see Roban's advertisement on page 000).

STRUCTURAL FIBERS DIVISION OF ESSEF CORPORATION,

Industrial Parkway, Chardon, OH 44024. USA. Tel: +1-216-286 4116. Telex: 980481. Fax: +1-216-286 6759. Manufacturers of fibreglass pressure vessels for water treatment, conditioning and filtration, well system pressure tanks for storage of well water, chemical storage tanks for water treatment industry.

STUCKLIN ET COMPAGNIE CIE AG,

Mühlerrainstrasse 26, CH-4414 Füllinsdorf, CH-4414. Switzerland. Tel: +41-061-901-36-22. Fax: +41-061-901-36-26. Pneumatex safety expansion tanks for heating and refrigerating systems.

SUPERIOR WATER SYSTEMS INC,

13529 South Normandie Avenue, Gardena, CA 90249. USA. Tel: +1-213-770 8920. Manufacturer of water softener and carbon filters, resin, RO units, tanks and valves.

DRAINAGE (INCLUDING DRAINAGE OF BUILDINGS)

SUTCLIFFE CROFTSHAW ENGINEERING LTD,
Neills Rd, Bold, St Helen's, Lancs WA9 4TH. UK. Tel: +44-744 810107. Telex: 629685. Fax: +44-744 821418. Design and fabricate stainless steel pressure vessels, heat exchangers and storage tanks to international codes and specifications.

SWHIFT SYSTEMS INC,
5600 Jacobson Rd, Sandpoint, ID 83864. USA. Tel: +1-208-265 4250. Manufacture stainless steel tank both pressure and non-pressure, for water purification industry and for hot water storage application.

TANKKI OY,
Oikarie 2, 63700 Ahtari, Finland. Tel: +358-65-30021. Fax: +358-65-30033. Stainless steel tanks up to 100M3.

VULCAN TANKS LTD,
Coles Park Lane, Coles Park Industrial Estate, Alfreton, Derby. UK. Tel: +44-773 835321. Telex: 377311. Fax: +44-773 836578. Vulcan Tanks Ltd are manufacturers and installers of cylindrical sectional steel tanks for the bulk storage of most liquids including water, trade effluent and sewage. Also manufacture ancillary equipment. Due to the tanks being of sectional construction they are ideal for shipping overseas.

WALTHAM CHEMICAL PUMP CORP (WALCHEM),
PO Box 565, 1396 Main St, Waltham, Massachusetts. USA. Tel: +1-617-899 8604. Telex: 923478. Fax: +1-617-647 9507. Manufacturers and suppliers of positive displacement metering pumps, fluid control systems and thermoplastic moulded tanks up to 5000 gallons.

FRED WATKINS (ENGINEERING) LTD,
Sling Engineering Works, Nr Coleford, Glos GL16 8JD. UK. Tel: +44-594 32271. Telex: 437125. Fax: +44-594 35064. New and unused pipework from 1.5ins to 40ins. Storage tanks for all liquids. Also valves and fittings and steam boilers.

WENDLAND MFG CO,
PO Box 808, 601 West 11th, San Angelo, TX 76902. USA. Tel: +1-615-655 6778. Fax: +1-915-655 0325. Manufacturers and suppliers of overground and underground water storage vessels.

WESSELS CO,
1625E Euclid Avenue, Detroit, MI 48211. USA. Tel: +1-313-875 5000. Fax: +1-313-875 5004. Manufacturers and distributors of pressure vessels for water filtration, also supply RO storage tanks.

WHALE TANKERS LTD,
Ravenshaw Lane, Solihull, West Midlands B91 2SU. UK. Tel: +44-21-704 3191. Telex: 336182. Fax: +44-21-705 3053. Tankers - gravity or vacuum filled, gully emptiers and jetters in capacities up to 5000 gallons for municipal and industrial waste handling and drainage system maintenance.

XERXES CORP,
1210 North Tustin Avenue, Anaheim, CA 92807. USA. Tel: +1-714-630 0012. Manufacturer of FRP tanks (above ground and underground), pipe, duct and custom engineered products.

XERXES CORP,
Via Del Santo, Imena, Padova 242-35010. Italy. Tel: +39-49767617. Telex: 430181. Fax: +39-49767321. Expansion vessels for heating systems and boilers, stainless steel expansion vessels, interchangeable membrane pressure tanks, plate-d-ssmanite heat exchangers, chaplets for foundry/radiator.

DRAINAGE (INCLUDING DRAINAGE OF BUILDINGS)

ARC PIPES,
Mells Rd, Mells, Frome, Somerset BA11 3PD. UK. Tel: +44-373 812791. Telex: 44393. Fax: +44-373 812442. Arc Pipes is the largest manufacturer of pre-cast concrete drainage products in the UK. 10 works situated throughout the country linked by the latest computer technology, which provides comprehensive and efficient nation wide service.

BIG 'O' INC,
PO Box 970, Exeter, Ontario N0M 1S0. Canada. Tel: +1-519-235 0870. Telex: 064-5659. Fax: +1-519-235 2144.

BM FLOW REGULATORS LTD,
4-6 Bridge St, Tadcaster, North Yorks LS24 9AL. UK. Tel: +44-937 832778. Telex: 57697 YORVEX BM. Fax: +44-937 834413. Stainless steel flow regulators for flood

DRAINAGE (INCLUDING DRAINAGE OF BUILDINGS)

control. Installed in sewers etc to control the flow. Vortex flow pattern enables large outlet areas to be used thus eliminating the risk of blockages.

CSR - HUMES PTY LTD,

PO Box 31, World Trade Centre, Melbourne, Victoria 3005. Australia. Tel: +61-3611 3311. Telex: 38015. Fax: +61-3614 6347. Humepipe Systems, steel reinforced concrete ranging in size from 100mm to 3,600mm, are produced for a wide variety of applications such as stormwater drainage, road culverts, sewerage and irrigation. Precast concrete products are available for a wide variety of applications both urban and rural. Humes Plastiline protects concrete pipes and structures from corrosion and renovation systems; these include Humes Duraliner and Spray Applied Linings (SAL). For soil stabilisation, they offer a range of ProPex Geotextiles or engineering fabrics for road construction, railway and drainage projects. Humes Concrete is Australia's leading producer of concrete and a significant contributor to the nation's construction. Ever expanding, Humes has become involved with the Advance Australia Award winning Envirocycle, a compact and inexpensive alternative to domestic sewerage, septic tank and pump-out systems.

DE LANGE PLASTIC LININGS,

Neptunusweg 4, 8939 AA Leeuwarden. Holland.

Tel: +31-58-884240. Fax: +31-58-884264. De

Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

EAST JORDAN IRON WORKS INC,

PO Box 439, 301 Spring St, East Jordan, Michigan 49727. USA. Tel: +1-616-536 2261. Fax: +1-616-536 7058. East Jordan Iron Works Inc, produces quality castings in grey and ductile iron. In the water distribution and sewerage business, East Jordan Iron Works manufactures municipal castings including manhole frames and covers, 'Waterite' units, curb (kerb) inlets, inlet gratings, valves and fire hydrants.

GPK - PRODUCTS INC,

PO Box 2872, Fargo, North Dakota 58108. USA. Tel: +1-701-293 7890. Fax: +1-701-293 6153. Manufacturers of PVC sewer and drainage fittings in both gasket joint and cement joint types.

GRUNDFOS INTERNATIONAL A/S,

P D Jensensvej 7, Bjerringbro 8850. Denmark. Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. Grundfos domestic drainage pumps model KP suitable for clean and slightly dirty water are used for drainage, groundwater lowering, dewatering, emptying pools etc. Capacity: Q: 0-20 cbm/h. H: 0-8m.

HEPWORTH BUILDING PRODUCTS,

Hazelhead, Stocksbridge, Sheffield S30 5HG. UK. Tel: +44-226 763561. Telex: 54294. Fax: +44-226 764827. Manufacturers of vitrified clay drainage pipes and fittings for buildings, drainage and sewerage, vitrified clay conduits for underground cable installations, vitrified clay stop tap guards and surface boxes, and thermo plastic systems for supply and above and below ground gravity drainage conduits.

HEPWORTH BUILDING PRODUCTS INTERNATIONAL LTD,

Edlington Lane, Edlington, Doncaster, South Yorks DN12 1BY. UK. Tel: +44-709 866500. Fax: +44-709 860004. Manufacturers and exporters of pipes and fittings systems, in plastics and vitrified clay materials for all aspects of water conveyance.

KSB INTERNATIONAL SA,

PO Box 225, Frankenthal (pfalz) D-7610. West Germany. Tel: +49-6233 863159. Telex: 465211. Fax: +49-6233 862577. Builders of pumps, pump stations and water supply systems for supplying drinking and raw water to homes, farms and industry. Also systems for the conveyance and removal of water.

MARLEY EXTRUSIONS LTD,

Dickley Lane, Lenham, Maidstone, Kent. UK. Tel: +44-622 858888. Telex: 965578. Fax: +44-622 858725. Produce a comprehensive range of rainwater systems, soil waste overflow and underground drainage. Product ranges are continually expanded as new products are designed and developed to meet market needs. Marley Extrusions has been assessed by BSI and achieved registration to BS5750 quality systems - an endorsement of their technical expertise and product quality.

NAYLOR BROS (CLAYWARE) LTD,
Clough Green, Cawthorne, Barnsley S75 4AD. UK.

Tel: +44-226 790591. Telex: 547787. Fax: +44-226 790531. Manufacturers of vitrified clay drainage materials.

POLYPIPE (ULSTER) LTD,
Unit 49, Seagoe Industrial Estate, Portadown,
Northern Ireland. Tel: +44-762 338370.
Telex: 747953. Fax: +44-762 332800.
All above and below ground drainage systems.

T SEVERN (FIBREGLASS PRODUCTS) LTD,
Woodside Mills, Halifax Rd, Elland, West
Yorks HX5 0SH. Tel: +44-422 777464.
Manufacture grease interceptors, guttering and
water tanks.

SPUN CONCRETE LTD,
Licfield Rd, Branston, Nr Burton on Trent, Staffs DE13 3HF.
UK. Tel: +44-283 712666. Telex: 341592. Manufacturer
of precast concrete products for: tunnel linings, sewers,
drainage systems etc.

WEBER SENSORTECHNIK GMBH,
2201 Kollmar, West Germany. Tel: +49-04128 591.
Telex: 218326. Fax: +49-04128 593. The flow-
captor Eurocard system finds extensive
application in the central monitoring and panelling
of drainage systems. The flow-captor can be
applied to liquid or semi-solid media and provides
high resistance to aggressive media due to a
stainless steel sensing surface.

WEDNESBURY TUBE,
Oxford St, Bilston, West Midlands WV14 7DS. UK.
Tel: +44-902 41133. Telex: 339046. Fax: +44-902
405838. Wednesbury Copper Tube for water, gas,
heating, sanitation and engineering purposes.
Manufactured to various international specifications,
available in soft, half hard (bendable) and hard tempers,
coils and straight lengths.

WHALE TANKERS LTD,
Ravenshaw Lane, Solihull, West Midlands B91 2SU. UK.
Tel: +44-21-704 3191. Telex: 336182. Fax: +44-21-705
3053. Tankers - gravity or vacuum filled, gully
emptiers and jettors in capacities up to 5000 gallons for
municipal and industrial waste handling and
drainage system maintenance.

PLUMBING - WATER IN BUILDINGS

B & K INDUSTRIES INC,
PO Box 816, 655 Wheat Lane, Wood Dale,
Illinois 60191. USA. Tel: +1-708-773 8585.
Fax: +1-708-773 0330. B & K Industries is
a quality distributor of a wide variety of
plumbing valves and specialities for industrial,
commercial and residential applications. Valves are
available in brass, bronze, cast iron, carbon s
teel and plastic. Other products include compression
repair fittings, PVC nipples, a variety of faucets and
various other plumbing specialities. Contact our sales
department for specific information on all of our
quality products.

B S S,
Fleet House, Lee Circle, Leicester LE1 3QG. UK.
Tel: +44-533-23232. Telex: 342761. A national
company supplying pipeline and mechanical services
equipment through a network of over thirty depots throughout
the UK. Each depot maintains comprehensive stocks to
provide a local service for the day-to-day requirements of
industries in the area.

EMMANUEL N KAZIS SA,
PO Box 51066, /GR-145, 10 Kifissia, Greece.
Tel: +30-1816712/8161702. Telex: 215870 EMKAGR.
Fax: +30-8161018. Manufacturing 'Torrent=Ca' Boilers:
For house heating - oil or gas fuel, working with high
efficiency and low temperatures. Sections are made of high
quality cast-iron.

ENVIROVAC INC,
1260 Turrer Drive, Rockford, IL 61111. USA. Tel: +1-815-
654 8300. Fax: +1-815-654 8306. Evac vacuum toilet
systems utilise only three pints of water per flush. These sys-
tems also feature small diameter piping, upward flush
capability and no slope requirement for piping. They are
installed in commercial buildings, ships, airplanes, trains,
marinas and construction sites etc.

HALSEY TAYLOR CO,
Rt 75 East, Freeport, IL 61032. USA.
Tel: +1-815-235 0066. Manufacturer of 'drinking type'
water coolers which can be retrofitted with a variety of
filtration systems.

PLUMBING - WATER IN BUILDINGS

HAUSERS WATER CONDITIONING SERVICES,

309 South Wayne St, Manchester, Iowa 52057. USA. Tel: +1-319-927 3716. Nationwide distributors of QEST plumbing systems-Amerek filtration products and Epco ultraviolet sterile faucets.

HEPWORTH BUILDING PRODUCTS INTERNATIONAL LTD,

Edlington Lane, Edlington, Doncaster, South Yorks DN12 1BY. UK. Tel: +44-709 866500. Fax: +44-709 860004. Manufacturers and exporters of pipes and fittings systems, in plastics and varified clay materiels for all aspects of water conveyence.

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WATER TREATMENT – A CHECKLIST FOR THE 1990S

by Adrian Coad, Water, Engineering and Development Centre (WEDC).

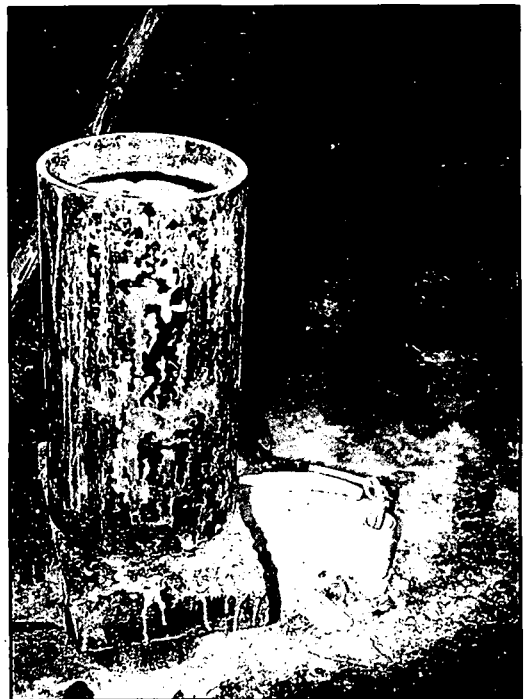
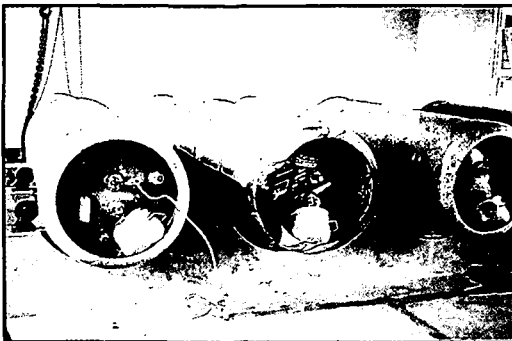
Now is a good time to evaluate attitudes and objectives in the field of water treatment in the light of the experiences and developments of the last decade. May I suggest the following as a checklist to aid in the evaluation of designs and management?

Sadly, the British climate does not suit mangoes. Padi does not grow in the desert. Just as the agriculturalist must consider climate and soil, so the water treatment engineer must study local conditions so that he can forecast which types of treatment plant will thrive in each situation. Some types of treatment plant perform well where maintenance of electronic equipment is commonplace, where electricity supplies are steady and reliable, and where there is little silt in the water. Other types are suited to lower manual wage rates and

more arduous conditions, such as unreliable power supplies.

A clear example is the vertical flow flocc blanket clarifier. This process can produce an excellent

BELOW: Different climate, different crop. Do local conditions guarantee a reliable supply of chlorine or will the operator soon be forced to improvise a bleaching powder system?





ABOVE: Concrete or complexity? Two different approaches to filter controls.

water under the right conditions, and can often deal with algae. But it needs a continuous flow of water (preferably at a constant rate) and many types cannot handle the heavy silt loads that are often found in rivers at the beginning of the rainy season. Skilled operation is required. Such plants are a great success in some places, and a disaster in others.

WHOLE-LIFE COSTS

Too often tenders are evaluated on the basis of first cost only. It makes sense to consider the total costs over the whole lifetime of the project, as in the following examples:

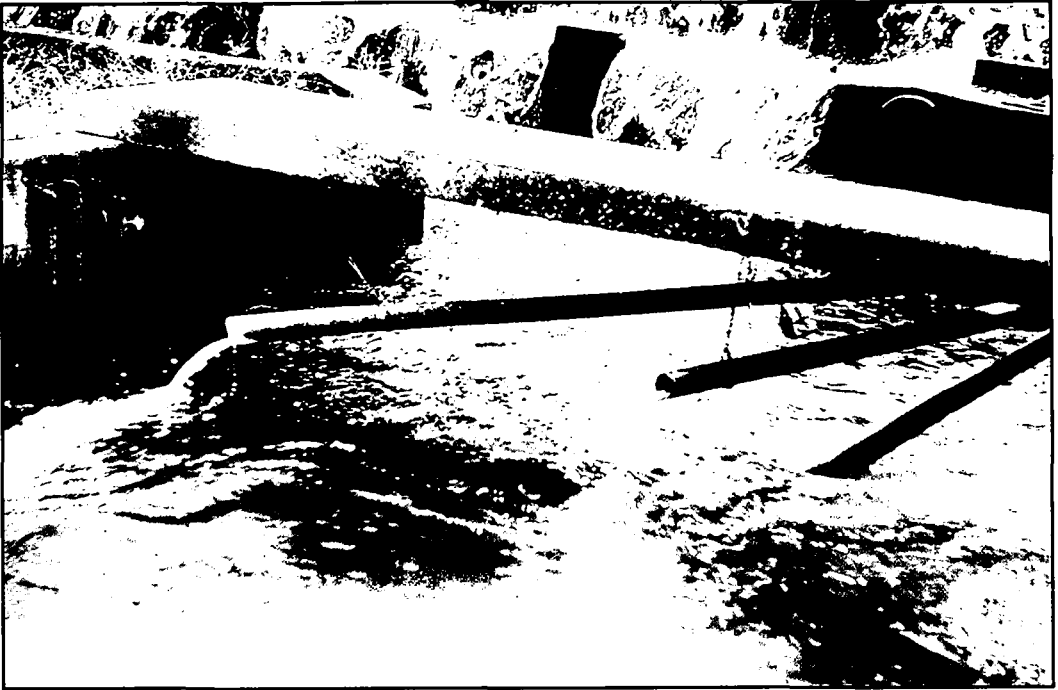
- A more expensive pump, if more efficient under actual operating conditions, may save more than the price differential (between it and a cheaper alternative) in one year because it uses less electricity;
- A slow sand filter plant may cost more to build, but the savings in chemical costs may soon make up the difference (chemical costs can be more than 20 per cent of the operations budget);
- Better insulation or better overload protection

systems can save expensive motor repairs and embarrassing breaks in supply.

The engineer may feel that it is impossible to change administrative procedures such as tender evaluations. However, economic analysis techniques (which estimate the present value of capital and recurrent costs together), are widely used by decision-makers in many contexts, so it makes sense to employ them in tender evaluations. Clear records of operation and maintenance costs are needed to make reliable forecasts of recurrent costs for this purpose.

CONCRETE OR COMPLEXITY?

In some cases it is essential to minimise land usage. Sometimes it is economical and feasible to use complex equipment, telemetry and microprocessor controls. But there are cases when it is better to spend more on excavation and concrete and less on imported equipment; possible benefits may be reliability and savings on foreign exchange (for first cost and spares). Usually there is more



ABOVE: *Flexibility – friend or foe? Changing the point of alum dosing to this position was not a good idea*

than one way of treating water – economic criteria (using shadow pricing to reflect the scarcity or otherwise of labour and foreign exchange) should be used to assist in selection.

Examples of these alternatives are easily found:

- In the case of a pump supplying treated water to a service reservoir, the designer may opt for a variable-speed pump and a small reservoir, or a cheaper constant-speed pump and a larger reservoir;
- In the case of rapid filters the choice may be between a flow controller valve to maintain a constant head, or a deeper variable-head plant, perhaps operating on the declining-rate principle;
- Slow sand filters require more construction than compact chemical treatment units, but they may prove more reliable in the long term.

FLEXIBILITY – FRIEND OR FOE?

Some plants should be designed to allow adjustments by operators to attain peak efficiency, because the operators are competent to do this. Other plants should provide little opportunity for adjustments because the operator may make things worse rather than better. For example, a well-trained technician may alter the points at

which chemicals are added to obtain the best effect, but a poorly-trained operator may change the dosing point so as to cause a serious deterioration in the whole plant. In the latter case it would be better if there were no possibility of changing the dosing point. Variable speed flocculators are another case where flexibility is not always beneficial. In fact motor-driven flocculators may be unnecessarily switched off by operators for a variety of reasons – another point in favour of baffle flocculators.

PRIDE AND PREJUDICE

How do we select processes and equipment for new treatment plants and extensions? Do we want the latest ideas, irrespective of whether they are proven or appropriate? (Pride?)

Do we ignore some possible methods (such as slow sand filters, baffle flocculators or raked filters) because someone has said they are old-fashioned? (Prejudice?)

PRIDE AND PREJUDICE ARE NOT GOOD ENGINEERING.

Sometimes district engineers are reluctant or unable to advise on operational procedures

because their studies have been too theoretical or too shallow. Often the necessary expertise exists somewhere in the organisation so that the needed training can be given. If not, outsiders can be brought in, or a relevant course can be found. Most undergraduate courses do not equip young engineers to manage treatment plants – further training is needed, preferably with ‘hands-on’ experience.

Care is needed when selecting courses. Some courses are concerned only with design, or do not consider the type of operating conditions that are commonly found in the field. Instructors should be familiar with local conditions.

THE PILOT UP-FRONT

Many questions about the performance of a planned treatment plant can be answered by building and running a pilot plant, before the full-scale plant is designed. A simple pilot filter can be made from a piece of pipe at least 150mm in diameter, and a ‘home-made’ system to control the flowrate. The depth and specification of the sand, and the filtration rate, should all be the same in the pilot filter and in the full-scale filter. Such pilot filters have saved much money and prevented mistakes.

WORTH A SECOND LOOK

Slow sand filters are coming back. There has been renewed interest in this proven method of treatment. Not only are such filters supplying large cities such as London, Paris and Amsterdam, but they are also gaining acceptance all over the world as the first choice for small supplies. There is widespread interest in slow sand filtration in the USA as a result of outbreaks of giardiasis caused by unfiltered, chlorinated supplies.

There have been failures. Often failures or shortcomings in slow sand filter performance can be traced to ignorance of one or more of the following four rules:

- Let the bugs breathe. The bacteria and other organisms that do much of the purification take oxygen from the water, so it is essential to maintain their supply by keeping the water flowing through the sand bed at all times, day and night;
- Little things mean a lot. Attention should be paid to small points of design and operation. The basic concept of slow sand filtration is simple, but the

plants must be designed with thought and operated with care. Common errors are the failure to prevent flow down the walls instead of through the sand bed, sudden changes in flow through the filter caused by the rapid opening of valves, and attempting to fill from above after resanding;

- Roughing before polishing. Slow sand filtration is a polishing or finishing process; water with turbidities in excess of 20 NTU needs roughing filtration before it reaches the slow sand filter.

Vertical sand filters and horizontal gravel filters have been used for this roughing treatment. A simple upflow sand filter is currently being developed at Loughborough University;

- Keep the algae in the dark. Algae are a cause of problems for rapid and slow filters. Their growth can be controlled by keeping them out of strong sunlight, which provides their energy. The covering of large filters is expensive, but roofs for small filters may be made from traditional materials.

As we review the progress of the Water Decade we can be proud of our successes, but we must also learn from our failures. Maintenance, reliability and sustainability are issues that will not go away. Resources are scarce. Now, more than ever, we need to re-evaluate our criteria and procedures to ensure that the systems we provide can be paid for and can be maintained, and to ensure that the best use is made of our manpower. Research and development work in South America has shown that new, more economical solutions can be found, and old technologies can be improved. In other continents, too, it may be that a fresh approach is needed.

We should stop trying to grow mangoes in cold climates and rice in the desert.

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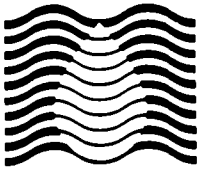
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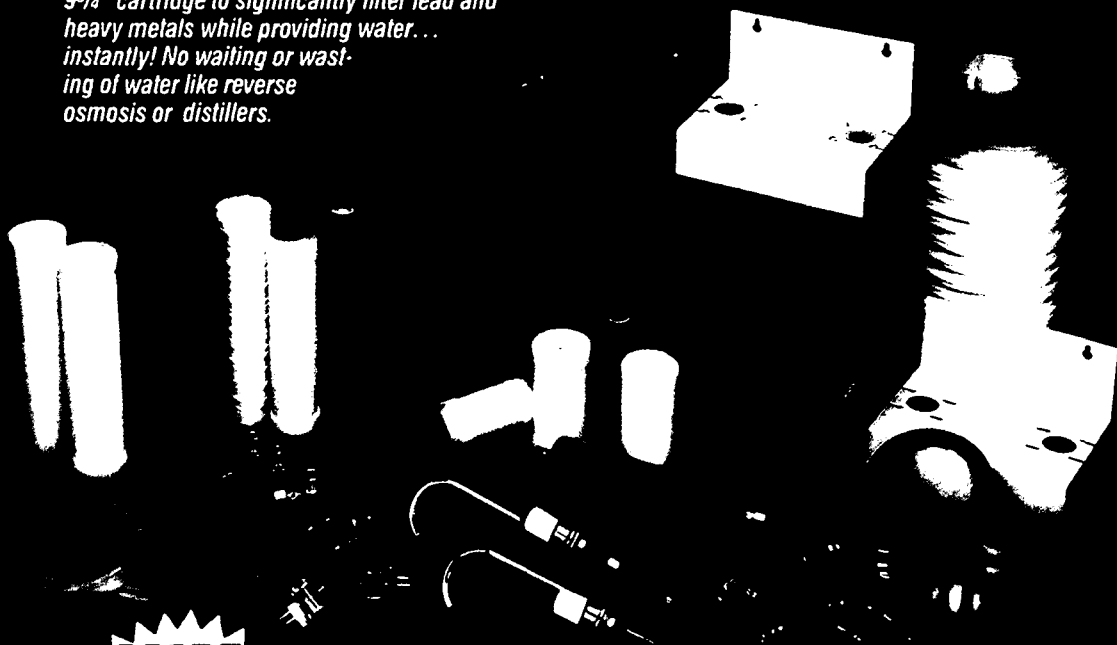
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CHEMICALS FOR WATER TREATMENT

JSA. Tel: +1-713-880 9981. Telex: 283909. Fax: +1-713-880 8113. A diversified corporation with manufacturing facilities located in Texas, a trading organisation in New Jersey and offices and agents worldwide. Provide chemicals for dechlorination, algae control, odour and taste control and corrosion protection.

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Manufacturer of water conditioning salt products.

CARMEUSE SA,
Rue de Chateau 13, 5210 Seieles. Belgium. Tel: +32-85-82-50-09. Telex: 59608. Fax: +32-85-82-63-02.
CARMEUSE is a producer of calcium carbonate, calcium oxide and calcium hydroxide, in Belgium, the Netherlands and France. In the water treatment area, the calcic products are used for: Flocculation of impure water, remineralisation of drinking water, softening of industrial and potable waters, pH correction of drinking waters and industrial waters, residual mud conditioning before dewatering, disinfection and pasteurisation of residual muds, dephosphatation of waters. A recent development is a ready-made lime milk with a dry content of 30 per cent, delivered to local water treatment plants. As some of the lime qualities are very pure, Carmeuse lime is often used in the area of drinking water treatment. Due to its excellent geographical position, close to the harbour of Antwerp and Rotterdam, Carmeuse exports large quantities of lime to all countries of the world, especially to Africa and the Middle East.

CARUS CHEMICAL CO,
1500 Eighth St, La Salle, IL 61301. USA. Tel: +1-815-223 1500. Manufacturer of potassium permanganate, chemical for water treatment, air pollution control and wastewater treatment.

CHEMICAL TESTING CORP,
35 Commerce Rd, CT, Stamford. USA. Tel: +1-203-357

9800. Manufactures water conditioning chemicals and equipment for boilers and cooling systems.

CHEMISCHE FABRIK KALK GMBH,
Postfach 91 01 57, Kalker Hauptstr 22, Cologne 91, D-5000 West Germany. Tel: +49-221-82961. Telex: 8873355. Fax: +49-221-8296-299. Chemicals for water purification.

CHEMOLIMPEX HUNGARIAN TRADING CO FOR CHEMICALS, H-1805 Budapest, PO Box 121. Hungary. Tel: +36-1-1640240. Telex: 226333. Fax: +36-1-1640078.
Chemolimpex handles the export of the ion-exchange resins which are manufactured by Nitrokemia and marketed under the brand-name VARION. Ion-exchange resins are widely used for water treatment in all fields of industry. We have developed specific ion-exchange resin types for the following main applications: conventional industrial water treatment, decontamination of radio-active waste, household-water treatment, micro-ion-exchange resin (more effective than powder resin).

CHEMPROHA CHEMICAL DISTRIBUTORS BV,
PO Box 35, 3330 AA, Zwijndrecht. The Netherlands. Tel: +31-1804 23488. Fax: +31-1804 27322. Contact Name: Mr Van 't Pveer. As a distributor of chemicals, with locations in the Netherlands, Belgium, West Germany, Poland, Hong Kong, Guangzhou, Singapore and Puerto Rico, Chemproha buys, transports and sells chemicals around the globe. Within our product range we handle a line of water treatment chemicals for surface, waste and process waters as well as for swimming pools, such as flocculating agents, pH-control products and water conditioning chemicals.

CHEMVIRO CARBON,
Boulevard de la Woluwe 60 bte 7, Brussels 1200. Belgium. Tel: +32-2-773 0211. Telex: 22481. Fax: +32-2-770 9394. Advanced technology based on uses of activated carbon for environmental control, product quality enhancement and improvement of industrial processes is Chemviron Carbon's business. From brewers and food processors to oil refiners and computer manufacturers, Chemviron Carbon people and technology are helping thousands of customers make better products more efficiently,

and millions of people are breathing cleaner air and drinking purer water because of Chemviron Carbon products.

CLARITY FILTERS,

2500-165th St, Hammond, IN 46320. USA. Tel: +1-800-848 7418. Contact Name: David Griffin.

Manufacturers water filter systems, housings, cartridges and components. We also stock a complete line of accessories including faucets, diverters fittings, tubing, replacement parts, and filtration media.

Clarity Filters exclusively features the ABA-2000 Lead/Heavy Metal filter cartridges.

CONTINENTAL PRODUCTS OF TEXAS,

Box 3627, Odessa, TX 79760. USA. Tel: +1-800-592 4684. Fax: +1-915-337 4685. Specialty chemicals for industrial water, process and pipeline corrosion and fouling problems. Excellent cooling tower, boiler, closed system, amine, glycol and produced water corrosion inhibitors. Biocides for cooling tower and production. Pipeline corrosion inhibitors oil and water soluble, proven and effective.

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1007 McCartney St, Pittsburgh, PA 15220. USA. Tel: +1-412-921 3620. Manufacturer of water treatments for boilers, cooling towers, closed systems and equipment for feeding and testing.

DIAMOND CRYSTAL SALT CO,

916 South Riverside Drive, St Clair, MI 48079. USA. Tel: +1-313-329 2211. Produces and markets a full line of salt products for a variety of uses, including water treatment.

DIVERSEY FAR EAST PTY LTD,

113 Neythal Rd, Jurong 2262. Singapore. Tel: +65-265 1988. Fax: +65-264 3450. Diversey (FE) Pty Ltd is one of many Diversey companies worldwide. Specialising in water treatment of boilers, chillers and swimming pools. Capabilities of full laboratory service plus in-field day to day back up give us a flexible system of backup to suit customer needs.

DOW CHEMICAL USA,

2040 Willard H Dow Center, Midland, MI 48674. USA. Tel: +1-517-636 1000. Manufactures a full line of ion exchange resins for water treatment as well as other specialised applications.

DR BRUNO LANGE GMBH,

Willstaetter 11, Dusseldorf 99, 4000. West Germany. Tel: +49-211-503-061. Telex: 8588757. Fax: +49-211-500-97143. Dr Bruno Lange GmbH is one of Europe's leading producers of photometers and reagents for waste water, drinking water and quality control.

DRACOR WATER SYSTEMS,

PO Box 2993, 3643 Hillsborough Rd, Durham, NC 27705. USA. Tel: +1-919-383 9421. Filtration, reverse osmosis, ultra filtration, ultra violet purification, deionisation and ion exchange resins for laboratories and critical industrial applications.

E I DU PONT DE NEMOURS & CO INC,

Room N-2522-2, 1007 Market St, Wilmington, DE 19898. USA. Tel: +1-302-774 1000. Telex: 835420 AA. Fax: +1-302-774 9560. Permaper permeators for water desalination and chemicals for water treatment.

EES CORP,

12850 Bournewood Drive, Sugar Land, Texas 77478. USA. Tel: +1-713-240 6770. Telex: 795459. Fax: +1-713-240 6762. The Aquaward® calcium hypochlorite water disinfection tablet contains 70 per cent available chlorine, which is the highest strength commercially available. These large, 2.625ins diameter, 145 gram tablets are also the safest form of chlorine. The tablets are dispensed in one of EES tablet feeders, which are capable of disinfecting up to 500,000 gallons per day. Disinfection is done with no moving parts or electricity.

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FIBREDYNE INC,

190 Crosby Rd, Dover, NH 03820. USA. Tel: +1-603-749 1610. Fax: +1-603-749 2699. Manufacture disposable water filter cartridges.

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CHEMICALS FOR WATER TREATMENT

60690. Manufacture and supply water treatment chemicals and equipment. Specialists in all forms of water and effluent treatment in industrial and domestic fields.

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GRACE DEARBORN LTD,

Widnes, Cheshire WA8 8UD. UK. Tel: +4451-424 5351. Fax: +4451-423 2722. Suppliers of speciality chemicals and consultancy for treatment of steam raising plants, cooling water systems, air conditioning plants and waste water treatment.

W R GRACE & CO, DEARBORN DIV,

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GREAT SALT LAKE MINERALS & CHEMICALS CORP,

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Granulated aluminium sulphate for water purification and sewage purification.

HYDRO-X A/S,

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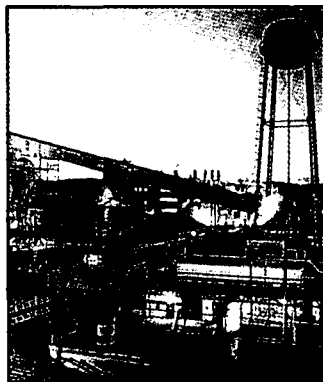
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K & K - GREEFF CHEMICALS LTD,
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KDF FLUID TREATMENT INC,
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PO Box 9740, San Diego, CA 92109. USA. Tel: +1-619-463 7967. Manufacture reverse osmosis and ultrafiltration maintenance chemicals: pre-treatment and cleaning.

KING LEE CHEMICAL CO,
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Manufacturers activated carbon in Sri Lanka which is marketed wholly by Sutcliffe.

MAGICHEM INC,
2080 East Lunt Avenue, Elk Grove Village, IL 60007. USA. Tel: +1-312-437 9400. Distributors of liquid polyphosphate water treatment additives for control of hydrogen sulphide odour, corrosion problems plus sequestering iron.

MELCHEMIE HOLLAND BV,
Jansbuicingsingel 20, Arnhem. The Netherlands. Tel: +31-85451251. Telex: 4501945523. Fax: +31-85-425-093. Dry Chlorine Products (calciumhypochlorite and other disinfectants), flocculants (aluminium sulphate, ferrous sulphate, polyelectrolytes), pH regulating agents (hydrated lime, sodiumcarbonate and sodiumbicarbonate), sanitiser 115,

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MOLRY-CHIMIE SA,

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MORTON SALT DIV MORTON-THIOKOL INC,

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OLIN CHEMICALS,

120 Long Ridge Rd, Stamford CT 06904. USA. Tel: +1-203-356 2000. Telex: 4750119. Fax: +1-203-356 3541. Manufacturer of HTH@Calcium Hypochlorite in granular and tablet forms and Isocyanurates in granular, powder and tablet forms. Applications in water treatment, beverage plants, industrial plants, food plants, sewage disposal.

OMNI FILTER CORP,

PO Box 2246, Hammond, IN 46323. USA. Tel: +1-219-989 9800. Contact Name: Jeff Rosenzweig. Manufacturers a full line of residential and light industrial water filtration products and water conditioning products to remove lead, chemicals, tastes, odours, rust and sediment and other contaminants from water, as well as replacement cartridges for major brands of filters.

PHYSICHEM TECHNOLOGIES INC,

13706 Research Boulevard J216, Austin, TX 78750. USA. Complete source for speciality water treatment chemicals, ion exchange resins, feed equipment, testing supplies and consulting services. Products and services designed to control corrosion and deposition as well as wastewater streams.

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PREUSSAG AG,

PO Box 6009 Kunststoffe und Armaturen, Peine D-3150. West Germany. Tel: +49-5171-4030. Telex: 92670. PVC SBF casing and screens for water wells, including PVC SBF precoated screens, PVC SBF NORIP pipes for monitoring wells, PVC SBF SIKO riser pipes, SBF handpumps KARDIA and TURNI, SBF drilling muds and additives, SBF DEPO pipes for dewatering or degasification of waste disposal sites, Chlorine for water treatment, SEBA Hydrogeological Equipment.

PREUSSAG ANLAGENBAU GMBH,

Karl-Wiechert-Allee 4, D-3000 Hannover 61. Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

PROMINENT FLUID CONTROLS,
1005 Parkway View Drive, Pittsburgh, PA 15205. USA. Tel: +1-412-787 2484. Manufacture chemical feed and control equipment for water treatment.

PURITE LTD,
Unit E, Bardet Way, Thame Industrial Estate, Thame, Oxon OX9 3SJ. UK. Tel: +44-844 217141. Telex: 837561. Manufacturers of reverse osmosis units, desalination and reverse osmosis units and cleaning chemicals, deionisation equipment, various filtration units and test kits.

PUROLITE CO DIV OF BRO TECH CORP,
150 Monument Rd, Bala Cynwyd, PA 19047. USA. Tel: +1-215-668 9090. Manufacturer of a complete line of ion exchange resins.

PUROLITE INTERNATIONAL,
Cowbridge Rd, Pontyclun, Mid Glamorgan CF7 8YL. UK. Tel: +44-443 229334. Telex: 498440. Fax: +44-443 222336. Manufacture ion exchange resins for water treatment and effluent treatment.

QUES INDUSTRIES INC,
PO Box 02590, Cleveland, OH 44102. USA. Tel: +1-216-961 7445. Manufactures water treatment chemicals: boiler water treatments, cooling water treatments, iron sequestrants, resin cleaners and biological cultures for grease trap and septic systems.

RESINTECH,
PO Box 966, Cherry Hill, NJ 08003. USA. Tel: +1-609-429 6620. Manufacturer of ion exchange resins.

RO/CO CHEMICAL SYSTEMS INC,
4004 Volta Avenue, Brentwood, MD 20722. USA. Tel: +1-301-779 2400. Distributor of water treatment chemicals, services and related chemical feed and control equipment.

ROHM & HAAS,
185 rue de Bercy, 75012 Paris. France. Tel: +33-1-4002 5400. Manufacturers of AMBERLITE, DUOLITE and IMAC ion exchange and absorbent resins and ROMICON ultrafiltration membranes and modules. Special resin grades for potable water treatment, radioactive waste decontamination, condensate polishing and industrial waste treatment. Acrylic and phenolic resins for the up

take of organic contaminants. Selective resins for heavy metals.

ROHM & HAAS CO,
Independence Mall West, Philadelphia PA 19105. USA. Tel: +1-215-592 3154. Telex: 845247. Fax: +1-215-592 3377. Multinational chemical company, manufacturer of ion exchange resin and absorbents for water treatment.

SCHAEFER CHEMICAL PRODUCTS CO,
3000 Carrollton Rd, Saginaw, MI 48604. USA. Tel: +1-517-753 1877. Manufacture water treatment chemical products.

SCHILLING-CHEMIE GMBH,
PO Box 11 36, Freiberg D-7149. West Germany. Tel: +49-7141 7030. Fax: +49-7141 703178. Various chemicals, control-equipments and pre-treatment plants for water treatment in cooling water, boiler water, heating water and drinking water.

SEE,
Rue de la Science 5, Brussels B 1040. Belgium. Tel: +32-2-230 9314. Telex: 25 237. Fax: +32-2-230 7613. Water treatment plants: drinking water, waste water, water for industry, swimming pool water. Chemical products for water conditioning. Prefabricated units for the production of drinking water and waste water treatment.

SELECTO INC,
1000 Cobb Place Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000® media and LeadOUT® filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale applications, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE® 'add-on' solid-state ultraviolet water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

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4825 North Scott St, Ste 400, Schiller Park, IL 60176-1354. USA. Tel: +1-312-671 0680. Mines, processes, packages and delivers salt for many markets including water conditioning. A full line of salt products is available in bulks, bags and blocks as solar, rock and evaporated.

SORB-TECH INC,
1442 Lake Front Circle #190, The Woodlands, TX 77380. USA. Tel: +1-713-292 1726. Sale and application of activated carbon.

SOUTHERN WATER CONDITIONING DIV ANDERSON CHEMICAL,
1840 Waterville Rd, Macon, GA 31206. USA. Manufacture water and wastewater treating equipment and chemicals.

STILES-KEM DIV MET-PRO CORP,
3301 South Sheridan Rd, Zion, IL 60099. USA. Tel: +1-312-746 8334. Manufacture water treatment chemicals for control of scale, red water and corrosion in municipal, industrial, commercial and domestic water systems to prolong life of water using equipment and distribution systems.

STRANCO LTD,
Commercial Rd, Eastbourne, Sussex BN21 3XE. UK. Tel: +44-323 37011. Fax: +44-323 646035. STRANCO'S industrial division manufactures polyelectrolyte preparation plant for the sewage and wastewater industries.

SUREX SP PRODUCTS LTD,
Units 10/7/11 Airport Trading Estate, Biggin Hill, Kent TN16 3BW. UK. Tel: +44-959 76000. Fax: +44-959 71000. Suppliers of water treatment chemicals, dosing systems and control filtration specialists to swimming pool, aquatic and all water treatment markets - national and international.

SUTCLIFFE SPEAKMAN CARBONS,
Guest St, Leigh, Lancs WN7 2HE. UK. Tel: +44-942 672101. Telex: 67555. Fax: +44-942 677136.
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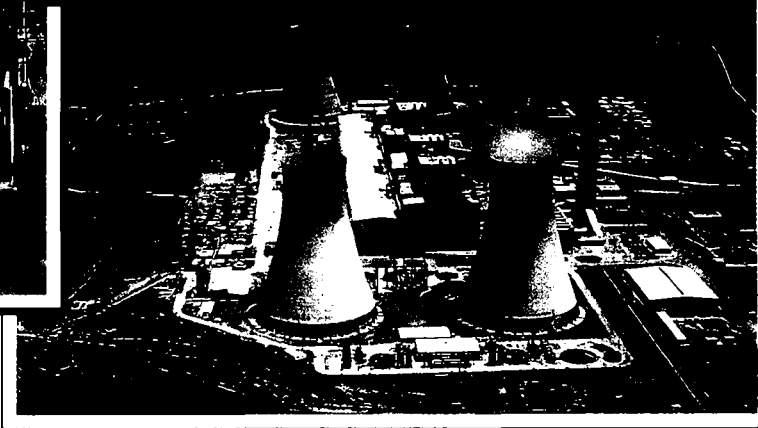
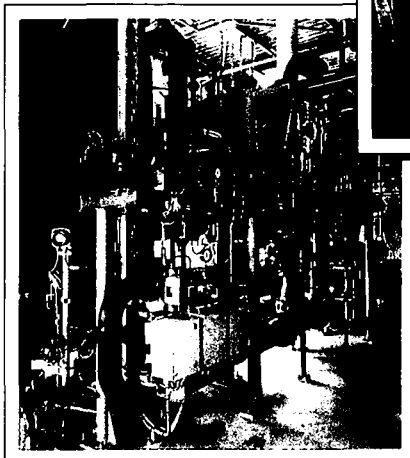
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PWT's all round capability has been reinforced by its integration into Thames Water Plc. This brings to **PWT** the financial strength of Thames Water's balance sheet, the knowledge of a major water and sewage utility, and their detailed experience of operating and maintaining a large number of water and sewage treatment plants.

PWT groups its business into discrete activities:
Design and Contracting
Products and Services
Pipeline Products

PWT DESIGN & CONTRACTING

PWT (Projects) employing 500 people based in Isleworth, Middlesex, is **PWT**'s UK based design and contracting company.

PWT Design & Contracting companies cover the full spectrum of equipment supply from small customised highly instrumented packages for the offshore oil industry to large water supply plants for major cities such as the Karkh plant serving Baghdad and the plant for Turkey's capital city, Ankara.

They operate on an international basis with major centres of process and design engineering expertise located in Auckland, London, Los Angeles, Melbourne and Sydney. These centres are supported by a worldwide network of subsidiary companies and agents. **PWT** is able to marshal skilled resources at short notice to deal with specific contract requirements throughout the world to ensure clients receive prompt and efficient service.

PWT Design & Contracting companies operate in all fields of industry including electrical power generation, oil, gas, petrochemicals, ferrous and non-ferrous metals, electronics, pulp and paper, food and pharmaceuticals. In fact, **PWT** is active in every industry requiring water and waste water treatment. **PWT** are the world leaders in the field of municipal water and sewage treatment. They are active in the smallest villages in the developing world on rural schemes and in major capital cities building massive water works.

PWT is flexible and can supply completely engineered mechanical and electrical packages direct to the end user client who maintains his own project management team or to other contractors. It also acts as a main contractor undertaking all aspects of the work on a "green field" site and acting in a "turnkey" regime. In recent years **PWT** has broadened its activities further in response to clients' current needs and will undertake total privatisation schemes e.g., BOOT (Build, Own, Operate and Transfer).

PWT's range of processes is exhaustive and includes clarification, flotation, filtration, ultrafiltration, chemical treatment, sludge handling, demineralisation, reverse osmosis, electro-dialysis, activated sludge, extended aeration, deep shaft, tertiary treatment, chlorination and ozonation. **PWT** Design & Contracting companies offer these processes separately or in combination plus many others based on their operating experience worldwide and through continuous development.

PWT's Design & Contracting companies not only design and build plant but provide extensive support after commissioning in terms of training, spare parts, and if required, a total operation and maintenance package.

PWT PRODUCTS AND SERVICES

This group of companies is responsible for a range of products and services for the treatment of water, waste water and process fluids.

The Permutit Company Limited, based in the UK sells and services standard and pre-engineered water treatment plant. It leads in its field and combines a long history of service and reliability with innovative cost effective products such as Scion and Hipol.

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PCI Membrane Systems Limited is the world's leading supplier of membrane separation systems for the food, pharmaceutical and allied industries. The company produces an extensive range of ultrafiltration and reverse osmosis membranes and combines this technology with engineering skills applicable to the industries it serves.

PWT Products & Services businesses operate on a worldwide basis, selling and servicing products and equipment in some of the world's remotest locations as well as in the middle of major conurbations. In addition to plant for fixed locations the area of mobile and transportable equipment for emergencies, military and stand-by use is becoming of greater importance.

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Talbot is known for its customer service and its innovation. For example the "Push-fit" range of service and main fittings has set new standards for quick and reliable installation of polyethylene pipework.

PWT continues to grow internationally. **PWT** Worldwide is part of the Thames Water Plc Group.



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**CONTINENTAL WATER SYSTEMS
CORP**

5405 Bandera Rd, Suite 117, San Antonio, Texas 78238. USA. Tel: +1-512-522 6100. Telex: 76-3601. Fax: +1-512-680 5763. Manufacturers of high purity water systems including reverse osmosis, ultra filtration and deionisation.

COSTER ENGINEERING ,

PO Box 3407, Airport Rd, Mankato, MN 56002. USA. Tel: +1-507-625 6621. Manufacturer of reverse osmosis equipment for municipal, industrial, farm and home applications.

COTTEN INDUSTRIES

275 Schoolheimer Rd, Canastota, New York 13032. USA. Tel: +1-315-363 8084. Manufacturers and suppliers of a complete line of water conditioners for softening, filtration, UV sterilisation. The company also produces reverse osmosis and demineralisation equipment.

**CROWN AGENTS QUALITY
ASSURANCE & INSPECTION
SERVICE ,**

St Nicholas House, Sutton, Surrey SM1 1EL UK. Tel:

DESALINATION DISTALATION & WATER SOFTENING

+4481-643 2211. Telex: 916205 GALOND G. Fax: +4481-770 9101. Contact Name: Roger Dane. For over 80 years our worldwide inspection service has protected the purchasing activities of our clients (public sector authorities and major international development agencies) by ensuring that goods ordered meet specified levels of quality, reliability and safety. The service operates at source and destination and covers all engineering plant and equipment and general stores commodities. See Groundwater Section for advertisement.

CROWN - PACIFIC INTERNATIONAL,
18001 South Mitchell, Irvine, CA 92714. USA. Tel: +1714-660 1798. Telex: 18100. Fax: +1714-660 9229. Suppliers of pumps and related equipment.

CRYSTALAB INC,
612 Capitol Avenue, Hartford, CT 06106. USA. Tel: +1-203-951 3215. Manufacturers of demineralizing equipment; regeneration of bulk ion exchange resins. Distributor of ion exchange resin.

CULLIGAN INTERNATIONAL CO,
1 Culligan Parkway, Northbrook, IL 60062. USA. Tel: +1-312-498 2000. Manufacture water conditioning equipment for household, commercial, industrial, including demineralisation, cooling tower treatment and reverse osmosis purification.

CULLIGAN INTERNATIONAL UK,
Unit 3, Blenheim Rd, High Wycombe, Bucks HP12 3RS. UK. Tel: +44-494 436484. Telex: 83146. Specialists in design, manufacture and commissioning of water treatment plant including domestic, commercial and industrial water softeners, chemical feeders, deioniser and reverse osmosis units (including desalination), package dealkalisation, reclamation, sewage treatment and potabilisation systems.

CWC INDUSTRIES INC,
2686 Lisbon Rd, Cleveland, OH 44104. USA. Tel: +1-216-721 4747. Manufacture water treatment compounds, water softeners, environmental testing and consultation.

D W SYSTEMS INC,
42066 Avenida Alvarado, Ste P, Temecula, CA 92390. USA. Tel: +1-714-676 7600. Engaged in design, engineering, consulting and manufacturing of systems and components for reverse osmosis, ultra-filtration and ultra-pure

water applications. Components include 2.5ins and 4ins low pressure vessel housings and filter canister housings.

DARCO WATER SYSTEMS INC,
PO Box 2993 3643 Hillsborough Rd, Durham, NC 27705. USA. Tel: +1-919-383 9421. Filtration, reverse osmosis, ultra filtration, ultraviolet purification, deionisation and ion exchange resins for laboratories and critical industrial applications.

DDS FILTRATION,
PO Box 149, Næskov DK-4900. Denmark. Tel: +45-53-92-27-99. Telex: 47558 DDSFIL DK. Fax: +45-53-92-31-11. DDS Filtration develops, manufactures and markets membranes and turnkey reverse osmosis plants. Both plate and frame as well as spiral wound systems are sold for a wide range of applications within the water treatment industry. Especially, DDS Filtration has a great experience in the Middle East area and North Africa.

DESALINATION SYSTEMS INC
1238 Simpson Way, Escorido, California 92025. USA. Tel: +1-619-746 8141. Telex: 697890. Fax: +1-619-747 8253. Major manufacturer/supplier of reverse osmosis and ultrafiltration membranes and spiral-wound elements to the OEM market.

DOWNEY WELDING & MFG CO INC,
PO Box 279, Downey, CA 90241. USA. Tel: +1-213-923 9616. Manufacturer of both domestic and commercial water softeners.

DRACOR WATER SYSTEMS,
PO Box 2993, 3643 Hillsborough Rd, Durham, NC 27705. USA. Tel: +1-919-383 9421. Filtration, reverse osmosis, ultra filtration, ultra violet purification, deionisation and ion exchange resins for laboratories and critical industrial applications.

DSS ENGINEERS INC,
150 South Pine Island Rd, Plantation, Florida. USA. Tel: +1-305-476 1800. Telex: 212710. Fax: +1-305-476 1850. Furnish engineering services for all types of desalination processes, mostly thermal and membrane types.

DUKTRAD INTERNATIONAL PVBA,
Ambachtanlaan 32, Loure 3030. Belgium. Tel: +32-1620-

5224 Fax: +32-1620 5254. The European sales office of Aneplas: filament wound pressure vessels for softening, deionisation or filtration plants. The tank range goes from 24ins up to 55ins and comes with a complete programme of tailor-made accessories.

E I DU PONT DE NEMOURS & CO INC,

Room N-2522-2, 1007 Market St, Wilmington, DE 19898. USA. Tel: +1-302-774 1000. Telex: 835420 AA. Fax: +1-302-774 9560. Permasep permeators for water desalination and chemicals for water treatment.

ECODYNE CORP,

PO Box 64420, St Paul, MN 55164. USA. Tel: +1-612-739 5330. Products include water softeners, refiners, filters, drinking water systems, chemicals and compounds, diaphragm, piston and peristaltic solution feeders, deionisation plants and custom units.

ELECTROCATALYTIC LTD,

Norman Way, Severn Bridge Industrial Estate, Portskewett, Newport, Gwent NP6 4YN. UK. Tel: +44-291 423833. Telex: 497870. The 'Pacpuri' on-site electrochlorination system is designed for the safe, hygienic production of sodium hypochlorite for potable water sterilisation. The packages include salt saturator and hypochlorite storage tanks, the brine injection pumps, a water softener, an electrolytic generator assembly, and a controlled power supply and system control panel. It is a development of the company's well proven 'Chloropac' electrochlorination system with over 1300 installations worldwide since the early 1970s.

ELGIN WATER CONDITIONERS INC,

1640 North Lafox, South Elgin, IL 60177. USA. Tel: +1-312-741 8777. Supplies water softner systems for residential, commercial and industrial applications. Service capabilities include industrial rebuilding and systems automation.

EMCO ENGINEERING INC

25 North St, Canton, MA 02021. USA. Tel: +1-617-828 7340. Telex: 924326. Fax: +1-617-828 1714. International organisation specialising in the manufacture of water and waste treatment equipment, including: reverse osmosis, brackish and sea-water desalting plants, ultrafiltration systems, sewage treatment systems, water softeners, reclamation systems, deionisation lime treatment, swimming pool equipment and water storage tanks.

ENVIROGENICS SYSTEMS CO,

9255 Teister Avenue, El-Monte, California 91731. USA. Tel: +1-818-573 9220. Telex: WU1698706. Fax: +1-818-572 8272. Envirogenics Systems Co is a world leader of water systems with over sixty years experience in design and construction of water processing throughout the world. Currently more than 190 plants in 23 countries are either in operation or under construction. These plants have a capacity of more than 190 million GPD of desalted water. These installations include reverse osmosis systems, multi-stage flash desalination plants and vertical tube evaporators all utilising Envirogenics Systems technology.

ENVIRONMENTAL PRODUCTS,

2131 South Tamiami Trail, Venice FL 34293. USA. Tel: +1-813-493 0301. An original equipment manufacturer of complete reverse osmosis units and components.

ERIE MANUFACTURING CO,

4000 South 13th St, Milwaukee, WI 53221. USA. Tel: +1-414-483 0524. Telex: 2-6867. Fax: +1-414-483 6610. Manufacturers of automatic water softener and filters control valves. These valves are available with electro/mechanical and electronic timers.

ERMCO INC,

1570 Fairview Avenue, St Louis, MO 63132. USA. Tel: +1-314-423 7711. Fax: +1-314-421 5904. Manufacturers of commercial, industrial water conditioning equipment. Industrial water softeners, pressure filter, dealkalizers and special tanks.

ESMIL ENGINEERING & CONTRACTING,

PO Box 7811, Amsterdam 1008AA. The Netherlands. Tel: +31-20-5411-054. Telex: 10295. Fax: +31-20-4444-36. Esmil designs and supplies equipment for desalination of sea and brackish water, acts as buying agent for any equipment and spares and gives technical courses in our training centre.

ESSENER HOCHDRUK-ROHRLEITUNGSBAU,

PO Box 120124, Essen 12, D-4300. West Germany. Tel: +49-201 349-25. Fax: +49-201 351423. Plants for the chemical industry and fertiliser factories including company-developed process and production know-how in the fields of large-scale evaporation and crystallisation for the production of salt and potable water from sea water; for the treatment

DESALINATION DISTALATION & WATER SOFTENING

of process solutions for valuable materials recovery and thus for water conservation.

EXCALIBUR EXTRUSIONS INC,
110 East Crowther Avenue, Placentia, CA 92670. USA.
Tel: +1-714-528 8834. Fax: +1-714-524 7453. Water tubes for desalination and reverse osmosis. Materials include PVC, CPVC, ABS, styrene and NORYL. Brinewells, wye strainers, plastic pipe, nipples and fittings. Materials include PVC, CPVC, polypropylene and polyethylene.

FABRICA TURBINE E CALDAIE,
FTC Legnano SRL, Piazza Monumento 12, Legnan, (Milan) 20025. Italy. Tel: +0331522111. Telex: 330661/314385 F TOSI. Fax: +0331593321. Fabrica Turbine E Caldaie - FTC Legnano SRL (Franco Tosi Group) represents a wealth of knowhow and experience in the fields of generation, conversion, utilisation and recovery of energy in its various forms, as well as in other areas such as sea water desalination, ship propulsion and in general industrial plants, where equipment produced by the company finds a field of application.

FAIREY INDUSTRIAL CERAMICS LTD,
Stone, Staffs ST15 0PU. UK. Tel: +44-785 813241. Telex: 36277. Fax: +44-785 818733. Fairey Industrial Ceramics Ltd are manufacturers of domestic water purification systems based mainly on use of re-built ceramic cartridges. The systems available cover point-of-use outlets to filters for small communities. Worldwide agency and distribution network available.

FILMTEC CORPORATION,
7200 Ohms Lane, Minneapolis, MN 55435. USA.
Manufactures thin-film composite RO membranes for use in home tap water purification, desalination and industrial water purification.

FLECK CONTROLS,
20580 Enterprise Avenue, Brookfield, WI 53005. USA. Tel: +1-414-784 4490. Manufacture water softener components.

FLOWMATIC SYSTEMS INC,
9470 Ulmerton Rd #4B, Largo, FL 34641. USA. Tel: +1-813-586 2656. Manufactures and sells to OEM's in the RO industry, including automatic shut-off valves, check valves, flow restrictors, membrane housings, inline filter housings and carbon filters.

FLUID MECHANICS INC,
PO Box 1215, Lafayette, IN 47901. USA. Tel: +1-317-742 23380. Manufacturer of non-salt, chemical-free water treatment products for residential and commercial applications. Water conditioner offers water conditioning as an alternative softening method to the ion-exchange system.

FLUID SEPARATIONS CORP,
14090 Horizon Boulevard, El Paso, TX 79927. USA. Tel: +1-915-852 1007. Manufactures commercial and industrial water treatment systems including reverse osmosis, ultrafiltration, separate bed DI, mixed bed DI and nitrogen blanket systems.

GRAMAGLIA STL,
Osimo, (Ancona), 60027. Italy. Tel: +39-071-715205. Fax: +39-071-7132427.

GREAT LAKES INTERNATIONAL,
1905 Kearney Avenue, Racine, WI 53403. USA. Tel: +1-414-634 2386. Telex: 262043. Fax: +1-414-634 6259. Full line supplier and manufacturer of RO systems, water chillers, inline filters and water processing systems. Also manufacture and market complete line of plastic components, tubing, pipe and other related accessories.

GREAT LAKES SOFT WATER CO,
3501 Dixon St, Stevens Point, WI 54481. USA. Tel: +1-715-344 9272. Water conditioning equipment for homes and businesses.

GREAT WESTERN PRODUCTS,
16591 Miliken Avenue, Irvine, CA 92714. USA. Tel: +1-714-863 9077. Manufacturer of airgaps for both inline and standpipes for installation of automatic water softeners.

GRUNDFOS INTERNATIONAL A/S,
P D Jensensvej 7, Bjerringbro 8850. Denmark. Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. Grundfos all stainless steel booster modules (with energy saving turbines as optional) for high pressure applications, eg reverse osmosis plants. Pressure up to 70 bars. Flow rates to 100 cbm/h.

GULDAGER SYSTEM,
Hejrevang 1-3, Allerød DK-3450. Denmark. Tel: +45-42-273100. Fax: +45-42-271504. Production, installation and service of electrolysis systems for the protection against

corrosion and scaling in domestic water systems, process water systems and filters for swimming pools, anti-fouling and cathodic protection.

HAGER & ELSASSER GMBH,
PO Box 800540, Stuttgart 80, 7000. West Germany. Tel: +49-711 7866-0. Fax: +49-711 7866-202. Water treatment plants for treatment of fresh water (sea and brash-water, ultra-pure water for electrical and pharmaceutical industry, boiler feed water) and waste-water (metal-working industry, textile industry, power plants and sewage water).

HALCO PRODUCTS,
100 North Gordon, Elk Grove, IL 60007-1193. USA. Tel: +1-312-956 1600. Manufacture under-sink RO units as well as design and build total package ultrapure water systems. Total package RO units and UF for special applications available.

HELLENBRAND WATER CONDITIONERS INC,
PO Box 187, 509 West Main, Waunakee, WI 53597-1197. USA. Tel: +1-608-849 5717. Manufactures and distributes residential and commercial water conditioners including softeners, iron filters, sediment filters, taste and odour filters and pH neutralising filters.

HERO REVERSE OSMOSIS SYSTEMS INC,
3112 45th St, West Palm Beach, FL 33402. USA. Tel: +1-305-683 0100. Manufacture of RO systems for home, business and industry.

HILMAR BECKER GESELLSCHAFT MBH & CO KG,
A-4020 Linz, Franzosenhausweg 50. Austria. Tel: +43-732/83-0-01. Telex: 021507 BECKER A. The sphere of operations of Hilmar Becker comprises the production, servicing and sale of water treatment plants and heating, ventilating and air conditioning equipment. The HB production shops turn out filtering, de-ironing, de-acidifying and softening plants, and plants for partial and full desalination and for reverse osmosis.

HOH WATER TECHNOLOGY CORP,
3481 Old Conejo Rd, Ste103, Newbury Park, CA 91320. USA. Tel: +1-805-499 0507. Fax: +1-805-499 0500. HOH Water Technology Corp is dedicated to

supplying the finest water treatment systems. Our patented HOH Electropure series of Ectrodeionisation water desalinators uniquely incorporate several treatment processes into a single unit, resulting in the systems's removal of most organic/inorganic contaminants from water at greatly reduced costs. HOH also offers the latest state-of-the-art reverse osmosis domestic and commercial technology.

HOME REVERSE OSMOSIS SYSTEMS,
380 North 35th Rd, LaSalle, IL 61301. USA. Tel: +1-815-224 2450. Manufacturing, assembling and wholesaling reverse osmosis drinking water systems for home. Wholesaling of component parts for RO equipment.

THE HOTSY COPR,
21 Inverness Way East, Englewood, CO, 80112. USA. Manufactures 15 models of corrosion resistant pumps for use in reverse osmosis systems. One-1.5gpm, up to 3000psi. Pumps available in pulley belt or direct drive configurations.

HUNGERFORD & TERRY INC,
PO Box 45, Clayton, NJ 08312. USA. Tel: +1-609-881 3200. Telex: 510-686-6580. Fax: +1-609-881 6859. Manufacturer of water treatment equipment for commercial and industrial applications including pressure filters, softeners, ion remove filters and special application ion exchange.

HYDRANAUTICS,
PO Box 3690, Santa Barbara, CA 93130. USA. Tel: +1-805-964 0765. Manufacturer of RO systems and elements.

HYDRO-FLOW FILTRATION SYSTEMS INC,
4085 East La Palma Avenue, Unit F, CA 92807. USA. Manufacturer of disposable inline carbon filters and phosphate feeders for use in RO filtration, beverage dispensers and ice machines.

HYDRO-PURE INC,
1001 East Shaw, Pasadena, TX 77506. USA. Tel: +1-713-477 2538. Distillation equipment.

HYDROTECH ENTERPRISES INC,
3036 North Lake Terrace, PO Box 142, Glenview, Illinois 60025-0142. USA. Tel: +1-708-998 6900. Fax: +1-708-998 8615. Manufacturer and assembler of pre-engineered and custom engineered systems for

KINGDOM OF SAUDI ARABIA

SALINE WATER

CONVERSION CORPORATION

Saudi Arabia with an area of over 2.1 million square kilometres is devoid of any rivers or lakes. Being an arid country, rainfall is scanty which cannot fulfill the needs of its growing population. The aquifers which hold extensive amounts of water are used for agricultural purposes although the sources are almost between one and two kilometres below the ground.

In order to fulfill the growing demand for water, the planners thought of tapping the abundantly available sea water on both the coasts of the Kingdom. Saline Water Conversion Corporation implements these plans to provide water to the evergrowing population needs and also to the industrial base which is fast developing in the Kingdom. In 1969 the Kingdom's first large scale desalination plant began operation; by 1983, Saudi Arabia became the world's leader in the production of desalinated water. The utilization of this source of water enabled the country to develop regardless of the condition of the ground water supply.

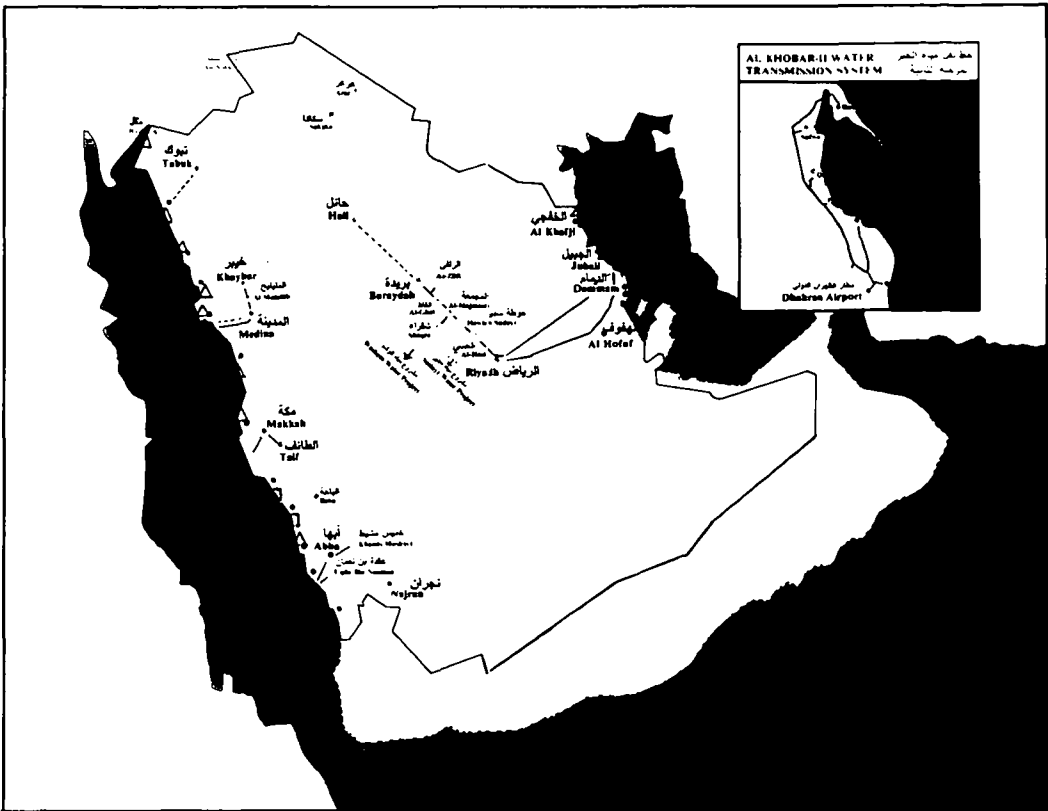
So far SWCC has constructed 27 plants on both coasts producing 565 million gallons of water per day coupled with

electric production of 4079 MW.

The task of supplying water does not end with its production, pipelines were constructed through inhospitable environment to supply water to inland regions. The table on the next page provides data on the pipelines already constructed and under construction. The task is enormous, so are the benefits derived from it. With abundant supply of water it was possible for Saudi Arabia to adapt the latest technological industrial base for development.

The technologies used for desalination of sea water require skilled manpower and SWCC has made all efforts by training and upgrading the skills of the manpower by establishing training centers to train Saudis to attain the high standards of operating and maintaining these plants. SWCC has also established a research and development facility to evaluate new technologies for desalination and improve on the existing ones.

The envisaged vision of the Government to provide water to the population has been fulfilled by the efforts made by SWCC. The work still continues in planning for new desalination facilities and pipelines.



Existing Desalinated Water Pipelines

NAME OF THE PROJECT	DESIGN FLOW RATE	PIPELINE LENGTH	PIPE MATERIAL AND DIAMETER	PUMP STATIONS TERMINALS	MISCELLANEOUS
Jubail-Riyadh Transmission	830,000 m ³ /day or 219 million USG/D	465 kms – Double line	Steel API Std: 60 in. dia.	6 pump stations 430 MW capacity Terminal at HPT, Riyadh 300,000 m ³ storage in 6 Conc. tanks	From Jubail Desal plants to Riyadh, via Dhahran, Sheddum, Hofuf, Khurais and Wasia.
Shoailbah-Makkah-Taif Water Transmission Facility	182,000 m ³ /day or 48 million USG/D	247 kms – 96 km Double line 55 km Single line	Steel API Std: 56 in. dia. 42 in. dia.	4 pump stations 85 MW capacity Two terminals 4 × 50,000 m ³ storage 2 × 25,000 m ³ storage	Tunnel: 13.2 km in length, through Taif 30 million USG to Makkah 18 million USG to Taif
Assir Phase One Water Transmission Facility	113,636 m ³ /day or 30 million USG/D	215 kms – 140 km Pressure line 75 km Gravity line	Steel API Std: Concrete cyl. pipes 42 in. & 36 in. dia. 48 in. & 20 in. dia.	4 pump stations 108 MW capacity Large terminal Abha Small – Bin Nauman Ukad	A series of tunnels Total length 10.5 km Storage Total – 125,000 m ³
Yanbu-Madina Water Transmission System	104,000 m ³ /day or 28 million USG/D	176 km – Madina 50 km – Yanbu (Pressure lines)	Steel API Std: 32 in. dia. Asbestos Cement Pipe 24 in. dia.	2 pump stations 17 MW capacity	22 million USG/D to Madina 6 million USG/D to Yanbu
Al Khobar 2 Water Transmission System	190,000 m ³ /day or 50 million USG/D	84.5 km	Concrete cyl pipes 1100 mm dia. – 30 km 1000 mm dia. – 71.5 km 900 mm dia. – 37.0 km 500 mm dia. – 25.25 km	1 pump station and 7 blending stations Storage capacity = 459,000 m ³	Storage at: 1. Al Khobar–96,000 m ³ 2. Dhahran–15,000 m ³ Airport 3. Dammam–200,000 m ³ 4. Sayhat–20,000 m ³ 5. Qatif–88,000 m ³ 6. Safwa–20,000 m ³ 7. Rahemah–20,000 m ³
Water Transmission from Jubail to Washem-Sudayr & Qasim	380,000 m ³ /day or 100 million USG/D	389 km Single line pressure 384 km Double line pressure & Gravity	Steel API Std: 60 in. dia. – 389 km Prestressed concrete 16,000 mm dia. – 205 km 2,000 mm dia. – 165 km Steel 48 in. – 163 km	4 pump stations between Jubail-Riyadh Qasim Storage at Buraydah = 300,000 m ³ Riyadh = 300,000 m ³	Branch lines 1. Zulfi line 400 mm dia. CCP 37.4 km 2. Shaqra Steel Pipeline 20 in. 96.8 km

desalination, water softening and water filtration. Technologies involved include desalination by Reverse Osmosis, ion exchange water softening, media and cartridge water filtration and ion exchange deionisation. All technologies are available on a variety of sizes and configurations to fit all user requirements.

HYDROTECHNIK GESELLSCHAFT MBH,

A-5033, Salzburg, Alpenstrasse 54, PO Box 14. Austria. Tel: +43-662 22-4-72. Telex: 633821 HYDRO A. The company's line-up includes the planning, installation and sale of water treatment plants, reverse osmosis, desalination and water supply facilities and waste water purifying plants for industrial and municipal use. Hydrotechnik turn out turnkey water treatment plants with the cooperation of experienced building firms, or supply merely the necessary mechanical and electrical equipment.

HYDROTECHNIK GMBH,

PO Box 14, Salzburg A-5033. Austria. Tel: +43-662-224-720/285310. Telex: 633-821. Hydrotechnik Austria have come to hold a worldwide leading position in the field of desalination beside its other activities in the area of water treatment. Hydrocompact HCRO Reverse Osmosis plants can economically provide portable water in quantities from 0,3, m³/hr up to 60 m³/hr as single unit using brackish or sea water. If larger capacities are required, several units could be operated in parallel or alternatively a conventional type reverse osmosis plant may be installed. Depending on the capacity, HC-RO-systems are available either as skid mounted or containerised version. By means of a computer program, the optimum operating conditions can be selected. These plants require very little energy. One of the many advantages of the HC-RO plants is the minimal installation period as these systems are prefabricated and tested on leakfree operation in Austria before delivery.

HYDROTECHNOLOGY INC,

24844 Anza Drive, Valencia, CA 91355. USA. Tel: +1-805-257 1777. Manufactures Hydropure® residential reverse osmosis drinking water appliances. A truly unique design aimed at longevity, serviceability and user satisfaction.

HYPERFIL INDUSTRIES INC,

1170 Van Horne Way, Anaheim, CA 92806. USA. Tel: +1-714-630 4381. Fax: +1-714-630 2366. Contact Name: Yolanda Gilley. Hyperfil manufacturers high

quality Spiral Wound Reverse Osmosis Hyperfiltration Membranes used in drinking water applications, and desalination systems. Available for chlorinated or non-chlorinated feeds. Systems and component parts also available for home, commercial and industrial applications.

IMB,

Mathias-Brüggen Strasse 17, Cologne 30, Bikendorf D-5000. West Germany. Tel: +49-221-58-8040. Fax: +49-221-588 0488. Water treatment systems from raw water filtration up to highly sophisticated systems for micro and ultra-filtration; reverse osmosis plants; desalination and decarbonisation of water by ion-exchange technologies.

IMI PLC,

PO Box 216, Witton, Birmingham B6 7BA. UK. Tel: +44-21-356 4848. Telex: 336771. Fax: +44-21-356 526. A decentralised organisation, internationally known in five main product areas - building products, fluid control, special engineering, drinks dispensers and refined and wrought metal. Suppliers of titanium and copper tubing to desalination plants.

INFOLCI ESPANOLA SA,

Arenida De Burgos, 19, Madrid 28036. Espana SpA. Tel/Fax: +34-766-34-00. Treatment plants for waste and drinking water.

ING HARTWIG KARRER GROSS-BANLAGEN - UND APPARATEBAU,

Gewerbestrasse 7, Uttendorf A-5261. Austria. Tel: +43-7724-6292. Telex: 27468 KARRER A. Karrer plan, produce, install and service: plants for the treatment of surface water (river and reservoir water) for drinking. Full desalination plants (reverse osmosis and/or ion exchange, for hospitals of dialysis quality). Fermentation gas plants for solid waste utilisation (agriculture, abattoirs etc) and waste water purification by a patented process.

ING KTHF6PÖRNER GESELLSCHAFT MBH,

Hamburgerstrasse 9, A-1050 Wien. Austria. Tel: +43-222-56-16-41. Telex: 13-6864. Among the many services offered by Pürner in various plant construction sectors - chemical, petrochemical, energy supply, environmental technology, food processing, mechanical engineering etc. Plants for the treatment of water from desalination facilities occupy

a special position. Purner offer consulting, feasibility studies, site analysis, raw materials, labour and pilot plant analysis, licence and know-how transfer, basic and detailed planning, delivery, erection and technical assistance in plant operation.

INTERNATIONAL SEA EQUIPMENT,

13263 72nd Avenue, Surrey, BC V3W 2S1, Canada. Tel: +1-604-594 8666. Design and manufacture of water desalination plants up to 25,000 cum/day (6.6MG/day), using mainly RO technology; undertakes plant operation and management and offers a unique project financing package

IONICS INC.,

65 Grove St, Watertown, MA 02172. USA. Tel: +1-617-926 2500. Telex: 922403. Fax: +1-617-926 4304. Total capability company operating in all fields of water and waste. Specialists in desalination of brackish and seawater, primarily using membrane processors such as EDR and RO. Also regular water treatment facilities.

JAY TECHNICAL SERVICES,

85 Gloucester Rd, Croydon, Surrey CR0 2DN. UK. Tel: +44-1-689 6755. Telex: 934715. Fax: +44-1-689 8158. Manufacturers and design consultants of water treatment plant, including base exchange softeners, demineralisation and dealkalisation plant supply, delivery and installation.

JENCONS (SCIENTIFIC) LTD,

Cherrycourt Way, Industrial Estate, Stanbridge Rd, Leighton Buzzard, Beds LU7 8UA. UK. Tel: +44-525 372010. Telex: 82164. Fax: +44-525 379547. For customers in laboratories requiring distilled water Jencons manufacture a range of 13 instruments giving a wide choice of units delivery between 3 and 8 litres per hour of high quality water, single or double distilled. An illustrated brochure in full colour is available on request. A 300 page catalogue covering a wide range of laboratory instruments is also available.

JOHNSON FILTRATION SYSTEMS,

Johnson House, Browells Lane, Feltham, Middlesex TW13 7EQ. UK. Tel: +44-1-751 4424. Telex: 935479 USELON. Fax: +44-1-890 1533. Manufacturers of well screens for water, oil and gas wells; screens for raw water intakes and water treatment processes. Also drilling fluids and logging equipment.

JOHNSON FILTRATION SYSTEMS INC,

PO Box 64118, St Paul, MN 55164. USA. Tel: +1-612-636 3900. Telex: 297451. Fax: +1-612-636 3132. Supply water well screens, environmental monitor screens and water treatment screens.

JUDO WASSERAUFBEREITUNG GMBH,

Hohreuschstr: 39-41, Winnenden D-7057. West Germany. Tel: +49-7195-692-0. Fax: +49-7195-692-110. Judo Wasseraufbereitung GmbH was founded in 1936 and currently consists of 180 employees. The company is engaged in the production of protective filters, dosing equipment, water softening equipment, reverse osmosis plants, desalination equipment, swimming-pool filter equipment and accessories.

K E WATERSOFTENERS LTD,

11 Oak Rd, Harold Wood, Essex RM3 0PH. UK. Tel: +44-4023 42185/40562. Manufacturers of watersofteners for base exchange. Suppliers of resins, pressure vessels, control valves and water meters. Facilities for installation of equipment and providing complete after sales service. Salt suppliers.

KABB INC,

5108 B Taravelia Rd, Marrero, LA 70072. USA. Tel: +1-504-340 1283. Manufactures POU reverse osmosis and GAC water treatment units that range in size from counter top to 500 gpd commercial systems.

KELCO WATER ENGINEERING INC,

228 South Clark Drive, Ste 102, Tempe, AZ 85281. USA. Tel: +1-602-829 1115. Custom engineered commercial reverse osmosis systems ranging from 250 gpd to two million gpd. High recovery rate industrial reverse osmosis systems in single and double pass configurations. State-of-the-art computer assisted design systems engineer RO systems for longevity, optimum performance and specific ion rejection.

KENNICOTT (NEI THOMPSON LTD),

PO Box 100 Ettingshall, Wolverhampton, West Midlands WV4 6JY. UK. Tel: +44-902 353353. Telex: 337412. Fax: +44-902 405500. Founded in 1902, Kennicott is a major UK based contractor of water treatment plant and gas gener-

DESALINATION DISTALATION & WATER SOFTENING

ation systems. The company specialises in plant for the production of high purity water for boiler feed, process and potable applications and systems for the on-site generation of sodium hypochlorite and hydrogen.

KINETICO INC,

10845 Kinsman Rd, Newbury, OH 44065. USA. Tel: +1-216-564 9111. Pioneer in manufacturing fully automatic, non electric, twin tank, demand water processing equipment. Offers systems for residential and commercial softening and for industrial softening, deionisation and metals recovery.

KING INDUSTRIES INTERNATIONAL,

1961 McGaw Avenue, Irvine, CA 92714. USA. Tel: +1-714-863 0713. Manufacturer of residential and commercial water conditioners, reverse osmosis systems and distributor of Royal Cleaning products. Line of soaps for use in soft water.

KING LEE CHEMICAL CO,

PO Box 146, Del Mar, California 92014. USA. Tel/Fax: 1-619-693 1358. King Lee is world pioneer and leading supplier for performance chemicals used when processing water with Reverse Osmosis and prevent scale formation within process equipment. In addition highly effective cleaners are available for restoring equipment performance. All products offered are safe, effective and economical to use. Distributor inquiries are welcome.

KISCO BOILER & ENGINEERING CO,

303 West Marquette Avenue, Oak Creek, WI 53154. USA. Tel: +1-414-764 5700. Manufacturer of commercial and industrial softeners, filters, de-aerators, condensate polishers, deionisation equipment and steel pressure vessels.

KISS INTERNATIONAL,

520 South Andreasen Drive, Escondido, CA 92025. USA. Tel: +1-619-480 4606. Manufacturer of a complete line of under the counter reverse osmosis systems. Product line consists of six different systems, as well as a complete commercial line.

KRAFTANLAGEN HEIDELBERG,

PO Box 103420, Britzspiel 7, Heidelberg 1, D-6900. West Germany. Tel: +49-6221-394-1. Telex: 0461-831. Revos, the mobile seawater desalination plant from Kraftanlagen,

eliminates impurities normally found in seawater. The resulting potable water corresponds to the physical/chemical and hygienic parameters of the regulations and standards set by the World Health Organisation.

KRUDICO INC,

Highway 71 East, Lake View, IA 51450. USA. Tel: +1-712-657 2628. Manufactures pellet chlorinators, dry pellet chlorinators, chlorine pellets, water softeners, iron filters, carbon filters and related products.

LABCONCO CORP,

8811 Prospect, Kansas City, MO 64132. USA. Tel: +1-816-333 8811. The company's water purification systems create ultrapure water through reverse osmosis. Available in freestanding, undercounter and benchtop models, the units deliver RO treated water quickly and efficiently.

LAYTON MFG,

PO Box 4458, Santa Ana, CA 92702. USA. Tel: +1-714-953 6300. Manufactures portable exchange stainless steel units to customer specifications and stainless automatic softeners to customer specifications.

LEE POLLUTION CONTROL LTD,

1 Station Rd, Four Ashes, Wolverhampton WV10 7DQ. UK. Tel: +44-902 791616. Telex: 335684. Fax: +44-902 791772. Contractors for custom designed and built water and effluent treatment plants.

LEIGH POLLUTION CONTROL LTD,

1 Station Rd, Four Ashes, Wolverhampton, West Midlands WV10 7DQ. UK. Tel: +44-902 791616. Telex: 335684. Fax: +44-902 791772. Suppliers of metal finishing products, water treatment and effluent treatment plant, water softeners and deionising equipment etc.

MARINCO SRL,

Via Crispi No 13, Bareggio, Milan 20070. Italy. Tel: +39-2-902 76451. Telex: 331554 SA.AL. Fax: +39-2-902-7118. Manufacturer of reverse osmosis desalimators for production of sweet drinking water from brackish water and sea water. Capacity from 20 gallons per day up to 100,000 gallons per day.

MARLO INC,

PO Box 4070, 2227 South St, Racine, WI 53404. USA. Tel: +1-414-681 1300. Sodium zeolite softeners, dissolve

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solids reduction systems, hot zeolite systems, ion exchange resins, alkalinity reduction systems, filtration media, nitrate removal systems, conventional pressure filters, chemical feed pumps, condensate filters and polishers.

MASTER WATER CONDITIONING CORP,

224 Shoemaker Rd, Pottstown, PA 19464. USA. Tel: +1-215-323 8358. Fax: +1-215-323 5526. Manufacturers of water softeners, filters, deionisers, reverse osmosis systems and ultraviolet purifiers.

MECHANICAL EQUIPMENT CO INC,

86¹ Carondelet St, New Orleans, LA 70130. USA. Tel: +1-504-523 7271. Telex: 460165. MECO is a leader in the engineering and manufacture of packaged water desalination equipment for land-based, marine, pharmaceutical, defense and offshore applications plus a variety of ancillary equipment such as heat exchangers, filters, pure steam generators, sample collectors etc.

MECOLA MILIEUTECHNIEK BV,

Corn Drebbeel Straat, Wijchen, BH 6603. The Netherlands. Tel: +31-8894 12176. Telex: 48769. Fax: +31-8894 21451. Sewage water treatment equipment, reverse osmosis equipment, pyrolyses, piping erection and welding, dissolved air flotation and radiation shielding.

MEDRO SYSTEMS INC,

416 East Industrial Boulevard, McKinney, TX 75069-7323 USA. Tel: +1-214-542 8200. Manufactures RO systems and water purification equipment for medical, commercial and industrial markets.

MEMBRANE PRODUCTS INC,

12791 Dean St, Santa Ana, CA 92708. USA. Tel: +1-714-832 7049. Manufacturer of reverse osmosis membrane elements for use in residential and commercial water systems. Manufactures custom sizes of spiral wrapped membrane elements with both cellulose acetate blend reverse osmosis membrane or with the customer's reverse osmosis, ultrafiltration or microfiltration membrane media.

MID AMERICA WATER TREATMENT,

901 West Lake St, Addison, IL 60101. USA. Tel: +1-312-289 6400. Water treatment components for industrial, commercial and residential use, which includes all kinds of

filters, reverse osmosis, drinking water, control valves and different types media.

MID AMERICA WATER TREATMENT INC INTERNATIONAL,

2045 Lake St, Hanover Park, IL 60103. USA. Tel: +1-312-289 6400. Manufacturer of a complete line of residential and commercial water conditioning equipment including softeners, filters, chemicals, chemical feed pumps, RO systems and a complete line of component parts, pressure vessels, resin, valves, brine tanks, feeder tanks, filter housings, cartridges and carbon.

MISSION MEMBRANES,

1107 West Mission Avenue, Escondido, CA 92025. USA. Tel: +1-416-562 4195. An operating division of Desalination Systems Inc, a widely recognised leader in the reverse osmosis water filtration field. No matter what kind of home or lab RO system the company can supply high quality, long-life cartridges to meet virtually any size or type of pressure vessel.

MMD,

CH4707, Deitingen. Switzerland. Tel: +41-65-431151. Fax: +41-65-44-3203. Distributors for Desalination Systems Inc.

MOYER DIEBEL CORP,

59 John Glenn Drive, Amherst, NY 14120. USA. Tel: +1-416-562 4195. Manufacturer of the revolutionary DO:FY:IN water distiller, a fully automatic distiller capable of producing nine gallons of distilled water every 24 hours. Also available, a complete line of reservoirs, stands, aeraid pump systems, pre and post-filtration systems.

MULTI-PURE,

9200 Deering Avenue, Chatsworth, CA 91351. USA. Tel: +1-805-252 0349. Manufacturer and supplier of activated carbon block filters and RO systems.

NATIONAL HYDRO INC,

1115 South 21st Avenue, Phoenix, AZ 85009. USA. Manufacture water softeners and filters.

NATIONAL WATER PURIFIERS CORP,

1065 East 14th St, Hialeah, FL 33010. USA. Tel: +1-305-887 0703. Manufacture residential and commercial water treatment equipment.

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NIMBUS WATER SYSTEMS INC,
PO Box 3263, 2316 Vineyard Avenue, Escondido, CA 92025. USA. Tel: +1-619-743 3734. Manufactures a full line of drinking water systems including portable, under-the-counter, cooler conversion and light commercial, ranging from three-400 gpd. Also a leading supplier of spiral wound membranes and auxiliary RO components and equipment.

NITTO DENKO TECHNICAL CORP,
2910 Corvin Drive, Santa Clara, CA 95051. USA. Tel: +1-408-720 8760. Manufacturer of reverse osmosis and ultrafiltration membranes, available in tubular, spiral wound and capillary configurations with a wide variety of membrane materials for almost any UF application.

NORWEGIAN WATER & ENERGY TECHNOLOGY,
Box 172, Stavanger, Rogaland, 4033 Forus, Norway. Tel: +47 4 571488. Fax: +47 4 571750. Consultants in the design and manufacture of plants for water and waste water treatment. Special emphasis on membrane technology and membrane based unit operations. Also sludge treatment.

NUOVA SAMIM SPA,
Via Caldera 21, 10153 Milan. Italy. Tel: +47-02-45288-308. Telex: 330264/330260/330120. Fax: +47-02-45288-481/502/468. Nuova Samim SpA, a member of ENI Group-Ente Nazionale Idrocarburi-Italian state owned group, is the head company of non-ferrous metallurgical activities with a total production capacity of over 500,000 TPY. We have 10 factories in Italy. Our Sulmona factory specialises exclusively in the production of high quality evaporator/condenser tubes of copper alloys. Our tubes are installed at main MSF desalination and thermal power plants throughout the world. For further information, please contact our commercial head office at Milan.

OCEA PRODUCTS INC,
PO Box 2159, Pascagoula, MS 39567. USA. Tel: +1-601-769 7150. Manufacturer of residential and commercial RO systems. Subcontractor of custom RO systems for private labeling. Training of distributors for sales, service and installation.

OMNI FILTER CORP,
PO Box 2246, Hammond, IN 46323. USA. Tel: +1-219-989 9800. Contact Name: Jeff Rosenzweig.

Manufacturers a full line of residential and light industrial water filtration products and water conditioning products to remove lead, chemicals, tastes, odours, rust and sediment and other contaminants from water, as well as replacement cartridges for major brands of filters.

OSMO MEMBRANE SYSTEMS DIV OSMONICS INC,
5951 Clearwater Drive, Minnetonka, MN 55343. USA. Tel: +1-612-933 2277. Reverse osmosis and ultrafiltration machines and replacement membrane elements for the most economical purification of tap water, well water and brackish water eliminate up to 97 per cent of dissolved salts.

OSMOSIS TECHNOLOGY INC,
6925 Aragon Circle #24, Buena Park, CA 90620. USA. Tel: +1-714-670 9303. Telex: 499-8515. Fax: +1-714-670 9323. Manufacturer of reverse osmosis membranes and related products and residential and semi-commercial applications. Choice of blend or CTA membranes at competitive prices.

PAYNE MANUFACTURING CO INC,
1900 Petra Lane Unit East, Placentia, CA 92670. USA. Tel: +1-714-777 1093. Fax: +1-714-514 8780. Manufacturers of OEM reverse osmosis purification systems and all component parts.

PENFIELD LIQUID TREATMENT SYSTEMS,
8 West St, Plantsville, CT 06479. USA. Tel: +1-203-621 9141. Fax: +1-203-621 2380. Manufacturers of filtration, softening, ion exchange, reverse osmosis and water filtration equipment.

PERMASEP PRODUCTS,
50-52 Rue Des Acacias, Geneva 24, CH-1211. Switzerland. Tel: +41-22-37-93-40. Fax: +41-22-379109. "Permasep" permeators for reverse osmosis water desalination were introduced by Du Pont in 1969. Since that time, they have been used in thousands of installations in dozens of countries around the world for desalination of brackish water and seawater, and for treatment of waste effluents. Today, Du Pont offers the broadest line of reverse osmosis permeators available in the world. "Permasep" permeators come in four product types, according to the type of water to be treated.

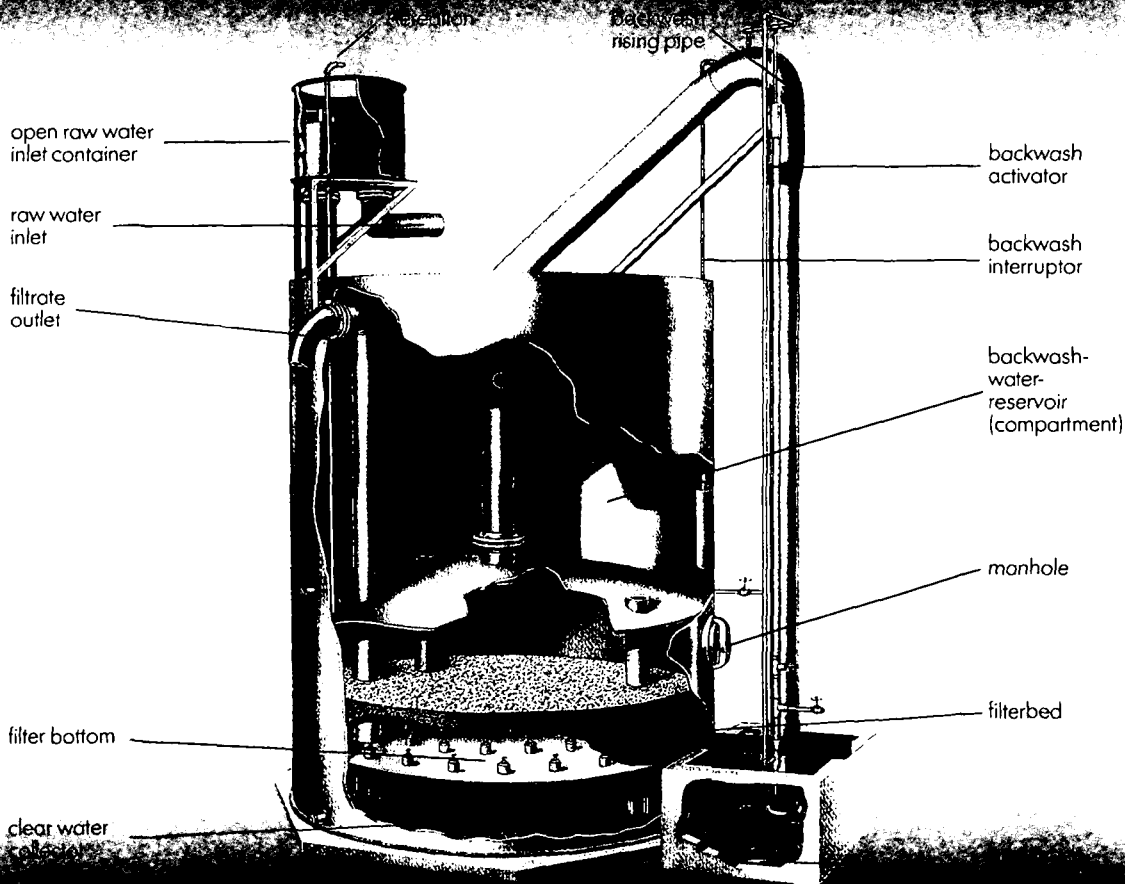
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- DOSING SYSTEMS AND EQUIPMENT
- METERS - FLOW MEASUREMENT
- COOLING TOWERS AND EQUIPMENT
- REVERSE OSMOSIS PLANTS
- DOSING PUMPS

THE PERMUTIT CO LTD,
Permutit House, 632-652 London Rd, Isleworth,
Middlesex TW7 4EZ. UK. Tel: +44-81-560 6431. Telex:
924640 PERM G. Fax: +44-81-568 9772. Desalination
by reverse osmosis: A comprehensive range of units
designed for economy, easy installation and simple
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ages with flow rates from 0.08m³/hr to 65/m³/hr. A
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ufacture and supply a complete range of water
purification equipment for industrial, commercial and
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ured in accordance with quality systems which have
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complying with BS5750 Pt 2; ISO9002. See PWT
Worldwide advertisement and editorial under
Wastewater Treatment, section 5.

PERMUTIT DOMESTIC WATER SOFT-
ENERS,
 Sterling House, 20 Station Rd, Gerrards Cross Bucks SL9
 8HR. UK. Tel: +44-753 889744. Fax: +44-753 880491.
 Permutit manufacture and market a comprehensive range of
 compact, single cabinet water softeners, suitable for residen-
 tial use. Larger units are also available for hotels and
 catering establishments. Complete service support is under-
 taken by Permutit's own nationwide service department.

PFIZER INC,
 235 East 42nd St, New York, NY 10017. USA. Tel: +1-
 212-573 2531. Telex: 420440. Fax: +1-212-573 1166.
 Pfizer Inc markets 'Flocon 100' the leading antiscalant for
 reverse osmosis systems as well as the 'Floclean' family of RO
 cleaning compounds. Pfizer also provides water analysis ser-
 vices, membrane flow-testing and autopsy services. In addition,
 Pfizer offers a computer programme to help designers and engi-
 neers determine optimum operating conditions and Flocon dosage.

PFIZER WATER TREATMENT
PRODUCTS,
 235 East 42nd St, New York, NY 10017. USA. Tel: +1-
 212-573 2531. Fax: +1-212-573 1166. Pfizer Water
 Treatment Products Group, a unit of the Pfizer Inc
 Pharmaceutical Corporation, manufactures the 'Flocon' line of
 antiscalants specifically designed to inhibit scale formation in

reverse osmosis desalination units. Pfizer also sells and dis-
 tributes the 'Floclean' cleaners for reverse osmosis membranes
 and provides a variety of services to the industry including
 water analysis, membrane autopsies and computerised dos-
 ing programmes.

POLAR BEAR WATER DISTILLER
MFG CO LTD,
 PO Box 113 Pickardville, Alberta T0G 1W0. Canada. Tel:
 +1-403-349 4872. Manufacture and distribute home and
 commercial water distillers.

POLAR BEAR WATER DIS-
TILLERS CO LTD,
 PO Box 113 Main St, Pickardville, Alberta T0G 1W1.
 Canada. Tel: +1-403-349 4872. Fax: +1-403-349 5904.
 Polar Bear Water Distillers is Canada's largest manufacturer
 of residential, commercial and industrial water distillers.
 Constructed of quality stainless steel, their units remove
 greater than 99 per cent of all contaminants from any source
 of food water, with virtually maintenance-free option avail-
 able. Polar Bear also manufactures a stainless steel purified
 water dispensing system for water profit centres. Backed by
 excellent warranty, Polar Bear is 'clearly' the best!

PREUSSAG ANLAGENBAU,
 PO Box 1320, Heinrich-Hertz-Strasse 23, Hemminger 1, D-
 3005 West Germany. Tel: +49-511 4206-0. Telex:
 923523. Fax: +49-511-4206-359.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.

PRO-FLO PRODUCTS INC,
 29 Ryder Rd, Wayne, NJ 07470. USA. Tel: +1-201-956
 1057. Telex: 5106013192. Fax: +1-201-585 1904.
 Manufacture products for treatment of water at residential
 and small commercial level, reverse osmosis, carbon filtra-
 tion and ultra-violet.

PURE SOLUTIONS DIV OF
IONICS INC,
 4101 East Wood St, Phoenix, AZ 85040. USA. Tel: +1-
 602-437 1355. Specify, design, fabricate, install and
 service water purification equipment, including filtration,
 reverse osmosis, degasification, deionisation, ultraviolet steril-
 isation and ozonation.

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PURE WATER INC,

PO Box 83226, Lincoln, NE 68501. USA. Tel: +1-402-467 2577. Manufacturer and marketer of water distillers for home, office and light commercial. A full range of vented distillation systems including manual, semi-automatic, fully-automatic, a refrigerated unit and convenience accessories that deliver distilled water to an accessory faucet or ice cube maker.

PURE WATER INTERNATIONAL INC,

3633 Pomona Boulevard, Pomona, CA 91768. USA. Tel: +1-714-594 4433. Manufacture point-of-use water purification devices.

PURE WATER PRODUCTS INC,

1121 East Tonto, Phoenix, AZ 85034. USA. Tel: +1-602-263 8899. Manufacture RO equipment for home and commercial applications.

PURE WATER TECHNOLOGIES INC,

257 Riverside Avenue, Westport, CT 06880. USA. Tel: +1-203-454 0006. Manufacturer of POU purification system and unique combination of ultraviolet and carbon filtration technology.

PURIFICATION PRODUCTS CO,

820 Los Vallecitos, Ste G, San Marcos, CA 92069. USA. Tel: +1-619-471 2991. Telex: 251761. Fax: +1-619-471 2046. Manufacturers of reverse osmosis, membrane element for point-of-use and point-of-entry water purification.

PURITAN WATER CONDITIONING INC,

216 Lafayette Avenue, Crawfordsville, Ind 47933. USA. Tel: +1-317-362 6340. Manufacture water softeners for use in the home and business.

PURITE LTD,

Unit E, Bandet Way, Thame Industrial Estate, Thame, Oxon OX9 3SJ UK. Tel: +44-844 217141. Telex: 837561. Manufacturers of reverse osmosis units, desalination and reverse osmosis units and cleaning chemicals, deionisation equipment, various filtration units and test kits.

PURWATER INTERNATIONAL CUNO INC,

3633 Pomona Boulevard, Pomona, CA 91768. USA. Tel:

+1-714-594 4433. Product line includes reverse osmosis membranes, through which water is forced to remove dissolved salts and chemical contaminants.

PWT PROJECTS LTD,

632-652 London Rd, Isleworth, Middlesex TW7 4EZ.

UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.

Fax: +44-81-568 5479. Pre-treatment and desalination of sea or brackish waters by reverse osmosis.

Treatment of low-TDS brackish water by electrodiolysis. Water softening by ion exchange and lime-based precipitation processes. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

RADIANT INDUSTRIES CORP,

1227 Rockaway Avenue, Brooklyn, NY 11236. USA. Tel: +1-718-649 5577. Manufacture a complete line of water conditioning equipment for domestic and commercial applications.

RAINSOFT WATER CONDITIONING CO,

2080 Lunt Avenue, Elk Grove Village, IL 60007. USA. Tel: +1-312-437 9400. Manufacturer of a complete line of water treatment equipment for home, business and industry: water softeners, deionisers, iron filters, turbidity filters, acid neutralisers, taste and odour filters, water purifiers and reverse osmosis equipment.

RAYNE CORP DIV OF RAYTEC WATER - GROUP,

PO Box 90, Santa Barbara, CA 93101. USA. Tel: +1-805-966 1695. Manufacture line of water conditioning equipment for home and commercial applications.

RAYTEC WATERGROUP,

500 West Oklahoma Avenue, Milwaukee, WI 53207. USA. Tel: +1-414-747 3760. Telex: 6878041. Fax: +1-414-747 3812. Raytec Watergroup is a market leader and has been supplying the finest in water treatment for over 40 years. Raytec Watergroup complete, state-of-the-art products line includes exclusive proprietary equipment designed to solve today's water problems.

RBC WATER EQUIPMENT MANUFACTURERS,

PO Box 16105, 4635 North Black Canyon Highway, Ste 206 Box 6, Phoenix, AZ 85011. USA. Tel: +1-602-242

8559. A full line manufacturer, assembler and distributor of water softeners, reverse osmosis, purification equipment, disinfection, filtration, water reuse, distillation and filtration equipment for residential and commercial systems.

REGENERATION SYSTEMS,

PO Box 388, Albion, MI 49224. USA. Tel: +1-517-629 2033. Design and build all types of equipment for regeneration of water softeners, filters and DI portable exchange tanks.

ROHM & HAAS (UK) CO,

Lernig House, 2 Mason's Avenue, Croydon, Surrey CR9 3NB. UK. Tel: +44-81-686 8844. Telex: 917266 R HCROV. Fax: +44-81-686 8329. manufacturers and suppliers of Amberlite, Duolite and Imac ion exchange resins for softening, dealkalisation, deionisation, denitrification and condensate polishing; polymeric absorbants, ion-specific and chelating resins for process and effluent treatment; Primafloc synthetic flocculants. Also suppliers of Romicon Ultra-Filtration systems and Hydranautics reverse osmosis membranes.

RUSTRAP MFG CO,

111 Howard St, East Edgerton, MI 56128. USA. Tel: +1-507-442 3451. Fax: +1-507-442 3775. Manufacturer of dual inline water filters, RV softeners and complete line of both commercial and residential water softeners.

S & G WATER CONDITIONING,

525 North York Rd, Warminster, PA 18974. USA. Tel: +1-215-672 2030. Manufacture of water conditioning equipment for home and business.

SAFE-T-SERVE,

PO Box 126, 1620 Gramercy, Torrance, CA. USA. Tel: +1-213-618 0160. Manufacture Safe-T-Serve drinking water system. Demand initiated RO appliance that rests and cleanses the membrane to extend its life and maintain high efficiency. Complete self-contained system provides easy installation and fits into the most confined area in vertical or horizontal position.

SALINE WATER CONVERSION CORP,

Prince Mohammed Bin Abdulaziz St, Olaya, PO Box 65968, Riyadh - 11432. Saudi Arabia. Tel: +996-1-463 1111. Telex: 400097 TAHLEA SJ. Fax: +996-1-464 1952. Saline Water Conversion

Corporation (SWCC) is a government agency, responsible for the desalination of seawater. It produces 565 Mgd of water and 4079 MW of power from desalination and power plants located on Red Sea and Arabian Gulf coasts. SWCC is a world leader in the field of desalination. There are six pipelines with a total length of 2860 kms supplying water to inland regions.

SASAKURA ENGINEERING CO,

2 Grove House, Foundry Lane, Horsham, Sussex. UK. Tel: +44-403 50692. Telex: 87144. Manufactures and suppliers of all types of desalination plants including multi-stage lath, thermo-compression, mechanical vapour compression and reverse osmosis.

SAXTON MFG CO,

6782 Milliken Avenue, Irvine, CA 92714. USA. Tel: +1-714-863 0606. Manufacturer of domestic and commercial water softeners and filters for the water conditioning industry. Manufacturer of a complete line of water softeners for hot water application.

SCIENCO SYSTEMS INC,

3240 North Broadway, St Louis, MO 63147. USA. Tel: +1-314-621 2536. Telex: 442449. Fax: +1-314-621 1952. Manufacture point of use water treatment equipment, on-site chlorine generators, small and large applications, mobile and fixed package water treatment systems for making potable water from surface, well, brackish and salt water.

SEA RECOVERY CORP,

PO Box 349, San Pedro, CA 90733. USA. Tel: +1-213-519 7801. Manufacturer of a complete line of reverse osmosis desalinators, from basic systems to turnkey operations. Ranges from 100 US gpd (3.8m³) to 100,000 US gpd (380m³). Systems available for virtually any use from sea water, brackish water or purified feed sources.

SEPARATION TECHNOLOGIES BV,

PO Box 90, Voorschoten, 2250 AB. The Netherlands. Tel: +31-01717 4940. Fax: +31-01717 8180. SETEC, Separation Technologies BV, is a company engaged in the supply of membrane technology, desalination and water treatment systems. SETEC is the only company worldwide involved in all membrane technologies available on the market. The wide experience in membrane technology will

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assure the utilisation of the most appropriate membrane for the present application in reverse osmosis, ultrafiltration, microfiltration, and electro-dialysis. Membrane research resulted in our own, the first commercially available, pervaporation membrane, enabling separation of water from organic liquids.

SEPARMATIC FILTER CO,
7628 West Florist Avenue, Milwaukee, WI 53218. USA.
Tel: +1-414-466 5200. Manufacture water purification equipment and chemical feed pumps.

SERVAPURE CO,
1101 Columbus Avenue, Bay City, MI 48708. USA.
Tel: +1-517-892 7745. Manufacture and sale of water vending machines using DI, RO or both. Manufacture and sale of DI regeneration equipment.

SETEC,
PO Box 90, Rouwkooplaan 14, Voorschoten 2251 AB. The Netherlands. Tel: +31-1717 4940. Telex: 39091. Fax: +31-1717 8180. Design and supply water treatment systems and membrane separation treatment systems, (microfiltration, ultrafiltration, reverse osmosis, electro-dialysis, pervaporation and gas separation).

SHAKESBY & SONS LTD,
97 Angela Rd, Horsford, Norwich NR10 3HF. Tel: +44-603 897735. Designers and manufacturers of equipment for the removal of iron, manganese and other contaminants from water supplies. Base exchange water softeners, pH adjustment and various types of sterilising equipment are produced and/or supplied. Most types of treatment plant commissioned, modified and serviced.

SOBEA,
PO Box 414, 62 Renen, Nanterre 92004. France. Tel: +33-1-47-24-22-66. Telex: 203978. Produce and install water treatment units for the purification of waste water by filtration.

SPRINGSOFT INTERNATIONAL INC,
2390 United Lane, Elk Grove, IL 60007. USA.
Manufacturer of a complete line of residential and commercial water softeners. A complete line of filters, chemical feeders, distillers, reverse osmosis systems and deionisation equipment is stocked for immediate delivery.

STA-RITE INDUSTRIES,
1875 Dewey Avenue, Benton Harbor, MI 49022. USA. Tel: +1-616-925 8812. Manufacture and assemble quality water softeners and filters for residential and commercial water treatment market.

STEELHEAD INC,
Box 21419, San Antonio, TX 78221. USA. Tel: +1-512-628 1066. Manufacture automatic mixed bed deionisers.

STELLA-META FILTERS LTD,
Laverstoke Mill, Whitchurch, Hants RG28 7NR. UK.
Tel: +44-256 892360. Telex: 859605. Fax: +44-256 892074. Stella-Meta Filters market mobile desalination equipment for use with brackish or sea water. **This complete range of desalting equipment enables saline water to be converted to potable supplies to World Health Organisation (WHO) standard and is available in transportable, trailer mounted or containerised modules. The initial pre-treatment process is the Stellar or Stellasep precoat filter system followed by a reverse Osmosis array which reduces the salt content. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.**

SUN STANDARD INC,
10105-C Acoma SE, Albuquerque, NM 87123. USA. Tel: +1-505-296 8000. Manufactures point-of-use solid carbon block drinking water purification systems. Stainless steel housings. Water dispensers designed to replace bottle water dispensers.

SUPERIOR WATER SYSTEMS INC,
13529 South Normandie Avenue, Gardena, CA 90249. USA. Tel: +1-213-770 8920. Manufacture of water softener and carbon filters, resin, RO units, tanks and valves.

SUPERSTILL TECHNOLOGY INC,
888 Second Avenue, Redwood City, CA 94063. USA. Tel: +1-415-366 1133. Manufactures Vapor Compression Water Processors™, one of the world's most energy efficient water distillers. Capacities range from 25 to 1000 gph (600-24,000 gpd).

SYBRON CHEMICALS INC,
PO Box 66, Birmingham Rd, Birmingham, NY 08011. USA. Tel: +1-609-894 8211. Fax: +1-609-894 8641. Sybron Chemicals Inc manufactures and markets ion exchange resins under the Ionic brand name for water soft-

ening, demineralisation and waste treatment; they also manufacture a complete line of biochem engineered bacteria for waste treatment.

TAPROBE CO,

PO Box 267, Wasco, IL 60183-0267. USA. Manufacturer of RO product water checker (tester) for user to determine when to change module.

TARI GESELLSCHAFT MBH,

A-5280 Braunau/Inn, Peier-Rosegger-Weg 12. Austria. Tel: +43-772/32-64. Telex: 027-75524. Tari GesmbH are engaged in water technology. Their products are used for water treatment, in particular drinking and service water from rivers, brackish and karst waters, for ultraviolet irradiation, reverse osmosis, full desalination and decarbonisation. For water treatment the firm produces ozonizing equipment. Tari undertake the planning, production and installation of various facilities, including small and large size swimming-pool systems using mechanical and chemical water treatment.

TOUCH-FLO MFG CO,

75 East Palm Avenue, Burbank, CA 91502. USA. Tel: +1-818-843 8117. Manufacture drinking water dispensers, saddle valves and air gaps for RO and carbon home filtration units.

TRAILIGAZ (TLG),

29-31, bd c/à la Muette, Garges les Gonesse Cedex, 95145 Garges les Gonesse. France. Tel: +33-1-39-86-60-29. Fax: +33-1-34-53-01-96. Ozonation equipment and plant design, manufacture and erection. The main use is for drinking and waste water treatment, and odour control.

TRANSCONTINENTAL WATER PURIFICATION,

PO Box 846, Eugene, OR 97440. USA. Water and wastewater equipment. Contractors and manufacturers representatives.

U-MARC INC,

1017 Dover Court, Libertyville, IL 60048. USA. Tel: +1-312-680 3687. Manufacture reverse osmosis equipment.

UOP FLUID SYSTEMS,

10054 Old Grove Rd, San Diego, CA 92131. USA. Tel: +1-619-695 3840. Telex: 188906. Fax: +1-619-695 2176. Spiral wound, reverse osmosis membrane elements

and pressure vessels. Applications include desalination, wastewater treatment and ultrapure water production.

VAPONICS INC,

Cordage Park, Plymouth, MA 02360. USA. Tel: +1-508-746 7555. Manufactures quality water purification systems including distillation, RO, ultrafiltration and deionisation for industry.

VOEST-ALPINE MONTAGE GESELLSCHAFT MBH,

Dieselstrasse 2, Wels A-4600. Austria. Tel: +43-7242/81-7-51. Telex: 02-5512. Voest Alpine Montage GesmbH, an affiliate of Voest Alpine AG, Linz, specialise among other things in water treatment plants, embracing filtering and softening plants, plants for part and full desalination, cooling and drinking water conditioning plants, seawater desalination plants (applying the VAM multi-effect process) and water supply projects using large-capacity tanks.

WAB WASTE & WATER TREATMENT,

Lieberstrabe 118a, A-1110 Vienna. Austria. Tel: +02227435600. Telex: 132291. Fax: +022274356032. Desalination and Water softening, Disinfection, Municipal water treatment, Package and Portable water treatment, Mechanical and Biological waste water treatment, Sludge treatment and dewatering, General equipment and process, Specialised equipment and processes.

WATER CONDITIONING CANADA LTD,

580 Park St, Regina, Saskatchewan S4N 5A9. Canada. Tel: +1-306-545 6990. Telex: 071-2718. The manufacture and distribution of residential, commercial and industrial water treatment equipment. Water softening, iron and sediment filtration, reverse osmosis and distillation as well as purification products

WATER CONDITIONING INC,

3119 O, Lincoln, NE 68501. USA. Tel: +1-402-435 6104. Manufacture a complete line of water conditioning and purification units and own line of components, tanks and brine tanks etc.

WATER EQUIPMENT TECHNOLOGIES INC,

832 Pike Rd, West Palm Beach, FL 33411. USA. Tel: +1-

DESALINATION DISTILLATION & WATER SOFTENING

407-684 6300. Manufacturers of water filtration and reverse osmosis products from 12 gallons to 250,000 gallons per day.

WATER FACTORY SYSTEMS,

345 McCormick Avenue, Costa Mesa, CA 92626. USA. Tel: +1-714-544 1722. Manufactures an extensive line of residential, office, commercial and industrial reverse osmosis systems. Drinking water appliances include the latest technological innovations combined with rigid quality control, factory testing and medical sanitising of each system.

WATER MAINTENANCE SERVICES INC,

8 South 335 Madison St, Willowbrook, IL 60521. USA. Tel: +1-312-654 8675. Water treatment system and services. Specialising in cooling tower and boiler treatment, reverse osmosis, demineralisation, full laboratory.

WATER RESOURCES INTERNATIONAL,

2310 West Sherman St, Phoenix, AZ 85009. USA. Tel: +1-602-268 2580. Manufacturer of a complete line of residential and commercial water conditioning equipment, reverse osmosis and all other filtering systems. Has complete line of soap products for soft water. Sales and marketing support available.

WATER SERVICES CORP/WATER-SOFT CO,

111E North St, Waukesha, WI 5318. USA. Tel: +1-414-547 1862. Fax: +1-414-547 5728. Manufacturers of reverse osmosis, iron exchange, filtration and ultra filtration equipment for commercial and industrial use.

WATER SOFT INC,

220 Ohio St, Ashland, OH 44805. USA. Tel: +1-419-289 0633. Manufactures a full line of water treatment equipment for residential and commercial use. Broad line covers water softeners, activated carbon filters, iron filters, turbidity filters, neutraliser filters and domestic chlorination systems.

WATERMAKERS INC,

1927 South Federal Highway, Ft Lauderdale, FL 33316. USA. Tel: +1-305-467 8920. Provide high quality of machine.

WATERWISE INC,

PO Box 4599, Center Hill, F. 33514. USA. Tel: +1-904-787 5008. Fax: +1-904-787 8123. Supplier for Distil

Clear Pure Water System and other distillation equipment including filters, bottles, dispensers, demand pumps, faucets, tubing and test equipment, home and office application.

WEIR WESTGARTH LTD,

80 Peach St, Wokingham, Berks RG41 1XH. UK. Tel: +44-734 792201. Telex: 849971. Fax: +44-734 775276. Weir has a range of desalination plants capable of producing water for drinking and industrial use from sea or brackish water supplies. Packaged thermal compression distillers and reverse osmosis plants are available up to 3000m³/day with multistage flash distillers and engineered RO plants capable of satisfying municipal water requirements.

WESTERN PURIFIER CO,

22900 Ventura Boulevard Suite 220, Woodland Hills, CA 91364. USA. Tel: +1-818-703 0444. Manufacturer and distributors of 1 to 2 GPM point of use residential, commercial and recreational water purifiers and filters.

WESTLAND WATER SYSTEMS INC,

1900 Petra Lane, Unit E, Placentia, CA 92670. USA. Tel: +1-714-993 2524. Manufacturer of reverse osmosis water treatment systems and component parts for residential and commercial use.

WETCO INC,

2661 Western St, Las Vegas, NV 89109. USA. Tel: +1-702-735 6902. Manufacture reverse osmosis equipment for home drinking water systems. Cast-in-place triacetate membranes need no drain or pre-filter. Handles chlorinated or non-chlorinated water, resistant to bacteria and high pH.

WM RHAGUE INC,

4343 South Hamilton Rd, Groveport, OH 43125. USA. Tel: +1-614-836 2195. Manufacturers of water conditioners, filters, reverse osmosis systems and distillers.

WOOD BROTHERS IND INC,

PO Box 4426, 4021 North 48 St, Lincoln, North East 68504. USA. Tel: +1-402-467 1236. A range of water softening products for both commercial and domestic applications. Iron filters, carbon filters, reverse osmosis equipment etc also available.

XENTEX INC,

14902 West 117th St, Olathe, KS 660622. USA. Tel: +1-913-764 3800. Fax: +1-913-764 1743. Supplier to

capital construction projects; water stills for hospitals and laboratories, water demineralisers and water softeners. Equipment for wastewater projects such as liquid solid separators, filtration equip, water recycle equip, pond and pit plastic liners etc.

ZENON WATER SYSTEMS INC,
845 Harrington Court, Burlington, Ontario L7N 3P3.
Canada. Tel: +1-416-639 6320. Specialises in advanced water treatment technology based products and services. Manufactures single and double RO systems, ultrafiltration, laboratory water purification systems, utilised on medical, electronics, pharmaceutical and many other applications.

DISINFECTION

ACTINI-FRANCE,
PO Box 80, Thonon 74202. France. Tel: +33-50711-800.
Telex: 385615. Fax: +33-50718682. Manufacturers of equipment for water sterilisation by ultra-violet rays. Complete range of water treatment equipment and filters.

ALANTIC ULTRAVIOLET CORP,
250 North Fehr Way, Bay Shore, NY 11706. USA. Tel: +1-516-586 5900. Telex: 645158. Fax: +1-516-595 2609. Manufacturer of ultraviolet water purifiers and ultraviolet/germicidal lamps.

AMERICAN OZONE (A SUBSIDIARY OF VECTOR CORP),
675 44th St, Marion, IA 52302. USA. Tel: +1-319-377 8263. Telex: 9105251630. Fax: +1-319-377 5574. Manufacturer of ozone-based water treatment systems and corona discharge. Ozone generators for point of use/point of entry applications.

AMERICAN ULTRAVIOLET CO,
271 Commerce st, Chatham, NJ 07054. USA. Tel: +1-201-635 8355. Telex: 139266. Fax: +1-201-665 9523. We manufacture germicidal ultraviolet water purifiers. Models are available from 1 gallon per minute.

APPLIED OZONE TECHNOLOGIES INC,
7900 Fruitville Rd, Sarasota, FL 34240. USA. Tel: +1-813-694 1328/813-377 9097. Manufacturers of ozone generating equipment, water purification equipment and chlorination equipment.

AQUA SYSTEMS OF FLORIDA,
3302 Aviation Boulevard, Vero Beach, FL 32960. USA. Tel: +1-305-567 1120. Manufacturers & distributors of ozone generators and packaged P/C systems for problem water supplies. Fully automatic ozone and GAC systems are offered.

AQUAFINE (UK) LTD,
20 Park St, Princes Risborough, Bucks HP17 9AH. UK. Tel: +44-844 46024. Telex: 837268. Fax: +44-844 2027. Since its inception in 1949, Aquafine has become the world's leading manufacturer of ultraviolet sterilisation equipment for liquids. Aquafine ultraviolet sterilisers provide bacteria-free water completely unchanged in pH, colour, taste, odour and temperature.

AQUAFINE CORP,
25230 West Avenue Stanford, Valencia, CA 91355. USA. Tel: +1-805-257 4770. Ultraviolet disinfection of high purity water systems. 99.9 per cent bacterial reduction without the use of harmful chemicals.

AQUAFINE CORPORATION,
25230 West Avenue Stanford, Valencia, CA 91355. USA. Tel: +1-805-257 4770. Telex: 651398. Fax: +1-805-257 2489. 1989 marks the 40th anniversary of Aquafine Corporation. Since its inception in 1949 Aquafine has devoted itself to manufacturing the highest quality ultraviolet disinfection equipment for fluids and backing that equipment with the finest level of personalized service imaginable. This devotion to quality of product and service has been a major factor in Aquafine's rise to the position of the world's leading manufacturer of ultraviolet disinfection equipment. Whether the need is for a compact UV device for laboratory use, or a large custom-built system for disinfecting the potable water for an entire town, Aquafine is ready and able to fill the requirements. Aquafine UV disinfection equipment is available for almost any application from local distributors worldwide. To discuss your specific needs or to obtain the name of your nearest Aquafine representative, call telex, fax, or write Aquafine today.

BERSON MILIEUTECHNIEK,
PO Box 90 De Huifkes 23, 5674 TL Nuenen, AB 5670. The Netherlands. Tel: +31-40-85-29-19. Telex: 51911. Fax: +31-40-83-57-55. Berson Milieutechniek is specialised in the design and production of UV water sterilisers, UV air sterilisers, UV oxidation units, electrolytic chlorinators. The large UV water sterilisation programme comprises installa-

DISINFECTION

tions working with low-pressure UV lamps (small capacities) as well as high-pressure UV lamps (large capacities); in different versions for many types of liquids.

BEST-WATER CONDITIONING INC,

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USA. Tel: +1-915-366 5295. Manufactures and assembles reverse osmosis systems, a repressurisation unit, post-carbon filtration and an ultraviolet disinfection unit built all-in-one on an open steel frame. The product water tank is also available to set next to the water equipment package.

CAPITAL CONTROLS CO INC,
PO Box 211, Colmar, PA 18915. USA. Tel: +1-215-822 2901. Manufacturer and distributor of equipment and systems for water disinfection and analysis.

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West Germany. Tel: +49-7623 1084. Telex: 773444
SPA E D. Fax: +49-7623 63360. CARELA is one of the
leading manufacturers of chemicals and equipment
for water supply industry, well, water tank and water
pipeline cleaning and disinfection. CARELA-BIO-PLUS-
forte for rehabilitation of aged water wells,
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gravel pack by means of brushing, block surging, jet-
ting and dosing processes.

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36 Mann St, South Attleboro, MA 02703. USA. Tel: +1-508-761 6300. Telex: 951402. Fax: +1-508-761 6304. Chemcon manufactures a broad line of non-hydraulic and hydraulic diaphragm metering pumps, related automatic controls and accessories. Also offer complete systems, pH control, liquid chlorination systems, polymer preparation systems, etc.

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733 NE Dixie Highway, FL 34957. USA. Tel: +1-407-334 8070. Telex: 350341. Fax: +1-407-334 7304. Rega gas chlorinators have up to 60 per cent fewer parts, reducing potential for problems and costly repairs commonly associated with more complex gas chlorinators. Feed rates up to 500 lbs/day (10kg/hr).

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4959 Dunman Avenue, Woodland Hills, CA 91364. USA. Tel: +1-818-340 3020. Manufacturer of ultraviolet water treatment units/systems for industrial and consumer applications. Also manufactures and supplies electronics, including solid state ballasts and True UV sensing, monitor and control systems.

CONTAMINATION CONTROL
LTD,
Box 14-621, Auckland, New Zealand. Tel: +64-9-579135. Fax: +64-9-5277654. Manufacturer and exporter of ultra-violet water sterilisers and other water treatment products.

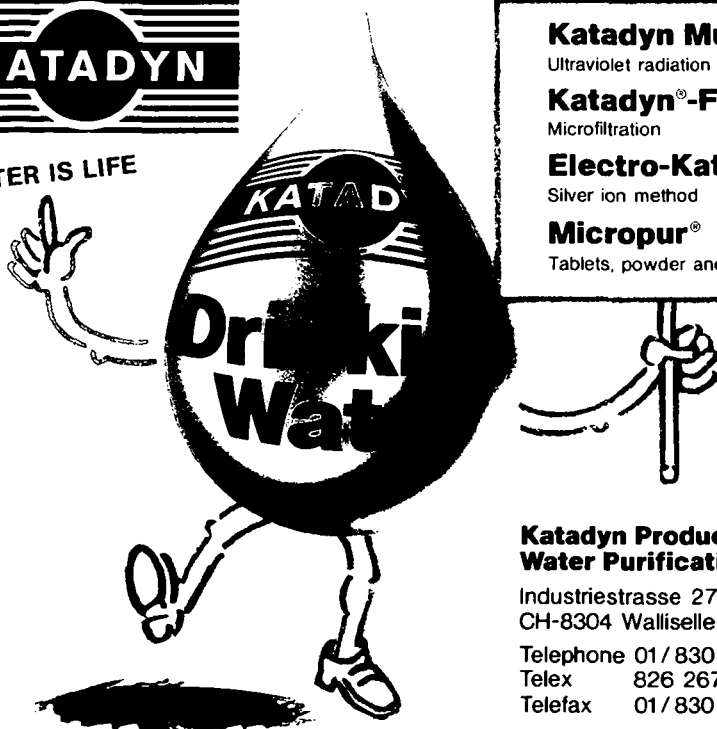
COTTEN INDUSTRIES,
275 Schoolheimer Rd, Canastota, New York 13032. USA. Tel: +1-315-363 8084. Manufacturers and suppliers of a complete line of water conditioners for softening, filtration, UV sterilisation. The company also produces reverse osmosis and demineralisation equipment.

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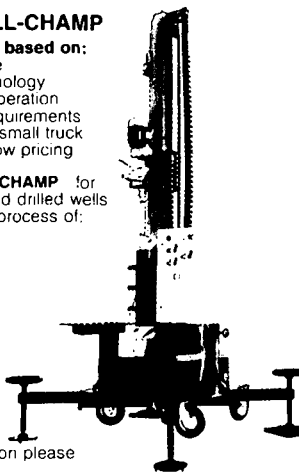
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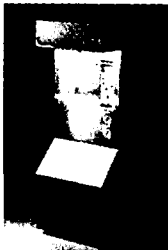
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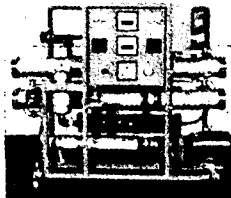
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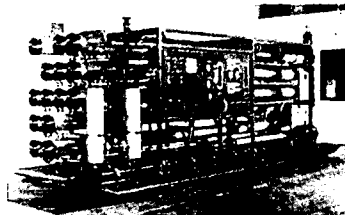
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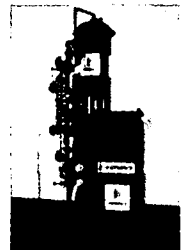
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4900 Este Avenue, Cincinnati, OH 45232. USA. Tel: +1-513-482 2100. Manufactures ozone generation systems for potable water and wastewater treatment, odour control and chemical synthesis in industrial and municipal applications.

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PO Box 64, 301 Major Mackenzie Drive, Richmond Hill, Ontario L4C 4X9. Canada. Tel: +1-416-884 9388. Telex: 06986766. Fax: +1-416-884 8296. Manufacturer of in-line water filter and sterilisers for domestic or commercial application. Units employ disposable or clearable/reusable cartridge. Branded or private label available.

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HANOVIA DIV CANRAD INC,

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HANOVIA LTD,

145 Farnham, Slough, Berks SL1 4XB. UK. Tel: +44-753 31351. Fax: +44-753 825206. Manufactures of ultra-violet water disinfection equipment.

HOÜLZLI KG,

A-4863 Seewalchen am Attersee, Ginzkeyweg 12. Austria. Tel: +43-7662/22-03. Telex: 02656/122 HGSE A. Hölzli KG specialises in the production of ultraviolet water sterilising facilities for drinking and service water. Registered under the name Uvaudes®, they are constantly tested and improved with the assistance of Austrian hygiene institutes and bear the Austrian quality label and the quality mark of the Austrian Association for Hygiene, Microbiology and Preventive Medicine.

HÜLZLI,

Seewalchen am Attersee, A-4863. Austria. Tel: +43-7662 2203. Telex: 26480 HOEKG A. In the ultraviolet sterilisation plants from Hülzli the water to be treated is conveyed through a number of radiation chambers containing specially

DISINFECTION

developed Uvaudes heavy-duty emitters designed to kill all germs present in the water without the need for any chemical reactions. This means that no chemicals or reaction vessels are necessary and the plants can be built into any supply line, normal light current being adequate for their operation.

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KANE INTERNATIONAL,

702 North Madison St, Rockford, IL 61107. USA. Tel: +1-815-968 7511. Distribute bacteriostatic water processor.

KATADYN PRODUCTS INC,

Industriestrasse 27, Wallisellen, CH 8304. Switzerland. Tel: +41-18-303677. Telex: 826267 Fax: +41-18-307942. Developing and manufacturing of economical, user-friendly and environmentally compatible methods of water disinfection and preservation.

KENNICOTT (NEI THOMPSON LTD),

PO Box 100 Ettingshall, Wolverhampton, West Midlands WV4 6JY UK. Tel: +44-902 353353. Telex: 337412. Fax: +44-902 405500. Founded in 1902, Kennicott is a major UK based contractor of water treatment plant and gas generation systems. The company specialises in plant for the production of high purity water for boiler feed, process and potable applications and systems for the on-site generation of sodium hypochlorite and hydrogen.

KRUDICO INC,

Highway 71 East, Lake View, IA 51450. USA. Tel: +1-712-657 2628. Manufactures pellet chlorinators, dry pellet chlorinators, chlorine pellets, water softeners, iron filters, carbon filters and related products.

LIGHT SOURCES INC,

PO Box 569 410 Main St, Ansonia, CT 06401. USA. Tel: +1-203-736 9961. Telex: 643266. Fax: +1-203-736 2879. Manufacturers of ultra-violet lamps for waste water, potable water and high purity water treatment.

MASTER WATER CONDITIONING CORP,

224 Shoemaker Rd, Pottstown, PA 19464. USA. Tel: +1-215-323 8358. Fax: +1-215-323 5526. Manufacturers of water softeners, filters, deionisers, reverse osmosis systems and ultraviolet purifiers.

OXI GENERATORS INC,

4990 Euclid Rd, Va Beach, VA 23462. USA. Tel: +1-804-497 3128. Fax: +1-804-624 2128. Oxi generators are mixed oxidant gas generators for on-site production of disinfectants for drinking water. Units require only salt, water and 4kwh of electricity per kg of disinfectant gas produced. Sizes available are 0.5, 1 and 2.3kg/day. Output gas is effective against bacteria, parasites and viruses.

OXIDIZERS INC,

4990 Euclid Rd, Virginia Beach, Virginia 23462. USA. Tel: +1-804-497 3128. Fax: +1-804-624 2128. Manufactures

self contained, on site, oxidant gas generators that provide safer water treatment than conventional methods at a lower cost. Oxi generators eliminate many problems with disinfected drinking water in remote areas.

OZONE PURE WATER INC,
2485 15th St, Sarasota, FL 34237. USA. Tel: +1-813-366 2509. Manufactures patented ozone systems to treat well water, central water, swimming pools, spas, cooling towers, sprinklers, RVs and boats without chemicals. Maintenance free, automatic, fully warranted. Corona discharge design.

OZOTECH INC,
PO Box 866 2401, Oberlin Rd, Yreka, CA 96097. USA. Tel: +1-916-842 4189. Manufactures and markets a line of small ozone generators utilising a technology developed specifically for residential and small commercial potable water treatment. Because they do not require feed-air drying or cooling, installation is very simple.

PCI OZONE CORP,
1 Fairfield Crescent, West Caldwell, NJ 07006. USA. Tel: +1-201-575 7052. Telex: 244067. Fax: +1-201-575 8941. PCI Ozone Corp provides ozone systems for use in water and wastewater treatment, odour control and chemical processes. Ozone in the presence of polluting compounds reacts rapidly to form environmentally safe byproducts. This process is particularly effective as a treatment for both potable water and wastewater disinfection.

PLENTY LTD,
Hambridge Rd, Newbury, Berks RG14 5TR. UK. Tel: +44-635 42363. Telex: 848023. Fax: +44-635 49758. Manufacture and design of filters, mixers, pumps, pipe cleaning equipment and electro chlorinators. Representation worldwide.

PORTACEL LTD,
10 Tannery Rd, Sovereign Way, Tonbridge, Kent TN9 1PR. UK. Tel: +44-732 364411. Telex: 95467 PORTAC G. Fax: +44-732 362575. Portacel Ltd manufacture and sell a full range of gas chlorinators suitable for the smallest village or largest city. They are available in manual or automatic form and can be provided with gas changeover valves, flexible connectors and other ancillary equipment. Portacel also manufacture chlorine residual analysers and gas-in-air leak detectors for chlorine. All equipment is specially designed for reliable use in hot, humid and dusty environments, yet is simple to install, maintain and operate.

See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

PORTER CHADBURN ENGINEERING LTD,
Park Lane Works, Bootle, Merseyside L30 4UP. UK. Tel: +44-51-525 4155. Telex: 629576. Fax: +44-51-525 4150. Suppliers of ceramic, ultra-violet, silver ion and cathodyn water treatment systems.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.

PROMINENT FLUID CONTROLS (UK) LTD,
Queen's Drive, Newnall, Wotton-on-Trent, Staffs DE1 10EG. UK. Tel: +44-283 214423. Telex: 342107. Specialists in design, manufacture and supply of chemical dosing equipment and pH, chlorine, Redox and conductivity control systems. Packaged fluoridation, chlorination and neutralisation systems, also ozone and chlorine dioxide generators from a comprehensive capability for potable, process, swimming pool and waste water requirements.

PURE WATER SYSTEMS INC,
210 Washington Avenue, Nutley, NJ 07110. USA. Tel: +1-201-235 1944. Manufacture ultra-violet water treatment products.

PWT PROJECTS LTD,
632-652 London Rd, Isleworth, Middlesex TW7 4EZ.
UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.
Fax: +44-81-568 5479. Disinfection of potable, industrial and waste waters by gaseous chlorine, ozone or hypochlorite - from power station water intake projects to village level chlorine solution gravity dosers.
See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

RICE INTERNATIONAL/CONSULTING ENTERPRISES,
1331 Patuxent Drive, Ashton, MD 20861. USA. Tel: +1-301-924 4224. Consultation in ozone technologies for water and waste water treatment.

SCIENCO SYSTEMS INC,
3240 North Broadway, St Louis, MO 63147. USA. Tel:

DISINFECTION

+1-314-621 2536. Telex: 442449. Fax: +1-314-621 1952. Manufacture point of use water treatment equipment, on-site chlorine generators, small and large applications, mobile and fixed package water treatment systems for making potable water from surface, well, brackish and salt water.

SELECTO INC,

1000 Cobb Pace Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000® media and leadOUT® filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale applications, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE® 'add-on' solid-state ultraviolet water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

MICHAEL SMITH ENGINEERS,

Oaks Rd, Woking, Surrey GU21 1PH. UK. Tel: +44-4862 71871. Telex: 859306 MSEWOK. Fax: +44-4862 23110. Engineers and distributors for specialised pumping equipment. Pumping systems and packaged dosing systems designed to customer requirements. Chlorination equipment and pumps.

SORBIOS GMBH,

Ackerstrasse 71-76, 1000 Berlin 65. West Germany. Tel: +49-30-469-4631. Fax: +49-30-469-46-46. Ozone generators, monitors, UV photometry, ozone process equipment, laboratory and engineering services, our partner in ozone technology for water treatment (ultrapure, drinking, swimming pool and sewage water) chemical synthesis and sterilising processes.

TARI GESELLSCHAFT MBH,

A-5280 Braunau/Inn, Peter-Rosegger-Weg 12. Austria. Tel: +43-7722/32-64. Telex: 027-75524. Tari GesmbH are engaged in water technology. Their products are used for water treatment, in particular drinking and service water from rivers, brackish and karst waters, for ultraviolet irradiation,

reverse osmosis, full desalination and decarbonisation. For water treatment the firm produces ozonising equipment. Tari undertake the planning, production and installation of various facilities, including small and large size swimming-pool systems using mechanical and chemical water treatment.

TFI CO/UV SYSTEMS,

4915 Niagara St, Commerce City, CO 80022. USA. Tel: +1-303-288 6823. Custom plastics manufacturing of process equipment, tanks, duct, plating systems, air scrubbers, etc with PVC, polypro, PE and PVDF. Manufactures UV units for drinking water, cooling towers and waste water treatment. Manufactures and services UV ozonators for industrial water treatment engineering and design of process control systems.

TROJAN TECHNOLOGIES INC,

845 Consortium Court, London, Ontario N6E 2SB. Canada. Tel: +1-519-685 6660. Telex: 064-7219. Fax: +1-519-681 8355. Manufacturers of ultra-violet disinfection systems for the municipal and waste water markets in pressurised or gravity flow types.

ULTRAVIOLET TECHNOLOGY INC,

8930 Osage Avenue, Sacramento, CA 95828. USA. Tel: +1-916-383 5111. Manufacture water disinfection systems.

WALLACE & TIERNAN LTD,

Priory Works, Tonbridge, Kent TN11 0QL. UK. Tel: +44-732 771777. Telex: 95278. Fax: +44-732 771800. Manufacturers and suppliers of chlorinators and associated metering and control equipment for the chemical treatment of water including: dosing pumps/dry chemical feeders; gas control units for chlorine, sulphur dioxide and ammonia; on-site electrolytic chlorinators for generating sodium hypochlorite from brine; controllers and monitors for maintaining a chlorine residual.

WILLAND UV SYSTEMS LTD,

York St, Wigan, Lancs WN3 4BY. UK. Tel: +44-942 321411. Fax: +44-942 820028. Contact Name: Mr W Blackledge or Mr A Julien. Designers and manufacturers of ultraviolet disinfection systems suitable for the treatment of domestic, industrial and municipal applications. In addition to the disinfection of water supplies Willand also advises and manufactures equipment for other specialist water treatment applications such as chlorine degradation, ozone destruction and TOC reduction.

PACKAGE & PORTABLE
TREATMENT UNITS

AL KAWTHER INDUSTRIES LTD,
PO Box 7771, Jeddah 21472. Saudi Arabia. Tel:
+966-2-636 0644. Telex: 602907 KAWTHER SJ. Fax:
+966-2-637 4337. Al Kawther provides a wide range
of consultancy, design and O & M services as well as
supplying: packaged water/wastewater treatment
plants, filters and sterilisers, custom built
water/wastewater treatment plants.

AMICA PRODUCTS (M) SDN BHD,
65-67 Jalan Maharajalela, Kuala Lumpur 50150. Peninsular
Malaysia. Tel: +60-3-243 733. Fax: +60-4-627548.
Distributor of water filters for domestic use covering the Asian
region.

AQUA CHEM INC,
PO Box 42, Milwaukee, WI 53201. USA. Tel: +1-414-
962 0100. Aqua Chem is a major supplier of packaged
water purification equipment for bottled water and pharma-
ceutical application and sea water desalination around the
world.

**AQUAMECH CORPORATION SDN
BHD,**
5 Jalan Segambut Pusat, Segambut, Kuala Lumpur 51200.
Malaysia. Tel: +60-3-626993062698296262524. Fax:
+60-3-621 5642. A Malaysian incorporated ltd company
specialising in designing, fabricating and installing package
and portable water treatment. Plants most suited, rural deve-
lopment in developing countries using upflow sludge
recirculating clarifier, pressure or auto/manual self-wash
gravity sand filters and tablets chlorination.

**AQUARIUS WATER PURIFICA-
TION LTD,**
Unit 12, Craven Court, Winwick Quay, Warrington,
Cheshire. UK. Tel: +44-925 445144. Telex: AQUA
627151. Fax: +44-925 413524. A150 portable water
purification unit - 150 gallons per hour, manual or electric
(mains - battery).

AQUASOLAR,
Guenbergstrabe 1, 3014 Laatzen 1, PO Box 110112.
West Germany. Tel: +49-51-18236914. Fax: +49-51-
18236550. Solar desalination plants to produce portable

water or/and water for irrigation. The plants can be con-
structed for a water production rate from 20 litre/day up to
1700 litre/day. In the water range of 20 up to 100
litre/day we suggest to use the small plant type 'SM'. And
over 1000 litre/day we suggest to use the plant type 'SME'
in addition the desalination plants can be integrated in a
Greenhouse. Complete constructed from AQUASOLAR too.
This enables to produce high quality food beside water pro-
duction. Solar Heater 'SOLADUR' with a hot water tank to
produce hot water by solar energy. No electric power: for
pumps are required!

**AUREPA FAHRZEUGWERKE HEIT-
GER GMBH & CO,**
11 Industriestrasse or PO Box 1480, Hockenheim-Talhaus
D-6832. West Germany. Tel: +49-6205/20060. Fax:
+49-6205/8324. Supply of stationary and mobile water
purification plants to purify any polluted surface water into
drinking water according WHO-standards. Specific:
Multifiltromat system, continuous operation, rinsing of filters
with pure water from integrated storage tanks with 5 bar pres-
sure within 180 sec. Using less than 1 per cent of clean
water obtained

**AZTEC ENVIRONMENTAL CON-
TROL LTD,**
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OX11 7FR. UK. Tel: +44-235 512000. Fax: +44-235
512020. Aztec can design, manufacture and supply a
range of plant including sedimentation, flotation, filtration
and reverse osmosis desalination treatment equipment.

BADEN ITALIANA SPA,
Via Benaco 117, Bedizzole 25081. Italy. Tel: +39-30-
674593. Telex: 300853. Manufacturers of primary water
treatment plants including treatments for aqueducts-municipal
or rural. Mobile plants using chlorine or ozone, in containers
to produce drinking water for smaller communities.

BWK GMBH,
Ingenieurgesellschaft für Wasserwirtschaft
Körnerstraße 3 - PO Box 1144 - D-6140 Bensheim,
**West Germany. Tel: +0049-6251 6007. Fax: +0049-
6251 4752. Contact Name: Mr Manfred Wagner.**
**Design, engineering and delivery of the BWK PCA-
Centra plants for remote rural areas from 6 - 30m³/h
per unit (package of flocculation/sedimentation and
filtration with the BWK-Automatic-Valveless-Gravity-
Filter system). Also mobile available.**

PACKAGE & PORTABLE TREATMENT UNITS

CHEMICAL ENGINEERING CORP.

PO Box 266, US Route 335, Churubusco, IN 46723. USA. Tel: +1-219-693 2141. Fax: +1-219-693 3956. Manufacture water softeners and filters. Also sell under-the-sink water treatment for drinking water. Handle commercial units for larger areas like hotels.

CHILTERN WATER TREATMENT CO.,

Treadaway Tech Centre, Treadaway Hill, Loudwater, High Wycombe, Bucks HP10 9RS. UK. Tel: +44-6825 27773. Telex: 837139. Fax: +44-494 465489. Manufacturers and suppliers of a range of packaged water treatment plant and designers and installers of water treatment equipment.

CLARITY FILTERS,

2500-165th St, Hammond, IN 46320. USA. Tel: +1-800-848 7418. Contact Name: David Griffin.

Manufacturers water filter systems, housings, cartridges and components. We also stock a complete line of accessories including faucets, diverters fittings, tubing, replacement parts, and filtration media. Clarity Filters exclusively features the ABA-2000 Lead/Heavy Metal filter cartridges.

CLEARWATER SYSTEMS,

Riverway Estate, Portsmouth Rd, Guildford GU3 1LZ. UK. Tel: +44-483 33831. Telex: 859-356. Fax: +44-483 34888. Clearwater Systems produce water, wastewater and sewerage treatment systems. Our standard products include packaged sewage treatment plants and packaged potable water treatment plants. Exporting to over 30 countries for simple installation on site.

CLEAVER - BROOKS,

PO Box 431, Milwaukee, WI 53201. USA. Tel: +1-414-962 0100. Complete boiler room and packaged water systems supplier.

CLIMAX PUMPS,

Wildon Engineering Ltd, White Ladies Close, Little London, Worcs WR1 1PZ. UK. Tel: +44-905 22014. Telex: 337300 TAYLEY G. Fax: +44-905 723828. Contact Name: Mr T Oakley. Climax produce a range of bacteriostatic water treatment filters suitable for the domestic market. Various sizes from portable units with 900 litre capacity to whole house systems treating 280,000 litres, to give pure tasting water. All products backed with certified test results.

CONDER GROUP PLC

Kingsworthy Court, Winchester, Hants SO23 7QA. UK. Tel: +44-962 882222. Telex: 47465. Fax: +44-962 885016. Clearwater specialise in package sewage and effluent treatment systems for the single dwelling to a complete township. Water treatment extends from simple filtration to plant producing ultra pure water for medical use.

ECOLOCHEM INC.,

PO Box 12775, Norfolk, Virginia 23502. USA. Tel: +1-804-855 9000. Telex: 240405 ECOL UR. Fax: +1-804-855 1478. Ecologhem provides emergency and supplemental mobile water treatment services including demineralisation, filtration, deoxygenisation and softening at flow rates up to 1000 gallons per minute per system; and mobile reverse osmosis trailers also available at flow rates up to 200 gallons per minute per system.

EL-CAR PATERSON CANDY IT SRL,

Via G Di Vittorio 307/5, Sesto, San Giovanni 20099. Italy. Tel: +39-2-2424841. Telex: 326166 ELCAR. Design, construction and installation of equipment and full plants for water treatment.

ENVIRO PURE MILIEU TECH,

PO Box 66008, Den Hag, GA 2506. The Netherlands. Tel: +31-70-55-3615. Telex: 33168. Fax: +31-70-55-3563. Supply water sterilisation equipment with ultra-violet units and manufacture complete potable water production sets from 500 litres per hour and upward. If required, a small generator is supplied for remote areas.

HESONWERK,

Pettenbacher Strasse 66, Vorchdorf A-4655. Austria. Tel: +43-7614/8301. Telex: 24466 HESON A. Apart from turning out various steel and plastic articles Hesonwerk specialise in the planning, production and installation of water treatment and waste water purification and recycling plants.

HYDROTECH ENTERPRISES INC.,

3036 North Lake Terrace, PO Box 142, Glenview, Illinois 60025-0142. USA. Tel: +1-708-998 6900. Fax: +1-708-998 8615. Hydrotech Enterprises Inc provides a complete and integrated line of package and portable treatment units & systems including portable deionisers, filters and reverse osmosis systems, drinking water purifiers, water softening & filtration equipment, packaged water deionisers and reverse

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The units are easy to operate and they produce potable water, packed in sterile polyethylene bags, at very low cost. The bags are manufactured in practical one liter portions (or smaller) thus making distribution both easy and hygienic. The water remains sterile until its consumption for a recommended maximum storage period of 5 years.

The unit is equipped with a diesel generator and is consequently totally autonomous. On its trailer, it is mobile and may be towed to virtually any manufacturing site.

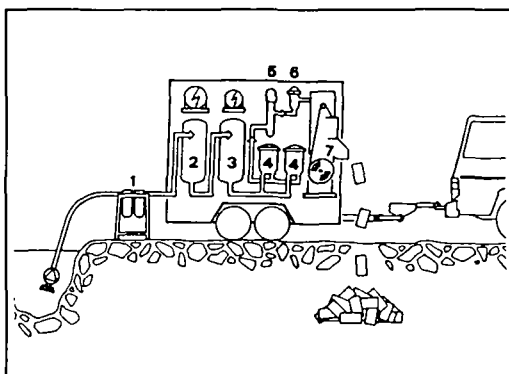
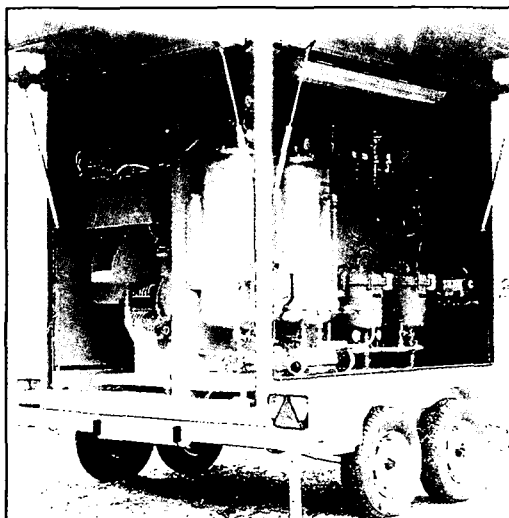
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3. *Absorption* (activated carbon);
4. *micro-filtration* over ceramic candles;
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6. *conservation* with silver ions (used only when water is packed for periods of long storage).

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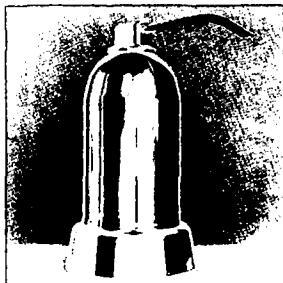
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osmosis equipment and complete and integrated packaged system. Treatment units are available in different configurations to meet all user requirements.

HYDROTECHNIK GMBH,

PO Box 14, Salzburg A-5033, Austria. Tel: +43-662-224 720/285310. Telex: 633-821. Using the results of research and development accumulated over 20 years, Hydrotechnik Austria have become a leading specialist in the fields of water treatment, sewage treatment and desalination technology. Depending on the required capacity, Hydrotechnik Austria provides either conventional plants or their Hydrocompact-plants, which are completely prefabricated and tested in Austria. Thereof results very short and simple erection work. The large number sold containerised Hydrocompact-plants, mainly to Arab and African countries, has proven their quality. Hundreds of these plants have been producing worldwide continuously drinking water for thousands of people.

**HYPERFIL INDUSTRIES INC,
1170 Van Horne Way, Anaheim, CA 92806. USA.**

Tel: +1-714-630 4381. Fax: +1-714-630 2366.
Contact Name: Yolanda Gilley. Hyperfil Industries has been manufacturing membranes for 10 years specialising in water purification of low pressure & standard municipal feed water supplies. Also manufactures home purification systems for under-the-sink applications, countertop and pressure assist units for low feed pressure. Membranes and systems available for chlorinated or non-chlorinated feeds.

JOHNSON FILTRATION SYSTEMS,

Johnson House, Browells Lane, Feltham, Middlesex TW13 7EQ. UK. Tel: +44-1-751 4424. Telex: 935479. Fax: +44-1-890 1533. Johnson Filtration Systems produce several ranges of package treatment plant for flows from 2.3m³/hr to 50 ML/DAY. THESE UTILISE JOHNSON MICROFLOC ADVANCED TECHNOLOGY TO PRODUCE WATER OF HIGH QUALITY AT HIGH RATES FROM SMALL UNITS. ALL TANKS ARE PREFABRICATED AND STAINLESS STEEL IS USED FOR THE SMALLEST UNITS.

JOHNSON MICROFLOC,

Johnson House, Browells Lane, Feltham, Middlesex TW13 7EQ. UK. Tel: +44-1-751 4424. Telex: 935479 USELON. Fax: +44-1-890 1533. Suppliers of advanced technology, High rate, water and wastewater treatment equipment including packaged portable water production systems

KENNICOTT (NEI THOMPSON LTD),

PO Box 100 Ertingshal, Wolverhampton, West Midlands WV4 6JY, UK. Tel: +44-902 353353. Telex: 337412. NEI TOM G. Fax: +44-902 405500. Over 80 years' experience of design and contracting water and industrial effluent treatment plant. Product range includes: clarification, filtration, dealkalisation, softening, deionisation, condensate polishing, oil/water separation, flotation, deaeration, degassing, reverse osmosis, ultrafiltration, liquid radioactive waste treatment, chemical dosing, potable/packaged water treatment plant and electrochlorination systems.

MEMCOR LTD,

Derby Rd, Wirksworth, Derby DE4 4EP. UK. Tel: +44-62-982 3811. Fax: +44-62-982 5169. Memcor designs, manufactures and installs industrial, commercial and domestic water treatment plant. Products include filters, softeners, dealkalisers, demineralisers. Membrane separation. Nationwide service organisation. Chemical cleaning/system sterilisation offered. Specialises in tailoring standard plant ranges for trace sales, and also offers full project capability.

OMNI FILTER CORP,

PO Box 2246, Hammond, IN 46323. USA. Tel: +1-219-989 9800. Contact Name: Jeff Rosenzweig. Manufacturers a full line of residential and light industrial water filtration products and water conditioning products to remove lead, chemicals, tastes, odours, rust and sediment and other contaminants from water, as well as replacement cartridges for major brands of filters.

POTAPAK LTD,

55 Long Acre, London WC2E 9LJ. UK. Tel: +44-71-836 1016. Telex: 297922. Manufacturers and distributors of packaged water treatment equipment for remote communities of 50 to 2500 people. Enhanced slow sand filtration requiring no chemicals or power for treatment process. Constructed entirely from durable, corrosion free materials.

**PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.**

Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

PURAC LTD,

MCD House, Birmingham Rd, Kidderminster, Worcs DY10 2SH. UK. Tel: +44-562 820010. Telex: 338472 PURAC.

PACKAGE & PORTABLE TREATMENT UNITS

Fax: +44-562 82008. Management contractors, process plant designers and constructors of potable water, process water and effluent treatment plant systems. Services range from supply of package treatment plants to construction of major turnkey plants. Specialists in dissolved air flotation.

PWT PROJECTS LTD,
632-652 London Rd, Isleworth, Middlesex TW7 4EZ.
UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.
Fax: +44-81-568 5479. Pre-engineered and packaged potable water treatment plants with outputs of 15m³/hr to over 1,000m³/hr. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

SCIENCO SYSTEMS INC,
3240 North Broadway, St Louis, MO 63147. USA. Tel: +1-314-621 2536. Telex: 442449. Fax: +1-314-621 1952. Manufacture point of use water treatment equipment, on-site chlorine generators, small and large applications, mobile and fixed package water treatment systems for making potable water from surface, well, brackish and salt water.

SODI SCIENTIFICA SPA,
Via A Polliziano No 20, Settignano Di Calenzano, Firenze 50040. Italy. Tel: +39-55-8873317. Fax: +39-55-8873140. Production and sale of water treatment equipment.

STELLA-META FILTERS LTD,
Laverstoke Mill, Whitchurch, Hants RG28 7NR. UK.
Tel: +44-256 892360. Telex: 859605. Fax: +44-256 892074. Stella Water Treatment Units. These equipments are, in essence, a miniature water works that may be moved at short notice from site to site and will accomplish the fine filtration and chlorination of potable water. As these units can process drinking water from practically any natural source they have proved invaluable in distressed areas, supplying pure water for isolated villages, construction gangs, farming enterprises, expeditions, oasis waters, exploration crews, surveying parties and drilling sites etc, etc. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

SUTCLIFFE POLCON LTD,
Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206

841503. Provides turnkey solutions for waste water purification including Hycor milli screens for sea outfalls and industrial applications, PCL belt dewatering presses and MEYN dissolved air equipment.

TLB CORPORATION,
150 Willard Avenue, Newington, CT 06111. USA. Tel: +1-203-233 5109. Fax: +1-203-233 1268. TLB Corporation is the only prefabricated sewage treatment plant manufacturer that uses 100 per cent noncorrosive materials. This means little maintenance, and longevity of perhaps over 100 years. Potable water treatment packages frequently include flocculation, sedimentation by plate settlers, dual media filtration and sanitising with either chlorination or ultraviolet.

WAB WASTE & WATER TREATMENT,
Leberstrabe 118a, A-1110 Vienna. Austria. Tel: +02227435600. Telex: 132291. Fax: +022274356032. Desalination and Water softening, Disinfection, Municipal water treatment, Package and Portable water treatment, Mechanical and Biological waste water treatment, Sludge treatment and dewatering, General equipment and process, Specialised equipment and processes.

WATER AIR TECHNOLOGY INTERNATIONAL INC,
1320 26th St, North West, Suite 8, Auburn, WA 98001. USA. Tel: +1-206-735 8020. Fax: +1-206-232 1880 Contact Name: Al Spokoyny. Designer and manufacturer of the WAT Water Filter. Stainless steel counter top filter uses GAC/KDF and attaches easily to any standard faucet to produce 20-22 gallons per hour of water-on-demand. No cartridge change is required - filter is backwashed weekly and refurbished every five years.

WATER CONDITIONING CANADA LTD,
580 Park St, Regina, Saskatchewan S4N 5A9. Canada. Tel: +1-306-545 6990. Telex: 071-2718. The manufacture and distribution of residential, commercial and industrial water treatment equipment. Water softening, iron and sediment filtration, reverse osmosis and distillation as well as purification products.

WATER TECH INC,
214 North East 83rd St, Vancouver, WA 98665. USA. Tel:

SWIMMING POOL WATER TREATMENT

+1-206-573 7176. Fax: +1-206-573 2662. Water Tech Inc. has hundreds of direct filtration and tube settler type packaged water systems - some in service for 25 years. Our new Pacer (TM) units are compact and economical with an upflow plastic media coagulation roughing filter, Trimedia polishing filter plus an optional coagulant controller. Systems range from 10-1400 gals/min in a single module.

WATER-LINE ITALIA SPA,
Via del Caravita No 5, 00186 Roma, Italia. Tel: +39-06-6798991. Telex: 616034 LATCO I. Fax: +39-06-6797665. Water-line Italia SpA. Head Office: Water-line SA, PO Box 23, 6805 Mezzovico. Switzerland. Manufacturing of mobile, autonomous plants for treatment, packaging and distribution of potable water into sterile bags. Supply and sale for Water Supply, Emergency Organisations, Red Cross, Military and Civil Protection. Stationary plants for production of bags of drinking water for market. Planning, manufacturing and sale of patented installations. Activity started 1973.

SWIMMING POOL WATER TREATMENT

APPLIED BIOCHEMISTS INC,
5300 West County Line Rd, Mequon, WI 53092. USA. Tel: +1-414-242 5870. Telex: 9102763618. Manufacture algocides for use in swimming pools.

AQUA ELECTRONICS LTD,
Dana Electronics Ltd, Dana Estate, Paddock Wood, Kent TN12 6UU. UK. Tel: +44-89-283 5555. Telex: 95197 KETLON C. Fax: +44-89-283 2389. Manufactures and supplies compact ozone generators for water purification, ie for swimming pool treatment.

AQUA PROCESS ENGINEERING LTD,
Aqua House, 27 Denison Rd, London SW19 2DJ. UK. Tel: +44-81-543 3647/8. Telex: 915089 AQUA G. Designers of swimming pool filtration systems.

AQUATEC MARKETING LTD,
Unit 3D, Kennetside, Newbury, Berks RG14 5PX. UK. Tel: +44-635 49143. Fax: +44-635 38681. Aquatech Marketing Ltd is an international distributor of swimming pool, spa, whirlpool, water treatment and water engineering

equipment. The company's comprehensive product range includes pressure vessels, pumps and irrigation equipment.

AZTEC ENVIRONMENTAL CONTROL LTD,
8 Hawksworth Rd Southmead Industrial Park, Didcot, Oxon OX11 7HR. UK. Tel: +0235 512000. Fax: +0235 512020. Aztec can supply a range of swimming pool equipment including pumps, filters, pool fittings, chemical test kits and cleaners etc.

ROBERT R BARTLETT & SONS,
Millbrook Rd, Stover Trading Estate, Yate, Bristol BS17 5PB. UK. Tel: +44-454 317612. Telex: 445599 RBBSL. Manufacturers and distributors of chemicals and test kits for the treatment of swimming pool water. Publishers of the pool care guide "enjoy your pool" 7th edition.

BAYROL CHEMISCHE FABRIK,
Lochamer Str 29, Martinsried 80333. West Germany. Tel: +49-89-85-7010. Telex: 524695. Fax: +49-89-85-701777. Swimming pool and whirlpool care for the public and private sectors and sauna care.

BIO-LAB INC,
PO Box 1489, Decatur, GA 30031. USA. Tel: +1-404-378 1753. Water treatment division speciality chemicals for water treatment, pool and spa and animal health.

CHEMPROHA CHEMICAL DISTRIBUTORS BV,
PO Box 35, 3330 AA, Zwijndrecht. The Netherlands. 21/5/90. Tel: +31-1804 23488. Fax: +31-1804 27322. Contact Name: Mr Van 't Pveer. As a distributor of chemicals, with locations in the Netherlands, Belgium, West Germany, Poland, Hong Kong, Guangzhou, Singapore and Puerto Rico, Chemproha buys, transports and sells chemicals around the globe. Within our product range we handle a line of water treatment chemicals for surface, waste and process waters as well as for swimming pools, such as flocculating agents, pH-control products and water conditioning chemicals.

W S CRASTER (PV) LTD,
Engineers & Founders, PO Box 336 Harare, Zimbabwe. Tel: +263-4-67676/7/8. Telex: 22547 CRASTR ZW. Fax: +263-4-66697. Manufacturers of Castromatic swimming pool filtration units. High pressure sand filters Caster Compact water treatment plants for drinking water, industrial

SWIMMING POOL WATER TREATMENT

effluent treatment, sewage treatment, valve industries, pumps, mining equipment.

DAVEY PRODUCTS PTY LTD,
118 Atkinson St, Oakleigh, Victoria 3166. Australia. Tel: +61-3-568 1655. Telex: AA139654. Fax: +61-3-568 4551. Manufacturers and marketers of swimming pool filters and pumps, and spa bath pumps.

D W DAVIES & CO INC,
3200 Phillips Avenue, Racine, WI 53403. USA. Tel: +1-414-637 6133. Swimming pool chemicals.

DE LANGE PLASTIC LININGS,
Neptunusweg 4, 8939 AA Leeuwarden. Holland.
Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

EES CORP,
12850 Bournewood Drive, Sugar Land, Texas 77478. USA. Tel: +1 713 240 6770. Telex: 795459. Fax: +1-713-240 6762. The 'Pre-Engineered' Sanilec® "Off-the-Shelf" systems are used around the world to disinfect large (greater than 100,000 gallons) commercial pools. The Sanilec® brine systems generate sodium hypochlorite from salt, water and electricity. The Sanilec® seawater systems need only seawater and electricity and can generate the sodium hypochlorite directly in the seawater pool. A Sanilec® system eliminates dangerous chlorine gas or other purchased disinfecting chemicals.

EMCO ENGINEERING INC,
25 North St, Canton, MA 02021. USA. Tel: +1-617-828 7340. Telex: 924326. Fax: +1-617-828 1714. Swimming pool equipment.

GENERAL FILTER CO,
600 Arrasmith Trail Ames, Iowa 50010-9761. USA. Tel: +1-515-232 4121. Fax: +1-515-232 2571. The GFC line of diatomite and sand filters for the medium and large pools covers the full range of requirements in swimming pool water conditioning. The Multicell horizontal filter presents many advantages for the larger pools. Backwashing with filtered water may be accomplished directly from the filter itself.

GILLIAM DIAFILTER ESPANOLA SPA,
Rodriguez Arias, 5-70, Bilbao, Vizcaya, 48008. Spain. Tel: +34 4 415 16 00. Supply and instal purification equipment for pools. Also provide water treatment quipment for industry.

GULDAGER SYSTEM,
Hejrevang 1-3, Allerød DK-3450. Denmark. Tel: +45-42-273100. Fax: +45-42-271504. Production, installation and service of electrolysis systems for the protection against corrosion and scaling in domestic water systems, process water systems and filters for swimming pools, anti-fouling and cathodic protection.

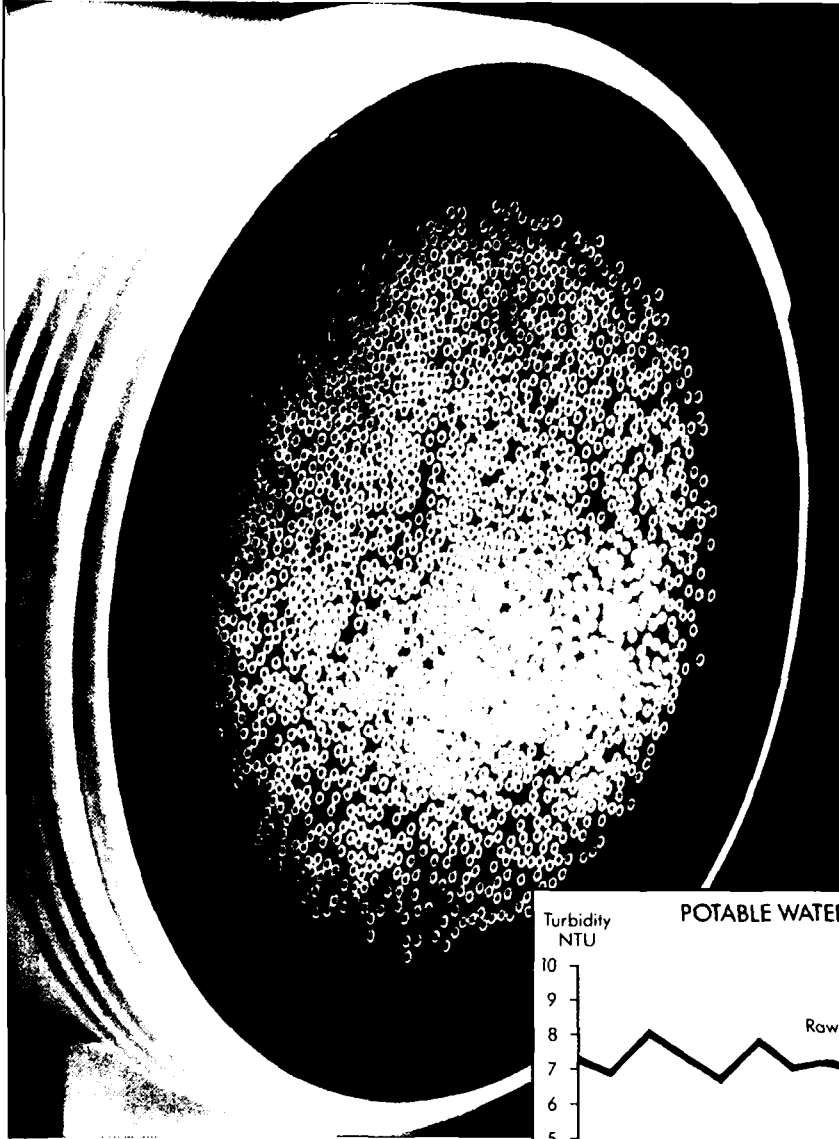
HYDROTECH CHEMICAL CORPORATION,
PO Box 6549, Marietta, GA 30065. USA. Tel: +1-404-952 2581. Fax: +1-404-953 2109. Hydrotech is a full line manufacturer of specialty chemicals and equipment for the swimming pool and spa/hot tub industry. Chemical products, which include both the Hydrotech and Guardex brand names, consist of chlorine and bromine disinfectants as well as water balancing and other specialty products. Equipment products consist of pumps, filters, heaters, lights and valves in the Purex name.

HYDROTECH ENTERPRISES INC,
3036 North Lake Terrace, PO Box 142, Glenview, Illinois 60025-0142. USA. Tel: +1-708-998 6900. Fax: +1-708-998 8615. Manufacturer and wholesaler of a complete line of water treatment equipment and supplies for industrial, medical, pharmaceutical, laboratory, commercial and residential applications.

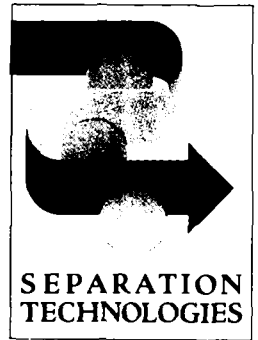
INTEC CORP,
1561 Rustic Hills Drive, Eagan, MN 55121. USA. Tel: +1-612-454 1544. Manufacturer of ionisation systems for non-chemical swimming pool sanitising, activated carbon filter media enhancers and non-chemical conditioners and water treatment systems for residential, commercial and industrial applications. Iron nitrite and VOC removal without ion exchange resins. Cooling tower and waste water treatment and H2S control.

INVARMEX UK LTD,
74a Cropwell Rd, Radcliffe On Trent, Notts NG12 2JG. UK. Tel: +44-602 332974/334455. Fax: +44-602 333388. Invarmex manufacture, distribute and export equipment for outdoor parks and swimming pool leisure complexes. Products include filters, pumps and circulation fit-

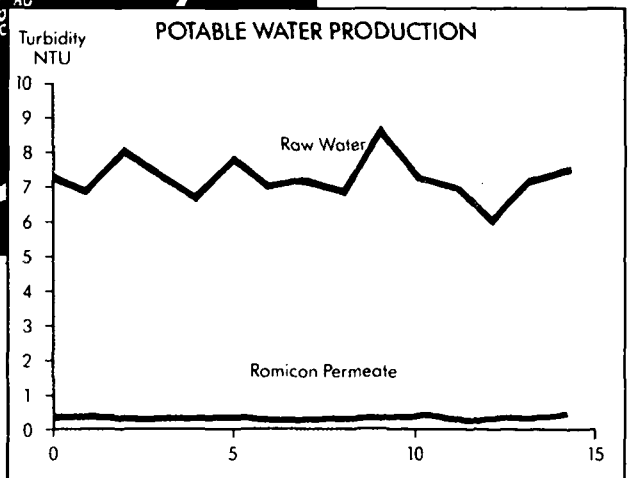
ROMICON HOLLOW FIBER FILTRATION



**WORLD LEADER
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**SEPARATION
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A DIVISION OF
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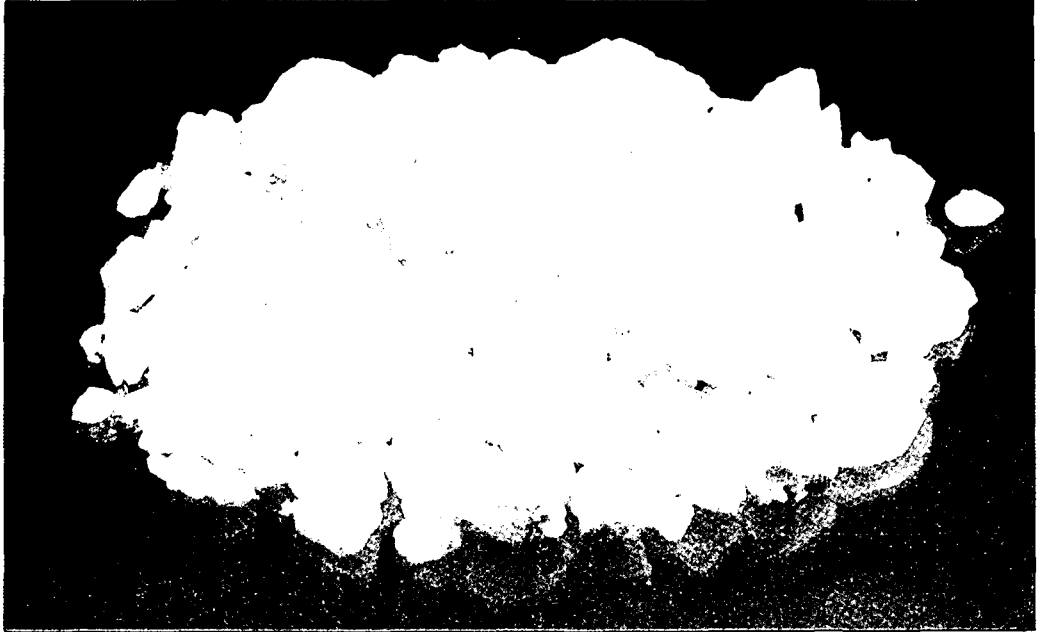


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granulated
 $\text{Al}_2/\text{SO}_{4/3} \cdot 13.5-14.5\text{H}_2\text{O}$

Chemical composition:

Al_2O_3 : 17-18%
Basicity: 0.0-0.5%
Fe: 0.005-0.007%
Insoluble residue: 0.04-0.07%
Grain fraction: 0-3mm, 3-8mm, 8-40mm
Packing: 5 ply paper bag & polyethylene bag

Fields of application:

- WATER PURIFICATION
- SEWAGE PURIFICATION



Manufactured by:
HUNGALU MOTIM WORKS

Hungary - 9201. Mosonmagyaróvár
P.O. Box: 75

Exported by:
HUNGALU TRADING CO. ALUKER

Hungary - 1388. Budapest P.O. Box. 63.

tings, flumes, slides pool covers and water fun equipment eg mushroom, jets etc. Also fountains and fittings.

THE MAGIK BOX COMPUTER LTD,

Swimming Pool House, Nugent Industrial Park, Cray Avenue, Orpington, Kent BR5 3RP. UK. Tel: +44-689 30354. The Magik Box reads both the pH and chlorine levels in the pool or spa water, then internally corrects any imbalance sending safe crystal clear water back to the pool. In addition it switches on and off pumps, lights and filters, gives a water temperature readout and has a 'party button' for shock dosing.

MELCHEMIE HOLLAND BV,

Jansbuictsingel 20, Arnhem. The Netherlands. Tel: +31-85451251. Telex: 4501945523. Fax: +31-85-425-093. Swimming pool chemicals.

NV AQUAVIA SA,

Vosselaestraat 73, Nevele B-9840. Belgium. Tel: +32-91-71-71-71. Telex: 11477. Fax: +91-71-71-80. Manufacture flotation, filtration (diatomite and sand) and aeration systems. Also install and design, if necessary, mechanical and chemical treatment systems, potable, swimming pool, industrial and municipal treatment.

OLIN CHEMICALS,

120 Long Ridge Rd, Stamford CT 06904. USA. Tel: +1-203-356 2000. Telex: 4750119. Fax: +1-203-356 3541. Manufacturer of swimming pool chemicals: HTH® Calcium Hypochlorite in granular and tablet forms, Isocyanates in granular, powder and tablet forms, Ancillary Products (Algicide, PH adjusters...)

OXI GENERATORS INC,

4990 Euclid Rd, Va Beach, VA 23462. USA. Tel: +1-804-497 3128. Fax: +1-804-624 2128. OXI mixed oxidant generators keep pools beautiful using only water, salt and electricity. At the same time, the hazards of both dry and liquid treatment systems are reduced. Pools look great and feel great with shimmering crystal clear water.

PREUSSAG ANLAGENBAU GMBH,

Karl-Wiechert-Allee 4, D-3000 Hannover 61. Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

SEKO SPA,

Via Don Luigi Sturzo 3, Cittaducale, RI 02015. Italy. Tel:

+39-746 62036. Fax: +39-746 62039. Manufacturing of solenoid metering pumps, peristaltic pumps and dosing systems for swimming pools etc.

STRANCO LTD,

Commercial Rd, Eastbourne, Sussex BN21 3XE. UK. Tel: +44-323 37011. Fax: +44-323 646035. Manufacturers of automatic pH/chlorine control and dosing systems for public swimming pools.

ERICH STROBL,

A-5021 Salzburg, Lastenstrasse 14, PO Box 49. Austria. Tel: +43-6222/72-1-31/75-3-59. Telex: 633387. Strobl specialise in water handling plants and systems. The line-up includes water treatment plants for swimming-pools. The firm undertakes the planning, production, installation and servicing of water-handling plants.

SUREX SP PRODUCTS LTD,

Units 10 & 11 Airport Trading Estate, Biggin Hill, Kent TN16 3BW. UK. Tel: +44-959 76000. Fax: +44-959 71000. Suppliers of water treatment chemicals, dosing systems and control filtration specialists to swimming pool, aquatic and all water treatment markets - national and international.

THERMELEK ENGINEERING SERVICES LTD,

Thermelek House, Peakdale Rd, Brookfield, Glossop Derby SK13 9LQ. UK. Tel: +44-4575 63451. Telex: 665759. Individual design through to on-site construction of filtration and water treatment for industrial processes, domestic water supplies, swimming pools etc. Specialists in ozone application and computerised control systems. Founders and manufacturers of the revolutionary BONDI Wave Generator.

WEBER SENSORTECHNIK GMBH,

2201 Kollmar. West Germany. Tel: +49-04128 591. Telex: 218326. Fax: +49-04128 593. Flow-captor flow switches and meters provide reliable and accurate control of water circulatory systems and operate with high repeatability. Additionally, the stainless steel sensing surface renders a high resistance to aggressive media. Combined with the flow-captor Eurocard system complete measurement systems can be installed to provide central adjustment and panning of measuring points for eg recirculatory systems for swimming pools and municipal baths. Vent-captor switches and meters for air and gaseous media pro-

TREATMENT FOR INDUSTRY & MEDICINE

vide reliable monitoring of air circulatory systems and heating/ventilation in municipal planning.

TREATMENT FOR INDUSTRY & MEDICINE

ALDOUS & STAMP LTD

86-90 Avenue Rd, Beckenham BR3 4SA. UK. Tel: +44-1-659 1833/4/5. Telex: 896691. Fax: +44-1-676 9676. Aldous and Stamp are specialist manufacturers and suppliers of chemicals and equipment for the treatment of water used in residential, commercial, industrial and heating/ventilating applications. Services include laboratory analysis, advice on treatment methods, design and supply of plant.

APPLIED WATER ENGINEERING (AWE) INC

2759 South 300 West 'G', Salt Lake City, UT 84115. USA. Tel: +1-801-486 7774. Applied Water Engineering Inc (AWE) manufactures reverse osmosis water purification systems with outputs from 22.5 litres per day and above. Applications include laboratory, medical, dialysis, spot rinse and drinking.

AQUA CHEM INC

PO Box 421, Milwaukee, WI 53201. USA. Tel: +1-414-962 0100. Aqua Chem is a major supplier of packaged water purification equipment for bottled water and pharmaceutical application and sea water desalination around the world.

AQUA FIRE ENERGY CORP

PO Box 356 223 Randolph Avenue, Clifton, NJ 07011. USA. Tel: +1-201-478 0880. Individualized and laboratory controlled boiler water and cooling water treatment services. Ferr-X hi-iron removal, nonchemical, aeration-filtration systems.

AQUALANG AG,

Albisriederstr. 5, PO Box, Zurich CH-8040. Switzerland. Tel: +01-491-14-23. Fax: +01-492-00-16. The Aqualang ion-exchanger produces chemically pure water, equal to bi-distilled water, straight from the tap, in abundance, always fresh, at very low costs, under strict control of a precision conductivity meter. No maintenance required apart from the periodical regeneration which is child's play and done in a jiffy. We guarantee full satisfaction for years and years to come.

AQUATIC TECHNOLOGY INC

PO Box 479, McLean, VA 22101. USA. Tel: +1-703-893 1211. Designs and services complete water treatment systems for industrial, commercial and residential applications. Pre-packaged cooling water treatment systems are sized from 50 ton to 100,000 ton units.

ARROWHEAD INDUSTRIAL WATER INC

300 Tri-State International, Suite 320, Lincs, Illinois 60015. USA. Tel: +1-312-940 1300. Fax: +1-312-940 1385. Suppliers of equipment, technologies and services to provide a higher purity water for industrial applications.

BAYROL CHEMISCHE FABRIK,

Lochhamer Str 29, Martinsried 8033. West Germany. Tel: +49-89-85 7010. Telex: 524695. Fax: +49-89-85 701777. Industrial water treatment. Swimming pool and whirlpool care for the public and private sectors.

CALCO LTD,

7011 Barry Avenue, Rosemont, IL 60018. USA. Tel: +1-312-296 6615. Manufactures and distributes products for producing ultra pure water.

CARELA,

R Späne GmbH, PO Box 11 28, 7888 Rheinfelden. West Germany. Tel: +49-7623 1084. Telex: 773444 SPAE D. Fax: +49-7623 63360. CARELA is one of the leading manufacturers of chemicals and equipment for water supply industry, well, water tank and water pipeline cleaning and disinfection. CARELA-BIO-PLUS-forte for rehabilitation of aged water wells, CARELA-BIO-PLUS for water tank cleaning / disinfection, CARELA-BIO-DES for pipeline disinfection and a range of 40 other CARELA products for industrial use. Apart from water related products, CARELA/R Späne GmbH manufactures several equipment and accessories as CARELA-WELL-MASTER for well rehabilitation of various diameters and up to 100 meters depths, through cleaning and disinfection of screen line and gravel pack by means of brushing, block surging, jetting and dosing processes.

CHEMPROHA CHEMICAL DISTRIBUTORS BV,

PO Box 35, 3330 AA, Zwijndrecht. The Netherlands. 21/5/90 Tel: +31-1804 23488. Fax: +31-1804 27322. Contact Name: Mr Van 't Pveer. As a

SWIMMING POOL WATER TREATMENT

distributor of chemicals, with locations in the Netherlands, Belgium, West Germany, Poland, Hong Kong, Guangzhou, Singapore and Puerto Rico. Chemproa buys, transports and sells chemicals around the globe. Within our product range we handle a line of water treatment chemicals for surface, waste and process waters as well as for swimming pools, such as flocculating agents, pH-control products and water conditioning chemicals.

CHRIST AG

Hauptstrasse 192, Aesch CH-4147, Switzerland. Tel: +41-61-78-46-46. Telex: 62458. Fax: +41-61-78-44-85.

Christ's processes are used for: the production of ultra pure water for electronic and pharmaceutical industries; the treatment and recycling of waste water from fertilizer plants; and for odour abatement of waste air.

CONTINENTAL PRODUCTS OF TEXAS

Box 3627, Odessa, TX 79760. USA. Tel: +1-800-592-4684. Fax: +1-915-337-4685. Speciality chemicals for industrial water, process and pipeline corrosion and fouling problems. Excellent cooling tower, boiler, closed system, amine, glycol and produced water corrosion inhibitors. Biocides for cooling tower and production. Pipeline corrosion inhibitors oil and water soluble, proven and effective.

CRYSTAL FLUID FILTER CO

865 Grand Boulevard, Westbury, NY 11590. USA. Tel: +1-516-333-6768. Sediment and odour removal filters, 3 gals to 167 gals per minute. Existing water pressure usually operates units, but pumps can be inserted. Constructed of plastic or SS filter media cartridges.

CUNO INC

400 Research Parkway, Meriden, CT 06450. USA. Tel: +1-203-237-5541. Telex: 221083. Fax: +1-203-238-8716. Cuno Process Filtration manufacturers general filtration and microfiltration products for the chemical, pharmaceutical, cosmetic, food and beverage, automotive and electronic industries. These products consist of membrane, depth, screen and sintered metal types and housings in materials ranging from economical plastics to extremely durable metals.

D W DAVIES & CO INC

3200 Phillips Avenue, Racine, WI 53403. USA. Tel: +1-414-637-6133. Provides a complete line of chemical water treatment for boilers and cooling towers. Also manufactures

a complete line of cleaning chemicals, including degreasers, soaps and swimming pool chemicals.

DAYTON INDUSTRIAL WATER

1288 McCook Avenue, Dayton, OH 45404. USA. Tel: +1-513-461-5900. Commercial, industrial and institutional water treatment.

ELGA LTD

High St, Lane End, High Wycombe, Bucks HP14 3JH. UK. Tel: +44-494 881393. Telex: 83516. Fax: +44-494 881007. Elga research, design and manufacture a wide range of water purification equipment and systems for the treatment of potable water, providing high purity water for all laboratory and industrial applications.

ELGA LTD

Lane End, Bucks HP14 3JH. UK. Tel: +44-494 881393. Telex: 83516. The Elga Group specialises in the design, manufacture and installation of water purification equipment ranging from high quality laboratory type deionisers to large industrial purpose-built systems. The main techniques employed are filtration, ion exchange, reverse osmosis and ultra-filtration.

ENCORE DESIGNS LTD

3929 Bell, Kansas City, MO 64111. USA. Tel: +1-816-531-8305. Custom applications specialists which develop prototype and custom systems incorporating reverse osmosis, pre-treatment, post-treatment and quality maintenance. Primary design applications include hemodialysis, pharmaceutical, laboratories, refining and distribution systems.

EQUIPOS Y PROCESOS SA,

C/Conde de Penalver, 45-30, Madrid, Madrid 28006. Spain. Tel: +34 1 401 30 01. Fax: +34 1 401 64 16. Treatment plants for raw water and industrial applications designed, constructed and installed on a turnkey basis.

ERMCO INC

1570 Fairview Avenue, St. Louis, MO 63132. USA. Tel: +1-314-423-7711. Fax: +1-314-421-5904. Manufacturers of commercial, industrial water conditioning equipment. Industrial water softeners, pressure filter, dealkalisers and special tanks.

FLUID SEPARATIONS CORP

14090 Horizon Boulevard, El Paso, TX 79927. USA. Tel: +1-915-852-1007. Manufacture commercial and industrial

SWIMMING POOL WATER TREATMENT

water treatment systems including reverse osmosis, ultrafiltration, separate bed DI, mixed bed DI and nitrogen blanket systems.

GILLIAM DIAFILTER ESPANOLA SPA,

Rodriguez Arias, 5-70, Bilbao, Vizcaya, 48008. Spain. Tel: +34 4 415 16 00. Supply and instal purification equipment for pools. Also provide water treatment quipment for industry.

W R GRACE & CO, DEARBORN DIV

300 Genesee St, Lake Zurich, IL 60047. USA. Tel: +1-312-438 8241. Telex: 2-2428. Fax: +1-312-540 1588.

Leader in development of solutions for industrial water treatment problems. For 100 years has provided products and services to meet industry's boiling water, cooling water and waste water treatment needs.

GRAVER WATER INTERNATIONAL

2720 US Highway 22, Union, NJ 07083. USA. Tel: +1-201-964 2554. Telex: 6853093. Fax: +1-201-964 7770. Graver designs and manufactures a complete line of water and waste treatment equipment to fit the needs of industrial corporation and electric generating utilities.

GUARDIAN CHEMICAL SPECIALITIES

PO Box 1743, 1225 West Princess St, York, PA 17405. USA. Tel: +1-717-848 2570. Develop and market products and consultation services for industrial influent to effluent water treatment requirments. This includes clarification, pre-treatment equipment, boiler water chemical treatment, cooling water chemical treatment, fuel additives and waste water programme.

HAGER & ELSASSER GMBH

PO B 800540, Stuttgart 80, 7000. West Germany. Tel: +49-711 7866-0. Fax: +49-711 7866-202. Water treatment plants for treatment of fresh water (sea and bralish-water, ultra-pure-water for electronical and pharmaceutical industry, boiler feed water) and waste-water (metal-working industry, textile industry, power plants and seepage water).

HALCO PRODUCTS

100 North Gordon Elk Grove, IL 60007-1193. USA. Tel: +1-312-956 1600. Fax: +1-312-956 4595. Manufacture

ultra pure water systems for use in semi/conductor and pharmaceutical industries. Engineering for process and design and also turn-key installations.

HUNGERFORD & TERRY INC

PO Box 45, Clayton, NJ 08312. USA. Tel: +1-609-881 3200. Telex: 510-686-6580. Fax: +1-609-881 6859. Manufacturer of water treatment equipment for commercial and industrial applications including pressure filters, softeners, ion remove filters and special application ion exchange.

HYDRANAUTICS

PO Box 3690, Santa Barbara, CA 93130. USA. Tel: +1-805-964 0765. Manufactures spiral wound cellulosic and non-cellulosic type membrane products and FRP pressure tubes. Designs complete systems for municipal and industrial water treatment applications.

HYDROTECH ENTERPRISES INC, 3036 North Lake Terrace, PO Box 142, Glenview, Illinois 60025-0142. USA. Tel: +1-708-998 6900.

Fax: +1-708-998 8615. Manufacturer of a complete line of water treatment equipment for industrial, pharmaceutical, medical and laboratory applications. Equipment includes complete & integrated systems and component parts. Products include packaged deionising cartridges, automatic dual bed deionisers, reverse osmosis water purifiers, water for injection systems, sterilisers, and ultrafiltration and microfiltration systems. Component parts include tanks, deionisation media, FilmTec reverse osmosis membranes and others.

HYDROTECHNIK GMBH

PO Box 14, Salzburg A-5033. Austria. Tel: +43-662-224-72-0/285310. Telex: 633-821.

The company's delivery programme includes design, fabrication, erection, installation and commissioning of: water treatment plants; reverse osmosis desalination; plants; sewage and waste water treatment plants for industry and municipalities; containerised package water treatment plants from 10m³/hr up to 250m³/hr, skid-mounted and containerised package desalination plants for brackish water and seawater, from 0.3m³/HR UP TO 60M³/HR; CONTAINERISED PACKAGE SEWAGE TREATMENT PLANTS; WASTE HEAT RECOVERY SYSTEMS; GAS CLEANING AND TREATMENT SYSTEMS; MEMBRANE SYSTEMS FOR GAS SPEARATION, WATER REFUSE AND RECOVERY OF VALUABLES.

HYPERFIL INDUSTRIES INC,
1170 Van Horne Way, Anaheim, CA 92806. USA. Tel:
+1-714-630 4381. Fax: +1-714-630 2366. Contact
Name: Yolanda Gilley. Drinking water specialists in
Reverse Osmosis Hyperfiltration membranes & tech-
nology. Hyperfil manufacturers Reverse Osmosis
Hyperfiltration Membranes and related components
for water purification in home and commercial appli-
cations. Manufacturer of completed RO units,
Point-of-Use systems, water vending machines, car
wash units and components. Membranes available
for small and large units, chlorinated and non-chlori-
nated feed water supplies.

I M B

Mathias-Brüggen Strasse 17, Cologne 30, Bikendorf D-
 5000. West Germany. Tel: +49-221 58-80-40. Fax:
 +49-221-58-80-488. Production of ultra-pure water for med-
 ical and pharmaceutical purposes, eg kidney dialysis and
 cell culture water supply. Water preparation to supply boiler
 feed water and treatment systems to operate cooling towers
 of open or closed design.

IMI BAILEY BIRKETT LTD,
Sharp St, Worsley, Manchester M28 5NA. UK. Tel:
+44-061-790 7741. Fax: +44-061-703 8451. IMI
Bailey Birkett's famous G4 pressure reducing valve is
one of the most versatile types available and ideally
suited to water treatment in industry and medicine
applications. The G4 is a self-actuating pilot operated
valve manufactured in bronze, cast iron and cast steel
and is available with alternative valve trims. For a
detailed technical specification leaflet on the G4 which
comes complete with a unique 'Selecta' device to facil-
itate accurate sizing and selection, contact the
marketing department.

KENDALL (SUBSIDIARY OF COLGATE-PALMOLIVE),

50 Kerry Place, Norwood, MA 02062. USA. Tel: +1-617-
 769 6112. Fax: +1-617-769 3274. The Kendall Co
 manufacture a line of poly-sulfane ultra-filtration membranes
 and membrane cartridges for the ultra-pure water industry,
 also a line of products for the bio-separation industry.

KENNICOTT (NEI THOMPSON LTD),

PO Box 100 Ettingshall, Wolverhampton, West Midlands
 WV4 6JY.UK. Tel: +44-902 353353. Telex: 337412. Fax:

+44-902 405500. Founded in 1902, Kennicott is a major
 UK based contractor of water treatment plant and gas gener-
 ation systems. The company specialises in plant for the
 production of high purity water for boiler feed, process and
 potable applications and systems for the on-site generation
 of sodium hypochlorite and hydrogen.

LAYNE-WESTERN CO INC

721 West Illinois Avenue, Aurora, IL 60506. USA. Tel: +1-
 312-897 6941. With 28 offices located throughout the US,
 Layne-Western Co is recognised as the leader in the field of
 water technology. Fully capable of providing practically
 every vital service needed by water users, municipal, indus-
 trial and agricultural. Services: complete hydrological
 engineering investigation, industrial and irrigation supply sys-
 tems, drill and maintain water wells, install and service deep
 well pumping equipment, sell and install water and waste
 water treatment equipment.

MARTINSTILL CORP,

2100 Judson Ave, Lincoln, NE 68521. USA. Tel: +1-402-
 474 7688. Fax: +1-402-474 7891. Contact Name: Gary
 Young. Marinstill is an engineering in the manufacture of
 commercial and industrial multiple-effect, and vapour com-
 pression distillation equipment for all high purity water
 markets including pharmaceutical process, medical, univer-
 sity/laboratory and bottled water. Marinstill additionally
 specialise in custom engineering distillation units for specific
 applications.

MECHANICAL EQUIPMENT CO INC

861 Carondelet St, New Orleans, Louisiana 70130. USA.
 Tel: +1-504-523 7271. Telex: 460165. MECO is a leader
 in the engineering and manufacture of packaged water
 desalination equipment for land-based, marine, pharmaceuti-
 cal, defense and offshore applications plus a variety of
 ancillary equipment such as heat exchangers, filters, pure
 steam generators, sample collectors etc.

MEDRO SYSTEMS INC

416 East Industrial Boulevard, McKinney, TX 75069-7323.
 USA. Tel: +1-214-542 8200. Manufactures RO systems
 and water purification equipment for medical, commercial
 and industrial markets.

MICROFLOC PRODUCTS, JOHN- SON FILTRATION SYSTEMS INC

PO Box 64118, 1950 Old Highway 8, New Brighton,

SWIMMING POOL WATER TREATMENT

MN 55112. USA. Tel: +1-612-636 3900. Water treatment equipment and systems for municipal and industrial applications.

MITCO AB INDUSTRIAL WATER TREATMENT,

Kaerlyckegatan 6, Gothenburg S-41791, Sweden. Tel: +46-31 640410. Fax: +46-31 531349. Industrial water treatment for boilers, cooling towers, process industries, industrial waste water treatment, refineries, steelmills, and paper mills.

MITCO WATER TREATMENT LTD,

Unit 4, Hancock's Industrial Estate, London Rd, Loudwater, High Wycombe, Bucks HP10 9RE. UK. Tel: +44-494 671600. Fax: +44-494 677398. Provide technical field service for industrial water systems analysis. Supply chemical additives for control of scale, corrosion and bacteria contamination. Supply pre-treatment equipment. Supply maintenance for de-alkalisation and demineralisation plant.

WALTER NOLD CO INC

24 Birch Rd, Natick, MA 017601696. USA. Tel: +1-617-653 1635. Walter Nold has researched and discovered a new process for the degasification of fluids - which can degas water, for instance, to boiler water purity.

OAKITE PRODUCTS INC

50 Valley Rd, Berkeley Heights, NJ 07992. USA. Tel: +1-201-464 6900. Development of materials and equipment for industrial water treatment and environmental sanitation.

OSMONICS INC,

5951 Clearwater Drive, Minnetonka, Minnesota 55343. USA. Tel: +1-612-933 2277. Telex: 029-0847. Fax: +1-612-933 0141. Osmonics manufactures reverse osmosis (RO) and ultrafiltration (UF) from small scale laboratory to full scale production high purity water machines/systems. OSMO® RO and UF systems are wall or skid mounted, completely pretested and ready to install. Osmonics manufactures all of the key components for RO/UF machines including pumps, prefilters and membrane elements for unique single source responsibility.

THE PERMUTIT CO LTD,

Permutit House, 632-652 London Rd, Isleworth, Middlesex TW7 4EZ. UK. Tel: +44-81-560 6431. Telex: 924640 PERM G. Fax: +44-81-568 9772. Permutit can

supply products to meet every water quality and quantity requirement, with standard products, custom designed packages or pre-engineered plant.

The Scion® range of units (with flow rates from 3 to 63m³/hr) are ideally suited for manufacturing industries such as pharmaceuticals and electronics, where superdeionised water is required for process application. The Permutit Co Ltd manufacture and supply a complete range of water purification equipment for industrial, commercial and laboratory applications. All products are manufactured in accordance with quality systems which have been approved by the British Standards Institute as complying with BS5750 Pt 2; ISO9002. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

PREUSSAG ANLAGENBAU GMBH,

Karl-Wiechert-Allee 4, D-3000 Hannover 61. Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

PURITE LTD

Unit E, Bardet Way, Thame Industrial Estate, Thame, Oxon OX9 3SJ. UK. Tel: +44-844 217141. Telex: 837561. Manufacturers of reverse osmosis units, cleaning chemicals, deionisation equipment, various filtration units and test kits.

PWT (HOLLAND) BV

Industrieweg 13, Assendelft 1566. The Netherlands. Tel: +31-75-285651. Telex: 19159. Fax: +31-75-28619. Pielkenrood Water Treatment is specialised in water purification. PWT has a complete range of systems and installations for the treatment of industrial effluent and process and surface water. Our systems are tailor-made and suited to upgrade existing systems.

PWT PROJECTS LTD,

632-652 London Rd, Isleworth, Middlesex TW7 4EZ. UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G. Fax: +44-81-568 5479. All aspects of industrial water treatment from consultation and design to plant commissioning and maintenance, on either an equipment supply or a turnkey basis. Process stages employed can include pre-treatment, desalination, demineralisation, remineralisation and polishing to produce water of any standard up to ultrapure quality. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

RYAN HERCO PRODUCTS CORP

2509 Naomi St, Burbank CA 91504. USA. Tel: +1-213-849 1141. Manufacture fluid handling products for industrial water treatment.

SALTECH CORPORATION

PO Box 26872, El Paso, TX 79926. USA. Tel: +1-915-592 7982. Manufacture industrial water purification equipment.

SEE

Rue de la Science, Brussels B 1040. Belgium. Tel: +32-2-230 9314. Telex: 25-237. Fax: +32-2-230 7613. Water treatment plants: drinking water, waste water, water for industry, swimming pool water. Chemical products for water conditioning. Pre-fabricated units for the production of drinking and waste water treatment.

SELECTO INC,

1000 Cobb Place Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000® media and leadOUT® filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale applications, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE® 'add-on' solid-state ultraviolet water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

SIMMERING - GRAZ - PAUKER AG (SGP)

Brehmstrasse 16, Wien A1110. Austria. Tel: +43-222-74-690. Telex: 131891 SGP S. Simmering-Graz-Pauker supply customised water treatment and flue gas cleaning plants. Applications include steam and industrial power plants and refuse and special refuse incinerators.

SOCIETE D'EPURATION ET D'ENTREPRISES SA

Rue de la Science 5, Brussels 1040. Belgium. Tel: +32 2 230 93 14. Fax: +32 2 230 76 13. SEE's equipment

treats water for many industries including brewing, food, and pharmaceuticals. It also treats water for metallurgical industries and thermic power stations.

ERICH STROBL

A-5021 Salzburg, Lastenstrasse 14, PO Box 49. Austria. Tel: +43-6222/72-1-31/75-3-59. Telex: 633387. Strobl specialise in water handling plants and systems. The line-up includes water treatment plants for swimming-pools, drinking water supply systems and water supply plants for industry. The firm undertakes the planning, production, installation and servicing of water-handling plants.

TECATOR AB,

PO Box 70, S-263 21 Höganäs. Sweden. Tel: +46-42-361500. Fax: +46-42-340349. Tecator is the world's leading company for automated routine analysis in water. Tecator is a world-wide supplier of analytical instruments for water and environmental analysis. Standard manual methods cannot meet today's requirements for speed, accuracy and safety. Therefore there is an increasing demand for automated and flexible water analysers, which are easy to start up, simple to use and provide fast and accurate results. Tecator offers a broad range of automated, flexible and accurate analysers fulfilling various needs and requirements in the water laboratory. Tecator provides complete application information and specialist support with each instrument. Ask for more information today.

TECHNIC CENTRAL SYSTEMS INC

118 No 36th St, Seattle, WA 98103. USA. Tel: +1-206-633 3080. Manufacture ultrapure water systems for laboratory, industrial and medical applications.

VERBUND-PLAN GMBH,

Am Hof 6A - A-1010 Vienna, Austria. Tel: +43-1-0222-53113 4800. Telex: 115978 VPLWN A. Fax: +43-1-0222-53113 4848. Verbund-Plan can offer consultancy services for water treatment for industry and for drinking water treatment.

WALLACE & TIERMAN DIV PEN- NWALKT CORP

25 Main St, Belleville, NJ 07109. USA. Tel: +1-201-759 8000. Manufacturer of chlorination and other chemical-feed equipment and systems for treatment of municipal and industrial water and wastewater; includes indicating and

GENERAL EQUIPMENT & PROCESSES

transmitting flowmeters, chemical metering pumps, dry chemical feeders and cathodic protection systems for water storage tanks and treatment structures.

WATER CONDITIONING CANADA LTD

580 Park St, Regina, Saskatchewan S4N 5A9, Canada. Tel: +1-306-545 6990. Telex: 071-2718. The manufacture and distribution of residential, commercial and industrial water treatment equipment. Water softening, iron and sediment filtration, reverse osmosis and distillation as well as purification products.

WATER SERVICES CORP/WATER-SOFT CO

111E North St, Waukesha, WI 5318, USA. Tel: +1-414-547 1862. Fax: +1-414-547 5728. Manufacturers of reverse osmosis, iron exchange, filtration and ultra filtration equipment for commercial and industrial use.

WATER TECH INC

214 North East 83rd St, Vancouver, WA 98665, USA. Tel: +1-206-573 7176. Manufacture potable and industrial water treatment packaged plants; also industrial wastewater treatment packaged plants.

WESTERN ENVIRONMENTAL MGT,

PO Box 1807, Carlsbad, NM 88220, USA. Tel: +1-505-885 5709. An industrial water treatment company that custom blends chemical products designed to ensure maximum scale and corrosion inhibition is maintained within boiler and cooling water systems. The programmes established have proven to reduce scale accumulations on heat exchange surfaces while passivating metals against corrosion.

XENTEX INC

14902 Wes: 117th St, Olathe, KS 66062, USA. Tel: +1-913-764 3800. Fax: +1-913-764 1743. Supplier to capital construction projects; water stills for hospitals and laboratories, water demineralizers and water softeners. Equipment for wastewater projects such as liquid solid separators, filtration equip, water recycle equip, pond and pit plastic liners etc.

ZYZA WATER SYSTEMS

1921 21st Avenue South, Seattle, WA 98144, USA. Tel: +1-206-328 4915. Manufacturer of high quality

water purification devices designed for medical applications.

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ACTION MFG & SUPPLY CO,

1226 South East 9th Terrace, Cape Coral, FL 33904, USA. Tel: +1-813-574 3443. Manufacture aerators and water conditioning equipment and all types of filters. Distributor of pumps and pressure tanks.

ALAMO WATER REFINERS INC,

1415 Jerry St, San Antonio, TX 78201, USA. Tel: +1-512-734 7771. Manufactures and wholesales water softeners, iron removal filters, aerators/degasifiers, sediment filters, taste and odour filters, chlorinators, iodine feed systems, pH neutralising systems, etc.

ALBION CONCRETE PRODUCTS,

Sales Office, Liangadog, Dyfed SA19 9LT, UK. Tel: +44-550 777327. Fax: +44-550 777328. Albion Concrete modular kits to provide wells, catchpits, storage tanks, water troughs, cesspits, septic tanks, full sewage treatment plants, all complete with sewage pumps, high pressure water pumps electrical systems etc also concrete pipes, box culverts and bridges.

ALLIANCE GROUP INC,

PO Box 17849 600 East Keefe, Milwaukee, WI 53217, USA. Tel: +1-414-332 8440. Complete water treatment programmes for heating and cooling equipment.

AMETEK/PLYMOUTH PRODUCTS DIVISION,

502 Indiana Avenue, Sheboygan, WI 53082-1047, USA. Tel: +1-414-457 9435. Manufactures a very broad line of cartridge filtration equipment for domestic, commercial and industrial use. Filter housings are available in various plastic materials as well as stainless steel, and vary in size from a small ice maker filter to large multiple cartridge units.

AQUA SYSTEMS/EXPORT MANAGEMENT INTERNATIONAL INC,

220 East Madison St, Ste 1010, Tampa, FL 33602, USA. Tel: +1-813-229 7744. Exports all water-related equipment to Latin America and Caribbean.

AQUA-AEROBIC SYSTEMS INC,
 PO Box 2026 6306 North Alpine Rd, Rockford, Illinois
 61130-0026. USA. Tel: +1-815-654 2501. Fax: +1-815-
 654 2508. Aqua-Aerobic Systems Inc is a
 designer/manufacturer of equipment used in the biological
 treatment of water and wastewater. Equipment includes:
*direct drive aerators, direct drive mixers, automatic back-
 wash filters and sequencing batch reactor (SBR) system.*

AQUASOLAR,
 Gutenbergstraße 1, 3014 Laatzen 1, PO Box 110112,
 West Germany. Tel: +49-51-18236914. Fax: +49-51-
 18236550. Solar desalination plants to produce portable
 water or/and water for irrigation. The plants can be con-
 structed for a water production rate from 20 litre/day up to
 1700 litre/day. In the water range of 20 up to 100
 litre/day we suggest to use the small plant type 'SIM'. And
 over 1000 litre/day we suggest to use the plant type 'SME'.
 In addition the desalination plants can be integrated in a
 Greenhouse. Complete constructed from AQUASOLAR too.
 This enables to produce high quality food beside water pro-
 duction. Solar Heater 'SOLADUR' with a hot water tank to
 produce hot water by solar energy. No electric power for
 pumps are required!

AQUATEC MARKETING LTD,
 Unit 1D, Kennelside, Newbury, Berks RG14 5PX. UK.
 Tel: +44-635 49141. Fax: +44-635 38681.
 Aquatech Marketing Ltd is an international distributor of
 swimming pool, spa, whirlpool, water treatment and water
 engineering equipment. The company's comprehensive prod-
 uct range includes pressure vessels, pumps and irrigation
 equipment.

ARC,
 Derby Unit Sales Office, Hemington Fields, Shardlow, Derby
 DE7 2HP. UK. Tel: +44-332 792266. Telex: 34365. Fax:
 +44-509 504120. Naturally rounded quartzite, bagged or
 loose, for filter support media.

ARLAT TECHNOLOGY INC,
 150 East Drive, Bromaleo, Ontario L6T 1C1. Canada. Tel:
 +416-458 8220. Fax: +416-458 8224. Arlat Technology
 Inc is a Canadian based manufacturer and representative of
 engineered process equipment for the water and wastewater
 treatment market. Arlat Technology Inc offers complete engi-
 neering and design capabilities along with products such as
 ultraviolet disinfection systems, ozonation equipment, plate
 settlers, clarifier mechanisms and static mixers.

ASTRO-PURE WATER PURIFIERS,
 4900 NW 15th St, Margate, FL 33063. USA. Tel: +1-
 305-971 9680.

AWC INC,
 330 East Highway 14, Tyler, MN 56178. USA. Tel: +1-
 507-247 5436. Manufactures complete line of residential
 and commercial water conditioning equipment. Distributors
 for Aquathin purification equipment.

BADEN ITALIANA SPA,
 Via Benaco 117, Bedizzole 25081. Italy. Tel: +39-30-
 674593. Telex: 300853. Manufacturers of primary
 water treatment plants including treatments for aqueducts-
 municipal or rural. Mobile plants using chlorine or ozone,
 in containers to produce drinking water for smaller
 communities.

BAUMEISTER KASTNER,
 A-8911 Admont, Weng 127. Austria. Tel: +43-
 3613/2772. The Admont-based engineering office
 Kastner (other offices in Graz and Kapfenberg) was
 founded in 1970 and is engaged in the planning,
 invitation to tender, building supervision and operation of
 municipal water supply plants, sewage disposal systems,
 clarification plants and refuse disposal facilities. The com-
 pany undertakes the execution of complete projects from the
 planning stage onwards and paying special attention to
 operating costs.

BENCKISER-KNAPSACK G MBH,
 Dr Albert Reimann Str 2, D-6802 Ladenburg,
 Bundesrepublik. Deutschland. Tel: +49-6203/774289.
 Fax: 49-620312818. Product systems for water treatment -
 for drinking water, cooling water, boiler water, autoclave
 water, waste water and sea water.

**BERGSOE ANTI CORROSION
 (BAC) AB,**
 Box 214, landskrona S-261 23. Sweden. Tel: +46-418
 16165. Fax: +46-418 27722. BAC supply and install
 pipelines and storage tanks - structures in soil and water,
 also cables, piles and sheet piling, as well as water towers
 and water treatment plants.

BETZ ENTEC INC,
 508 Prudential Rd, Horsham, PA 19044. USA. Tel: +1-215-
 674 9200. Specialises in water treatment products and
 services for boiler, cooling and air conditioning systems.

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BOLIDEN WATER TREATMENT,
PO Box 902, Helsingborg S25109. Sweden. Tel: +46-42-171000. Telex: 72185 BOLIDVS. Fax: +46 42-130570.
Boliden Water Treatment Divisions business is to develop, manufacture and market precipitants for treating drinking water and sewage water as well as systems for storage and dosing of these products. Boliden Water Treatment takes responsibility for the entire treatment process with process engineering knowhow, precipitants, transport systems, equipment for storage, dosing and mixing of the products – all to achieve an optimum combination of cost and best results. Precipitation products for water and waste water treatment include: aluminium sulphate, ferric aluminium sulphate, ferric chloride/sulphate, polymerised chloride or sulphate based liquid and solid precipitants. The company also provides research and development, technical knowhow on new treatment processes for chemical waste water treatment, pre-precipitation, removal of phosphorus and nitrogen. Water and waste water equipment includes: centrifuges, dosing pumps, scrapes, silos and dosing equipment.

BRASWELL WATER QUALITY SYSTEMS INC.,
839 South Kingshighway, Cape Girardeau, MO 63701. USA. Tel: +1-314-334 8873. Manufacturer of water conditioning equipment. Braswell system features meter-initiated counter-current regeneration, one-piece solid slate panel, control valve with one internal moving part and 100 per cent pure brine regeneration.

BRITE-TECH CORPORATION SDN BHD,
12, Jalan 27a, Kawasan 16, SG Rasa Industrial Area, Klang, Selangor Darul Ehsan 41300. Malaysia. Tel: +60-3-34289883-3424034/5. Fax: +60-3-3424033. Brite-Tech has been established as a company which specialises in total water management. The company provides a complete range of services and products in the field of water treatment, pollution control, process additives and fuel treatment. Its motto is 'make water treatment part of productivity'.

BWK GMBH,
Ingenieurgesellschaft für Wasserwirtschaft
Körnerstraße 3 – PO Box 1144 – D-6140 Bensheim,
West Germany. Tel: +0049-6251 6007. Fax: +0049-
6251 4752. Contact Name: Mr Manfred Wagner.
Design, process engineering, construction, mechanical/electrical engineering of potable water treatment works. Design, engineering and delivery of the BWK-

Automatic-Valveless-Gravity-Filter system with capacity from 6 – 2400m³/h per unit.

CARTER INDUSTRIAL PRODUCTS LTD,
Bedford Rd, Birmingham, West Midlands B11 1AY. UK. Tel: +44-21-772 4300. Telex: 339219. Fax: +44-21-772 3672. Manufacturers of industrial water cooling towers, water purification and effluent treatment plants.

CHEMOLIMPEX HUNGARIAN TRADING CO FOR CHEMICALS,
H-1805 Budapest, PO Box 121. Hungary. Tel: +36-1-1640240. Telex: 226333. Fax: +36-1-1640078.
Chemolimpex handles the export of the ion-exchange resins which are manufactured by Nitrokemia and marketed under the brand-name VARION. Ion-exchange resins are widely used for water treatment in all fields of industry. We have developed specific ion-exchange resin types for the following main applications: conventional industrial water treatment, decontamination of radio-active waste, household-water treatment, micro-ion-exchange resin (more effective than powder resin).

CLARITY FILTERS,
2500-165th St, Hammond, IN 46320. USA. Tel: +1-800-848 7418. Contact Name: David Griffin.
Manufacturers water filter systems, housings, cartridges and components. We also stock a complete line of accessories including faucets, diverters fittings, tubing, replacement parts, and filtration media.
Clarity Filters exclusively features the ABA-2000 Lead/Heavy Metal filter cartridges.

COMMERCIAL FILTERS,
1515 West South St, Lebanon, IN 46052. USA. Tel: +1-317-482 3900. Fax: +1-317-482 8410. Commercial Filters Division of Parker Hannifin Corporation, produces industrial filtration products for both industrial and consumer use. We are one of the major producers of water filtration equipment.

CRYSTAL FLUID FILTER CO,
865 Grand Boulevard, Westbury, NY 11590. USA Tel: +1-516-333 6768. Sediment and odour removal filters, 3 gals to 167 gals per minute. Existing water pressure usually operates units, but pumps can be inserted. Constructed of plastic or SS filter media cartridges.

CUNO INC,

400 Research Parkway, Meriden, CT 06450 USA. Tel: +1-203-237 5541. Telex: 221083. Fax: +1-203-238 8716.

Cuno Process Filtration manufactures general filtration and microfiltration products for the chemical, pharmaceutical, cosmetic, food and beverage, automotive and electronic industries. These products consist of membrane, depth, screen and sintered metal types and housings in materials ranging from economical plastics to extremely durable metals.

DARCHET ENGRG & WATER TREATMENT PTE LTD,

Box 1001 Kim Chuan Light Industries Park, #01-2530 Hougang Avenue 1, 1953, Singapore. Tel: +65-3-2883566. Fax: +65-2841984. We specialise in water and waste water treatment and offer a total system approach: ultrapure water system; industrial waste/recycling system; package sewage treatment plant; package chemical injection plant; reverse osmosis desalination; package potable water system; ultrafiltration system; media filter; softener; Iron/Mn filter and oil/water separator.

DAYTON INDUSTRIAL WATER,

1288 McCook Avenue, Dayton, OH 45404. USA. Tel: +1-513-461 5900. Commercial, industrial and institutional water treatment.

DDS FILTRATION,

PO Box 149, Nakskov DK-4900, Denmark. Tel: +45-53-92-27-99. Telex: 47558 DDSFIL DK. Fax: +45-53-92-31-11. DDS Filtration develops, manufactures and markets membranes and turnkey reverse osmosis plants. Both plate and frame as well as spiral wound systems are sold for a wide range of applications within the water treatment industry. Especially, DDS Filtration has a great experience in the Middle East area and North Africa.

DEGREMONT LAING LTD,

Page St, London NW7 2ER, UK. Tel: +44-81-959 3636. Telex: 8958741. Fax: +44-81-906-5164. Complete range of municipal/industrial water and waste treatment plant. Processes include: Pulsator clarifiers, Aquazur filters, dissolved air flotation, ozone generation - sludge dewatering, desalination plants, turnkey contracts, pressure filters, biological treatment.

DELTA ENGINEERING BV,

PO Box 227, Vlaardingse 3130 AE, The Netherlands. Tel:

+31-10-46-00-000. Telex: 24536. Fax: +31-10-46-00-898. Designers and contractors for complete water treatment installations.

DELTA PURE FILTRATION CORP,

305 South Richardson Rd, Ashland, VA 23005 USA. Tel: +1-804-798 2888. Manufacturer of a complete line of a high quality wound cartridge filters for sediment removal. Currently being used nationwide in a variety of commercial and industrial water applications.

DRAGERWERK AKTIENESELLSCHAFT,

Moislinger Allee 53-55, D-2400 Lubeck 1, Germany. Tel: +49-451 8820 Telex: 268070. Fax: +49-451-882 2080. Gas Analysis Division. In order to reduce the number of potentially hazardous situations at the workplace and minimise any damage resulting from these hazards, many different gases, vapours, and aerosols must be monitored. For that purpose Drager offers easy-to-handle and economical measuring systems. With more than 200 different Drager-Tubes, over 350 separate hazards can be determined in air, soil and water samples.

DU-MOR SOFT WATER CO,

23737 US 33, Elkhart, IN 46517. USA. Tel: +1-219-875 8596. Water conditioning equipment assembly, wholesale and retail.

DURABLE MANUFACTURING CO,

232 South Evergreen St, Bensenville, IL 60106. USA. Tel: +1-312-766 0398. Manufacture depth wound polypropylene water filter cartridges in all sizes and packaged with your label or ours.

THE DYMAX GROUP INC,

PO Box 57, Pleasanton, CA 94566. USA. Tel: +1-415-463 1888. Manufacturers agents/distributors-liquid handling equipment, including filters, conditioners and minerals.

DYNAMIC INDUSTRIES & DEVELOPMENT INC,

2921 North 84th St, Omaha, NE 68134. USA. Tel: +402-571-6820. Designs and manufactures broad line of filtration, purification and conditioning equipment for domestic, commercial and industrial use. Some of the latest, most advanced equipment and technology for specialised water treatment.

GENERAL EQUIPMENT & PROCESSES

EBARA CORPORATION,

11-1 Haneda Asahicho, Ohta-Ku, Tokyo 144. Japan. Tel: +81-3-743 6716 London: +44-81-892-8971. Telex: EBARATYO J 22988. Fax: +81-3-745 3576 London: +44-81-891-6730. London Office: Regal House, London Rd, Twickenham, Middlesex TW1 3QS. Pollution control and environmental protection; cleansing potable water, sewage and effluent.

EDEN EQUIPMENT CO,

17649 Jacquelyn Lane, Huntington Beach, CA 92647. USA. Tel: +1-714-842 8181. Filter supplies and equipment.

ELC WATER TREATMENT CO,

7603-A Blueberry Lane, Powell, IN 37849. USA. Tel: +1-615-947 3601. Manufactures RKK multi filters developed for water needs such as removal of chemicals, organics, chlorine, pesticides, detergents and undissolved particles (sediment discoloration.) Bacteria growth inhibitor, dependable service and reasonably priced.

ENTING WATER CONDITIONING INC,

Box 5463211 Dryden Rd, Dayton, OH 45449. USA. Manufacture, assembly and distribution of POE, POU water conditioning products for residential, commercial and industrial use.

ENVIROGARD PRODUCTS LTD,

PO Box 64, 301 Major Mackenzie Drive, Richmond Hill, Ont L4C 4X9. Canada. Tel: +1-416-884 9388. Telex: 06986766. Fax: +1-416-884 8296. Manufacturer of in line water filter and sterilisers for domestic or commercial application. Units employ disposable or cleanable/reusable cartridge. Branded or private label available.

ENVIRONMENTAL ELEMENTS CORP,

Box 1318, Baltimore, MD 21203. USA. Tel: +1-301-368-7272. Low headless rapid gravity sand filters for removal of suspended solids and turbidity from water and waste water.

FASTEK - A KODAK CO,

7120 Henry Clay Boulevard, Liverpool NY 13088. USA. Tel: +1-315-451 0592. Committed to research in both filtration and separation technology. Product line includes reverse osmosis membrane elements, disposable cartridge filters for liquids and gases, in-line ceramic filters for specialty gases and microparticle spheres for filters testing.

FILTERCOLD CORP INC,

1840 East University #2, Tempe, AZ 85281. USA. Tel: +1-602-894 2941. Fax: +1-602-894 5485. Manufactures water filtration, concentrating on carbon filtration.

FILTERITE,

5 West Aylesbury Rd, Timonium, MD 21093. USA. Tel: +1-301-252 0800 Ext 6053. Manufactures a full line of residential and light commercial water filtration products to remove sediment, dirt and rust, unpleasant tastes and odours, and chemical contaminants as well as replacement cartridges for all major brands of filters.

FILTRINE MFG CO,

Main St, Harrisville, NH 03450. USA. Tel: +1-603-827 3321. Manufactures water filters, fountains and coolers for process and drinking water applications.

FILTROS PLANT, FERRO CORP,

603 West Commercial St, East Rochester, NY 14445. USA. Tel: +1-716-586 8770. Manufacturer of porous ceramic products for water and wastewater applications. Specifically diffusers and filters.

FRAM CORP - GENERAL PRODUCTS DIV,

135 Zene St, Henderson, NC 27536. USA. Manufacture water filters.

GEC ELECTRICAL PROJECTS LTD,

Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-788 542144. Telex: 311335. Fax: +44-788 60767. Contact Name: Mr F W Ballard or Mr S W G Cheshire. Mechanical, electrical and control engineering company with experience in water and sewage pumping stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor convertor equipment particularly suited to the control of pumps, compressors and fans.

GELMAN SCIENCES INC,

600 South Wagner Rd, Ann Arbor, MI 48106. USA. Tel: +1-313-665 0651. Manufacturer of depth and membrane filters. Offer cartridge filters, capsules, devices and housings for high purity (30um to 0.1um) liquids and gases.

GRAVER WATER INTERNATIONAL,

2720 US Highway 22, Union, NJ 07083. USA. Tel: +1-201-964 2554. Telex: 6853093. Fax: +1-201-964 7770. Graver designs and manufactures a complete line of water and waste treatment equipment to fit the needs of industrial corporation and electric generating utilities.

GREAT LAKES INTERNATIONAL,

1905 Kearney Avenue, Racine, WI 53403. USA. Tel: +1-414-634 2386. Telex: 262043. Fax: +1-414-634 6259. Full line supplier and manufacturer of RO systems, water chillers, inline filters and water processing systems. Also manufacture and market complete line of plastic components, tubing, pipe and other related accessories.

GRUNDFOS INTERNATIONAL A/S,

P D Jensensvej 7, Bjerringbro 8850. Denmark. Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. Grundfos all stainless steel raw water pumps models BP - SP - CR are widely used in municipal water treatment plants throughout the world. Capacity: Q up to 280cmb/h. H up to 500m.

GW PLASTICS INC,

Pleasant St, Bethel, VT 05032. USA. Tel: +1-802-234 9941. Manufacture custom injection molding/supplying center cores for cartridge filters.

HARMSCO INDUSTRIAL FILTERS,

PO Box 14066, North Palm Beach, FL 33408. USA. Tel: +1-407-848 9628. Fax: +1-407-845 2474. Harmsco Inc has been in business 35 years, producing stainless steel filter housings and pleated filter cartridges for the water industry. All products comply with FDA and NSF requirements.

HAYWARD BRACKETT LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 844509. Designs and manufacturers a complete range of manual basket strainers and automatic self cleaning strainers for pipelines.

HAZLETON ENVIRONMENTAL PRODUCTS INC,

225 North Cedar St, Hazleton, Pennsylvania 18201-0488. USA. Tel: +1-717-455 7711. Telex: 831881.

Fax: +1-717-459 2586. Contact Name: Mr Randy Galgon. Designers and manufacturers of static sludge removal equipment for flocculated silts and clays in potable water treatment. Low initial cost; simple installation; made to fit most basin designs; and easy to maintain.

HESONWERK,

A-4655 Vorchdorf, Pettenbacher Strasse 66. Austria. Tel: +43-7614/8301. Telex: 24466. Apart from turning out various steel and plastic articles Hesonwerk specialise in the planning, production and installation of water treatment and waste water purification and recycling plants.

HOWARD E HUTCHING CO INC

PO Box 249, 7190 Penryn Plaza, Penryn, CA 95663. USA. Tel: +1-916-663 1371. Manufactures chemical meter equipment, proportional feed systems and systems design. Water and waste water treatment.

HUBERT STAVOREN BV,

20 Kooyweg, Stavoren 8715 EP. The Netherlands. Tel: +31-51-49-1625. Telex: 46110 EHSTA NL. Fax: +31-51-49-2198. The company design, manufacture and install equipment for water treatment and waste water treatment.

HUDSON CORP OF TEXAS,

01 Newell St, San Antonio, TX 78212. USA. Tel: +1-512-226 3196. Manufacture water treating equipment.

HUTTER & SCHRANTZ AKTIENGESELLSCHAFT,

Grossmarkstrasse 7, Wien A-1232. Austria. Tel: +43-222-6775-11. Telex: 132420 HUSCH A. H & S filter elements are used mainly in solid/liquid and solid/gas separation. The materials used are technical fabrics - of metal wire or synthetic monofils and multifils - and/or perforated sheets. By various mechanical shaping methods and injection moulding the said filter materials are turned into filter elements differing in form according to the problem to be solved or to customers' drawings.

HYDRO-MAX CORP DIV RAYTEC WATERGROUP,

500 West Oklahoma Avenue, Milwaukee, WI 53207. USA. Tel: +1-414-747 3700. Manufacture water treatment equipment for domestic, commercial and industrial applications, specialising in industrial.

GENERAL EQUIPMENT & PROCESSES

HYDROFLO INC,

15 West Ayiesbury Rd, Timonium, MD 21093. USA. Tel: +1-301-561 4423. Manufactures a complete line of residential, commercial and industrial water treatment products. Patents pending on the NFA15 automatic neutraliser and Maryland State Health Department approved NSR844MP automatic household nitrate removal unit. Exclusive distributor of locally mined 98 per cent CaCO₃, Calcite product for neutralisation. Full line of water treatment chemicals and cartridge filters. Distributor of REO Pure, CTA membrane, reverse osmosis units from 10 to 25,000 gpd. Boiler water and cooling tower treatment specially engineered products. One to 100 cu ft automatic conditioners, iron filters, sediment filters etc.

HYDROMATION BELGIUM,

PO Box 99, 3700 Tongeren, Belgium. Tel: +32-12-233361. Telex: 39118. Fax: +32-12-238992. Hydromation Belgium manufacture and install water filtration equipment.

HYTREX FILTER DIV OSMONICS INC,

5951 Clearwater Dr, Minnetonka, MN 55343. USA. Tel: +1-612-933 2277. Manufactures extensive line of high quality filtration products and disposables.

ILLINOIS WATER TREATMENT CO,

4669 Shepherd Trail, Rockford, IL 61103. USA. Tel: +1-815-877 3041. Water treatment equipment manufacturer.

INAQUA ENTERPRISES INC,

6265 East Sawgrass Rd, Sarasota, FL 34240. USA. Tel: +1-813-377 1889. Manufacturer of commercial industrial and residential water treatment equipment. Also a major distributor of component parts.

INDUSTRIAL FILTER & PUMP MFG CO,

5900 Ogden Avenue, Cicero, IL 60650. USA. Tel: +1-312-656 7800. Manufacturer of filters, demineralizers and pumps used in water treatment industry.

INTERATOM,

Friedrich-Ebert-Strasse, Bergisch, Gladbach 5060, West Germany. Tel: +49-2204 840. Telex: 08874457. Fax: +49-2204 840207. Complete works for production of drinking or industrial water: water treatment plant, desalina-

tion plant, super filtration in closed water circuits, supplementary modules for existing systems, analysis and monitoring etc.

INTERNATIONAL WATER SYSTEMS,

1069 Evans Avenue, Akron, OH 44305. USA. Tel: +1-216-633 1114. Manufacturer of complete line of water treatment equipment. Distribute plumbing and waterwell supplies, extensive application and design capabilities for domestic, commercial and industrial requirements. One of the largest suppliers to independent water conditioning dealers and assemblers providing full line of products incorporating latest technology.

ION EXCHANGE PRODUCTS INC,

4834 South Halsted St, Chicago, IL 60609. USA. Tel: +1-312-254 1300. Since 1922 has been in the business of supplying quality water treatment equipment for industries, cities, hospitals, laboratories, off-shore and homes.

JORD ENGINEERS LTD,

Unit 4, Loomer Rd Industrial Estate, Cnesterton, Newcastle-upon-Tyne, Staffs ST5 7LB. UK. Tel: +44-0782 563917. Manufacturers of rotary and belt vacuum filters. Pressure filters. Standard and high rate sedimentation thickeners and clarifiers. Flotators, aerators. Rebirthment of filter presses. Plant design and layout for turnkey operations.

K J WATER TREATMENTS LTD,

KJ House, 15 Hardings Lane Penge, London SE20. UK. Tel: +44-81-659 7216/7. Fax: +44-81-676 0138.

Manufacturers and suppliers of a complete range of water treatment equipment and chemicals; including consultancy, design, chemical cleaning, chlorination and contract servicing.

KENDALL (SUBSIDIARY OF COLGATE-PALMOLIVE),

50 Kerry Place, Norwood, MA 02062. USA. Tel: +1-617-769 6112. Fax: +1-617-769 3274. The Kendall Co manufacture a line of polysulfone ultra-filtration membranes and membrane cartridges for the ultra-pure water industry, also a line of products for the bio-separation industry.

KENNICOTT/THOMPSON CHARLTON ENGINEERS,

Spring Rd, Waverhampton, West Midlands WV4 6JX. UK. Tel: +44-902 353353. Telex: 337412. Fax: +44-902

405500. Founded in 1902, Kennicott is a major water treatment company offering a comprehensive range of treatment plants and processes for a wide variety of industrial and potable applications.

KEYSTONE FILTER DIV MET-PRO CORP,

2385 North Penn Rd, Hatfield, PA 19440. USA. Tel: +1-215-822 1963. Manufacturer of water filter and replacement cartridges. Also design and manufacture custom filter cartridges and cartridge components.

KOSKO MANUFACTURING CO,

PO Box 211, 800 So McClellan St, Warsaw, IN 46580. USA. Tel: +1-219-267 6217. Manufacture full water conditioning line.

L A WATER TREATMENT CORP,

17400 East Chestnut St, City of Industry, CA 91749. USA. Tel: +1-213-912 5411. Engineer, design and manufacture water treatment equipment for all applications.

LANCASTER PUMP, A DIVISION OF C-B TOOL CO,

1340 Manheim Pike, Lancaster, PA 17601. USA. Tel: +1-717-397 3521. Manufacture domestic water treatment equipment.

CLAUDE LAVAL CORP,

1911 North Helm Avenue, Fresno, CA 93727. USA. Tel: +1-209-255 1601. Full line manufacturer of filtration products featuring Lakos sand separators and pump protection sand separators. Also, cartridge filters, screen filters and sand media filters.

LAYNE-WESTERN CO INC,

721 West Illinois Avenue, Aurora, IL 60506. USA. Tel: +1-312-897 6941. With 28 offices located throughout the US, Layne-Western Co is recognised as the leader in the field of water technology. Fully capable of providing practically every vital service needed by water users, municipal, industrial and agricultural. Services: complete hydrological engineering investigation, industrial and irrigation supply systems, drill and maintain water wells, install and service deep well pumping equipment, sell and install water and waste water treatment equipment for municipal and industrial use.

LYONNAISE DES EAUX,

52 Rue de Lisbonne, Paris, Cedex 08, 75008. France. Tel:

+33-40-75-70-00. Telex: 643-407. Fax: +33-1-45624270. Lyonnaise serve communities in fulfilling long-term needs of municipalities and industry in the field of water supply and management, waste water treatment, drinking water distribution, sanitation and financial engineering.

MAHON & MCPHILLIPS (STRATFORD) LTD,,

Holford Way, Witton, Birmingham, West Midlands B6 7AX. UK. Tel: +44-21-356 7606. Telex: 334041. Fax: +44-21-356 892. Mechanical plant contractors, designers and manufacturers in the field of municipal and industrial water and waste water treatment.

MARLO INC,

PO Box 4070, 2227 South St, Racine, WI 53404. USA. Tel: +1-414-681 1300. Manufacturer of water treatment equipment for residential, commercial and industrial applications.

MAROLF INC

15500 49th St North, Clearwater, FL 33520. USA. Tel: +1-813-536 5991. Manufacture of water and wastewater treatment equipment for use in subdivisions and municipalities.

MEISSNER FILTRATION PRODUCTS,

3750 Cohasset St, Burbank, CA 91505. USA. Tel: +1-818-767 3262. Manufacturer of wide range of pleated filter elements suitable for the removal of particulates and colloids from water and chemicals.

MICROFLOC PRODUCTS, JOHNSON FILTRATION SYSTEMS INC,

PO Box 64118, 1950 Old Highway 8, MN 55112. USA. Tel: +1-612-636 3900. Water treatment equipment and systems for municipal and industrial applications.

MINNTECH CORP,

14905 28th Avenue North, Minneapolis MN 55441. USA. Tel: +1-612-553 3325. The hollow fiber ultrafilter is a polysulfone ultrafilter which can be used in a standard 10ins industrial filter housing. The device contains 32sq ft of surface area.

MITCO WATER LABORATORIES INC,

PO Box 1435, Winter Haven, FL 33882-1435. USA. Tel: +1-813-967 4456. Chemicals, equipment and service for

GENERAL EQUIPMENT & PROCESSES

treatment of commercial and industrial cooling tower, boiler and potable water systems. Ion exchange, reverse osmosis and filtration process water purification equipment. Full service analytical laboratory.

MONARCH WATER SYSTEMS,
245 North Valley Rd, Xenia, OH 45385. USA. Tel: +1-513-426-7000. Manufacture pressure vessel water treatment equipment for domestic and commercial use. Also distribute parts for many systems including valves, controls, resin, filter media and instrumentation.

NV AQUAVIA SA,
Vosseloestraat 73, Nevele B-9840. Belgium. Tel: +32-91-71-71-71. Telex: 11477. Fax: +91-71-71-80. Manufacture flotation, filtration (diatomite and sand) and ceration systems. Also install and design, if necessary, mechanical and chemical treatment systems, potable, swimming pool, industrial and municipal treatment.

OLIN CORP,
120 Long Ridge Rd, Stamford, CT 06904. USA. Tel: +1-203-356-2029. Basic water filters for taste and odour or sediment reduction, standard water filters for taste, odour and sediment reduction, patented automatic water filter (with controls) for reduction of taste, odour, sediment, organic chemical and inorganic chemical problems; and the technically advanced and patented reverse osmosis system, the Ultra II (with controls) for reduction of taste, odour, sediment, organic chemical and inorganic chemical problems.

OLIN WATER SERVICES - OLIN CORP,
51 Corporate Woods, 9393 West 110th St, Overland Park, KA 66210. USA. Tel: +1-913-451-3100. Water treatment programmes, ie chemicals, equipment and service.

OMNIPURE FILTER CO,
PO Box 1359 518 Kit Avenue, Caldwell, ID 83605. USA. Tel: +1-208-454-2597. Fax: +1-208-454-0020. Dk supply inline, disposable, carbon filters, sediment filters and cartridge type carbon filter elements. Uses include RO filtration, distillers, beverage dispensers, refrigeration and more. Dedicated to quality, reliability and fast customer service.

ORC/KDF TECHNOLOGIES,
120 South Washington, Constantine, MI 49042. USA. Tel: +1-616-435-5835. Marketing the KDF 55-D media for the removal of chlorine, chloramines, hydrogen sulphide, iron

and pre-treatment before RO systems to protect the membrane from chlorine and bacteria degradation.

PALL PROCESS FILTRATION CORP PALL ULTRAFINE FILTRATION CORP,
2200 Northern Boulevard, East Hills, NY 11548. USA. Tel: +1-516-484-5400. International leader in design, manufacture and marketing of sophisticated filters and other fluid clarification devices which serve the health care, aeropower and fluid processing markets.

PARKER HANNIFIN CORP,
17325 Euclid Avenue, Cleveland, OH 44112. USA. Tel: +1-216-531-3000. Parker Hannifin is a leading producer of filtration and motion control components and systems. Its commercial filters division offers a line of home water filters and cartridges that remove sediment, rust, algae, chlorine and odours.

PATERSON CANDY INTERNATIONAL LTD,
21 The Mall, Ealing, London W5 2PU. UK. Tel: +44-81-578-1311. Telex: 27239. Design, process engineering, construction, mechanical/electrical engineering or potable water treatment works from village schemes to major cities worldwide.

PEERLESS INC,
1701 East Vine St, Kalamazoo, MI 49001. USA. Tel: +1-616-344-6137. Manufacturer of all types of water treatment equipment including softeners, filters, deionisers, condensate polishers, dealkalisers etc.

THE PERMUTIT CO LTD,
Permutit House, 632-652 London Rd, Isleworth, Middlesex TW7 4EZ. UK. Tel: +44-81-560 6431. Telex: 924640 PERM G. Fax: +44-81-568 9772. Permutit supply plant for various water treatment processes including softening, filtration, reverse osmosis, electro dialysis and deionisation. Units for all these processes can be supplied in a standard package, or may be tailored to meet more specific requirements. The Permutit Co Ltd manufacture and supply a complete range of water purification equipment for industrial, commercial and laboratory applications. All products are manufactured in accordance with quality systems which have been approved by the British Standards Institute as complying with BS5750

Pt 2; ISO9002. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

PEWPLAN (WT) LTD,
Beechwood Hall, Kingsmead Rd, High Wycombe, Bucks HP11 1LA. UK. Tel: +44-494 35671. Telex: 837139. Fax: +44-494 465489. Undertake design and contracting of major water treatment installations.

PLASWORLD-DIV OF RAYTEC WATER-GROUP,
500 West Oklahoma Avenue, Milwaukee, WI 53207. USA. Tel: +1-414-747 3700. Supplier of residential and commercial water treatment equipment to independent water treatment dealers. Proprietary products in water conditioning and reverse osmosis.

PLYMOUTH SALES CO INC,
1115 West Struck Avenue, Orange, CA 92667. USA. Tel: +1-714-997 5482. Wholesale distribution of filter housings, cartridges and accessories to water improvement industry.

POLYMETRICS INC,
101 Nicholson Lane, San Jose, CA 95134. USA. Tel: +1-408-433 1919. Manufacturer of water purification equipment.

PORTALS WATER TREATMENT,
Oldfield Lodge, 156 Bridge Rd, Maidenhead SL6 8DG. UK. Tel: +44-628 771444. Telex: 849067. Fax: +44-628 771567. Process, design and engineering of water, effluent, sewage and process liquids treatment project. PWT undertake contracts of any size throughout the world, and supply their own fully proven range of pre-engineered products and protect systems with a comprehensive range of speciality chemicals.

PWT PROJECTS LTD,
632-652 London Rd, Isleworth, Middlesex TW7 4EZ.
UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.
Fax: +44-81-568 5479. All aspects of municipal treatment - surface and groundwater abstraction and pumping, presettlement, clarification, flotation; rapid gravity and pressure filtration employing sand, anthracite and carbon media; full chemical treatment; water remineralisation. Turnkey contracts and project management; plant operation and maintenance. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

QSP DISTRIBUTING CO INC,
PO Box 6, Luverne, MN 56156. USA. Tel: +1-507-283 9591. Wholesaler-supplier of water conditioning materials, components and related products.

REFINITE WATER CONDITIONING CO INC,
PO Box 11676 555 Paddock Parkway, Rock Hill, South Carolina 29730. USA. Tel: +1-803-324 7600. Fax: +1-803-324 1116. Offers stainless steel, aluminum and PVC lined or zinc coated carbon steel. Standard products include carbon absorption, packed tower aerators, ion exchange systems, diatomaceous earth filters, cooling tower filters, iron removal plants, horizontal multi-cell pressure filters, gravity filters and packaged clarifier/filter plants.

ROHM & HAAS,
185 rue de Bercy, 75012 Paris. France. Tel: +33-1-4002 5400. Manufacturers of **ROMICON ultrafiltration membranes and modules and AMBERLITE, DUOLITE and IMAC ion exchange and absorbent resins. Hollow fibre ultrafiltration systems for potable water treatment. Pre- and post-demineralisation units for industrial water treatment.**

ROMICON INC,
100 Cummings Park, Woburn, Massachusetts 01801. USA. Tel: +1-617-935 7840. Telex: 94-9333. Fax: +1-617-935 7183. Manufacturers of ultrafiltration membrane modules and fully automated ultrafiltration systems.

SAUR (SOCIETE D'AMENAGEMENT URBAIN ET RURAL),
Challenger, 1, Avenue Eugene Freyssinet, 78064 Saint Quentin Yvelles Cedex. Tel: +1-33-30-60-22-60. Telex: 689 292 SAUR F. Fax: +1-33-30-60-27-89. SAUR is the third largest water treatment and supply group in France where it serves 5,500 local authorities. It also handles waste water collection and treatment for 1.6 million people and collects and processes refuse from one-and-a-half million inhabitants. SAUR ensures the design and the execution of the plants necessary for the treatment of water and refuse (2,000 building references). The international activity of SAUR represents 38 per cent of the global activity. SAUR is present in Europe (Great Britain, Spain, Italy), in Canada and in Africa (15 countries) and serves 16 million people throughout the world.

GENERAL EQUIPMENT & PROCESSES

SAXTON MANUFACTURING CO,
16782 Milliken Avenue, Irvine, CA 92714. USA. Tel: +1-714-863 0606. Manufacture water conditioning equipment for home, commercial and photographic markets.

SEE,

Rue de la Science, Brussels B 1040. Belgium. Tel: +32-2-230 9314. Telex: 25 237. Fax: +32-2-230 7613. Water treatment plants: drinking water, waste water, water for industry, swimming pool water. Chemical products for water conditioning. Pre-fabricated units for the production of drinking water and waste treatment.

SELANEX LTD,

Langton House, Battle, Sussex TN33 0AQ. UK. Tel: +44-4246 3404. Telex: 95460 SELINEX G. Fax: +44-4246 4878. Authorised stockists of valves, tanks, filters, control systems and ancillaries for water treatment trade use. Products marketed for Aquamatic, Fleck, Park International, Matt-Son, Rotoplast, Euroqua and Erie in UK and Ireland.

SELECTO INC,

1000 Cobb Place Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000® media and leadOUT® filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale applications, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE® 'add-on' solid-state ultraviolet water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

SERCK BAKER LTD,

Riga House, 380 Bristol Rd, Gloucester GL2 6XY. UK. Tel: +44-452 421561. Telex: 43567. Fax: +44-452 423414. Design, install and commission total water and effluent treatment systems. Specialists in filtration, aeration and chemical injection systems.

SERFILCO LTD,

234 Depo' St, IL 60025. USA. Tel: +1-312-998 9300.

Manufacture individual chemical pumps, filter chambers for water and chemical solutions; filtration systems, steam cleaners/hot pressure washers; automatic gravity and vacuum filtration systems, polishing filter for waste treatment systems and other related equipment.

SERFILCO UK LTD,

Unit 4B, Broadoak Industrial Park, Ashburton Rd West, Trafford Park, Manchester M17 1RW. UK. Tel: +44-61-872 1317. Telex: 665424. Fax: +44-61-873 8027. Manufacturers of plastic pumps, filter chambers and filter cartridges as components in complete filtration systems.

SOCIETE D'EPURATION ET D'ENTREPRISES SA,

Rue de la Science 5, Brussels 1040. Belgium. Tel: +32 2 230 93 14. Fax: +32 2 230 76 13. SEE manufactures and installs plants all over the world for treating drinking water from both surface water (rivers, lakes and dams) and underground sources.

SPRINGSOFT,

2390 United Lane, Elk Grove, IL 60007. USA. Tel: +1-312-894 5000. Full stock of all water treatment materials - complete systems, residential and commercial.

STA-RITE INDUSTRIES INC, WATER TREATMENT DIV,

1875 Dewey Avenue, Benton Harbor, MI 49022. USA. Tel: +1-616-925 8812. Manufactures a broad line of commercial/industrial water treatment products. The commercial/industrial line ranges from small commercial units to large commercial and industrial units as well as complete multiple-unit systems capable of treating the very largest and complex applications.

ERICH STROBL,

A-5021 Salzburg, Lastenrass 14, PO Box 49. Austria. Tel: +43-6222/72-1-31/75-3-59. Telex: 633387. Strobl specialise in water handling plants and systems. The line-up includes water treatment plants for swimming-pools, drinking water supply systems and water supply plants for industry. The firm undertakes the planning, production, installation and servicing of water-handling plants.

SULZER BROTHERS LTD,

CH-8401 Winterthur, Switzerland. Tel: +41-52-81-11-22. Telex: 896060. Fax: +41-52-23-42-83. Sulzer water treatment and wastewater purification plants meet the special

requirements associated with all kinds of municipal and industrial applications. In addition, pumps are supplied for communal and industrial water supply and irrigation installations. Furthermore, pumps, deconters and fluid-bed driers required for the treatment of waste waters and sewage sludges.

SUNBIRD SALES INC,
Box 125 Rt 68 Highway 107, Cullowhee, NC 28723.
USA. Tel: +1-704-293 5912. Sales and distribution of water and wastewater treatment equipment.

SUTCLIFFE CROFTSHAW,
Neills Rd, Bold, St Helen's, Lancs WA9 4TH. UK. Tel:
+44-744 810107. Telex: 629685. Fax: +44-744
821418. Is the UK's leading designer of custom-built
plants for the recovery of toxic solvents from industrial
emissions.

SUTCLIFFE INDUSTRIAL SERVICES
LTD,
82 Silverdale Rd, Ecclesall, Sheffield, South Yorks S11
9JL. UK. Tel: **+44-742 360530. Fax: +44-742 361154.**
Handles all types of media for the water and sewage
industry and refurbishes filtration systems.

SUTCLIFFE POLCON LTD,
Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel:
+44-206 852121. Telex: 98391. Fax: +44-206
841503. Provides turnkey solutions for waste water
purification including Hycor milli screens for sea out-
falls and industrial applications, PCL belt dewatering
presses and MEYN dissolved air equipment.

TECATOR AB,
PO Box 70, S-263 21 Höganäs. Sweden. Tel: **+46-42-**
361500. Fax: +46-42-340349. Tecator is the world's
leading company for automated routine analysis in
water. Tecator is a world-wide supplier of analytical
instruments for water and environmental analysis.
Standard manual methods cannot meet today's
requirements for speed, accuracy and safety.
Therefore there is an increasing demand for auto-
mated and flexible water analysers, which are easy
to start up, simple to use and provide fast and accu-
rate results. Tecator offers a broad range of
automated, flexible and accurate analysers fulfilling
various needs and requirements in the water labora-
tory. Tecator provides complete application

information and specialist support with each instru-
ment. Ask for more information today.

UNOX EFFLUENT TREATMENT SYS-
TEMS (WIMPEY ENGINEERING),
27 Hammersmith Grove, London W6 7EN. UK. Tel: **+44-**
81-748 2000. Telex: 25666. Fax: +44-81-748
0076/748 6083. Contractors and specialist process and
equipment suppliers to the water and sewage treatment
industry.

VOEST-ALPINE AG,
Postfach 2. A-4010 Linz. Austria. Tel: **+43-732/585-1.**
Telex: 2208-600 VA A. The company's water engineering
activities form only part of the varied range of products and
services. They include: drinking-water treatment; of surface
and ground water; service water treatment; treatment of cir-
cuit, cooling and process water; mechanical, biological and
chemical treatment of sewage and industrial waste; stabilisa-
tion, digestion, thickening, draining, drying, composting,
disposal and incineration of sludge; and sludge draining
using screen belt presses.

WAB WASTE & WATER TREAT-
MENT,
Leberstrabe 118a, A-1110 Vienna. Austria. Tel:
+02227435600. Telex: 132291. Fax:
+022274356032. Desalination and Water softening,
Disinfection, Municipal water treatment, Package and
Portable water treatment, Mechanical and Biological waste
water treatment, Sludge treatment and dewatering, General
equipment and process, Specialised equipment and pro-
cesses.

WATER ENGINEERING LTD,
International Division, Aynho Rd, Adderbury, Banbury,
Oxon OX17 3NL. UK. Tel: +44-295 810581. Telex:
83655. Fax: +44-295 811913. Contact Name: Ken
Brearley. Water Engineering Ltd maintains its position
as a leader in water treatment technology. Modern
treatment facilities include clarification, flotation,
rapid gravity filtration and disinfection and treatment.
Plants can be operated and controlled using the most
sophisticated electronic and computerised control sys-
tems. Manufacturing and industrial processes
requiring a water supply with special properties can
benefit from one or more of the following processes:
clarification, coagulation, filtration, ion-exchange and
de-mineralisation. The company's ability to supply

GENERAL EQUIPMENT & PROCESSES

the expertise and supply the necessary equipment is reflected in the growing number of satisfied clients who have benefitted from the company's services.

WATER ENGINEERING SERVICES,

Unit F, Kemberion, Halesfield 22, Telford TF7 4QX. UK. Tel: +44-952 290497. Telex: 35835. Fax: +44-952 290353. Suppliers of packaged and purpose built water/effluent treatment plants including pressure filters, deionisation units, reverse osmosis and rotating biological contactors for sewage treatment.

WATER REFINING INDUSTRIAL INC,

500 North Verity Parkway, Middletown, OH 45042. USA. Tel: +1-513-423 9421. Co has designed, manufactured and supplied water conditioning equipment worldwide since 1957. Unique polyethylene linings, solid state controls, broad line of standard vessel designs mean quick deliveries and competitive pricing. Near total control of in-house manufacturing assures top quality.

WATERCO INDUSTRIES,

4811 North East 12th Avenue, Ft Lauderdale, FL 33334. USA. Tel: +1 305-772 0020. Fax: +1-305-776 5403. WATERCO have manufactured water purification equipment since 1973. Manufacturing a complete line from counter-top to custom designs for large commercial installations. USEPA registered and serving clients all over the world and USA.

WATERSAFE INTERNATIONAL,

4201 Mesa Vista Drive, La Canada, CA 91011. USA. Tel: +1-818-952 1045. Manufactures and distributes both wholesale and retail total water conditioning systems for homes, businesses and agriculture. Product line includes travel units to whole house systems. Unique system consists of catalytic conditioner, sediment filter and high volume replaceable backwashable carbon filter.

WEBER SENSORTECHNIK GMBH,

2201 Kollmar. West Germany. Tel: +49-04128 591. Telex: 218326. Fax: +49-04128 593. Flow-captor flow switches and meters provide reliable and accurate control of water circulatory systems and operate with high repeatability. The small, compact and maintenance-free units are easy to install and can be fitted either into pipes or inline depending on the application. Alternatively custom-made systems can be provided according to

individual requirements. Sensing is carried out non-intrusively, thus not affecting flow profile. Available are analog or digital outputs, the latter being suitable for direct feeding into a PC computer for further processing.

WESTERN WATER INTERNATIONAL INC,

7715 Penn Belt Drive, Forestville, MD 20747. USA. Tel: +1-301-568 0200. Exclusive manufacturer of Aquaspace® filter compound and water filter product line. Systems available for residential, commercial and industrial applications. Specialising in total systems for POE. POU systems and replacement cartridges also available. Non-chemical systems for cooling towers, boilers and vending machines etc.

WESTMOOR LTD,

3452 North Knox Avenue, Chicago, IL 60641. USA. Tel: +1-312-282 2237. Fax: +1-312-282 4954. Manufacture rotary vane, positive displacement air blowers used for aeration. Products include pumps and pump units plus aeration kits. Aeration systems by Westmoor are used in waste water facilities, lake management and aquaculture, where conventional blowers are unable to overcome the static pressure of greater than 3ft of water.

WICOR CANADA INC, FILTER-SOFT DIV,

111 Plymouth St, Winnipeg, Manitoba R2X 2V5. Canada. Tel: +1-204-694 2288. Manufacturer of residential and commercial water treatment equipment including softeners, filters, cartridge-type filters and related products.

WILLIAMETTE WATER & SOLAR CO,

1301 West 6th Avenue, Eugene, OR 97402. USA. Tel: +1-503-484 2027. Assemblers of component parts for filters, softeners, RO's, private label available. New product testing. Manufactures representatives for commercial equipment. Many lines.

WSH LABORATORIES LTD,

3851 B 21st NE, Calgary, Alberta T2E 6T5. Canada. Tel: +1-403-250 9164. Manufacturer of clear water treatment systems and complete line of softeners, dealkalisers, chemical iron filter and the unique non-chemical iron filter with the ARV valve.

**WYNHAUSEN/O & G WATER
CONDITIONING,**

431 South San Gabriel Boulevard, San Gabriel, CA. USA.
Tel: +1-818-287 2148. Manufacturers of water conditioning equipment.

ZEMARC CORP,

2240 Gaspar Avenue, Los Angeles, CA 90040. USA. Tel: +1-213-721 5598. Manufacture filter housings and replaceable filter cartridges.

**SPECIALISED EQUIPMENT &
PROCESSES**

APV CHEMICAL MACHINERY,

Glenburn Rd, College Milton North, Glasgow, East Kilbride G74 5BJ. UK. Tel: +44-3552 25461. Telex: 777755 APVOC. Fax: +44-3552 63496. Designers and manufacturers of all types of fluid mixing equipment. Also canned, glandless, leakproof pumps; ceramic lined pumps; metering pumps and dosing sets.

**AQUA PROCESS ENGINEERING
LTD,**

Aqua House, 27 Denison Rd, London SW19 2DJ. UK. Tel: +44-81-543 3647/8. Telex: 915089 AQUA G. Engineers in potable water treatment. Specialists in pressure filtration plant refurbishment and site installation.

BECKEL- EDELSTAHL,

PO Box 97, Bad Isx 97, A-4820. Austria. Tel: +43-6132-33-770. Telex: 68138. Beckel-Edelstahl supplies stainless steel equipment for water supply and sewage disposal. The line-up embraces: components for tanks, eg pressure doors, food and delivery pipes (to give uniform spiral or parallel flow), extraction turbines, pipe fittings and complete pipe installations, double-walled doors, ventilation louvers of fixed and moveable design, manhole components, eg manhole covers, ventilation shafts, well heads and risers, intake strainers, components for sewers and sewage treatment plants, eg wall entrances, bulkheads, slide valves, overflows, ground water and backwash flaps etc.

BIRTLEY,

Avenue de Tervueren 32-36, Boite 11-12, Brussels B1040. Belgium. Tel: +32-2-73-60037. Telex: 24-747. Fax: +32-2-736 4476. Self-cleaning water intakes for rivers, canals or main pipes have an opening of 1mm without moving parts;

automatic filters and strainers are remote controlled or not, have no moving parts, and a filtration size ranging from 100 to 800 microns, pressure goes up to 20 bars (about 300 psi); separators, remote controlled or not are fully automatic. There are no moving parts. They have a separation level ranging from 10 to 100 microns and deal with all pressures and require practically no maintenance.

BRITISH FILTERS LTD,

Thames Industrial Estate, Fieldhouse Lane, Marlow, Bucks SL7 1TD. UK. Tel: +44-6284 73131. Telex: 849216. Fax: +44-6284 75955. Manufacturers of pre-coat filters and water filtration equipment in general.

CLACK - CORP,

PO Box 500, 4462 Duraform Lane, Windson, WI 53598. USA. Tel: +1-608-251 3010. Fax: +1-608-846 2586. Manufacture and distribute water treatment components including: reverse-osmosis, ion exchange resins, pressure vessels, brine tanks and accessories, activated carbon, and a complete line of filter media.

CLARITY FILTERS,

2500-165th St, Hammond, IN 46320. USA. Tel: +1-800-848 7418. Contact Name: David Griffin. Manufacturers water filter systems, housings, cartridges and components. We also stock a complete line of accessories including faucets, diverters fittings, tubing, replacement parts, and filtration media. Clarity Filters exclusively features the ABA-2000 Lead/Heavy Metal filter cartridges.

CRYSTAL FLUID FILTER CO,

865 Grand Boulevard, Westbury, NY 11590. USA. Tel: +1-516-333 6768. Sediment and odour removal filters, 3 gals to 167 gals per minute. Existing water pressure usually operates units, but pumps can be inserted. Constructed of plastic or SS filter media cartridges.

DARCY PRODUCTS,

Invictor Works, East Malling, Kent ME19 6BP. UK. Tel: +44 732 843131. Telex: 95131. Fax: +44-732-870016. Manufacturers of the Drizit Range of oil absorbents for the control and clean up of oil pollution. Fiber materials sold in loose cushion and boom and sheet pure polypropylene for all applications.

**DRAGERWERK AKTIENE-
SELLSCHAFT,**

Moislinger Allee 53-55, D-2400 Lubeck 1. Germany.

Tel: +49-451 8820 Telex: 268070. Fax: +49-451-882 2080. Gas Analysis Division. In order to reduce the number of potentially hazardous situations at the workplace and minimise any damage resulting from these hazards, many different gases, vapours, and aerosols must be monitored. For that purpose Drager offers easy-to-handle and economical measuring systems. With more than 200 different Drager-Tubes, over 350 separate hazards can be determined in air, soil and water samples.

EBCO MANUFACTURING CO,
265 North Hamilton Rd, Columbus, OH 43213. USA. Tel: +1-614 861 1350. Manufacture water coolers, fountains and chillers.

ENVIRO-CARE CO,
5614 West Grand Avenue, Chicago, IL 60639. USA. Tel: +1-312-745 7773. Fax: +1-312-745 8383. Flo-screen of revolutionary simplicity in design and operation, stainless steel construction, for intercepting and positively removing debris. Minimum screen opening - 0.125in uses minimum energy and is maintenance free.

ETA PROCESS PLANT LTD,
The Levels, Brereton, Rugeley Staffs WS15 1RD. UK.
Tel: +44-889 576501. Telex: 36519 ETARUG G. Fax: +44-889 579856. ETA Process Plant designs and supplies plant for the removal of volatile organic contaminants from potable water supplies, degassers for the removal of CO₂ and H₂S and aerators for assisting in iron deposition. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

EVERPURE INC,
660 North Blackhawk Drive, Westmont, IL 60559. USA. Tel: +1-312-654 4000. Telex: 210050. Fax: +1-312-850 0799. Point-of-use water treatment for premium quality drinking and cooking water in restaurants and homes.

EWCSUPPLY CO,
3233 South Main St, Elkhart, IN 46514. USA. Specialising in sales of QEST polybutylene plumbing materials exclusively to the water conditioning industry.

FIBERGRATE CORP,
PO Box 814610, Dallas, TX 75381-4610. USA. Tel: +1-214-250 1633. Fax: +1-214-2150 1530. Manufacturer

of fiberglass grating, walkways, platforms, bridges, ladders, handrails and other corrosion-resistant pedestrian facilities; complete concept to completion capabilities including design and installation.

FIBREDYNE INC,
190 Crosby Rd, Dover, NH 03820. USA. Tel: +1-603-749 1610. Fax: +1-603-749 2699. Manufacture disposable water filter cartridges.

FILTROS PLANT FERRO CORP,
603 West Commercial St East, Rochester, NY 14445. USA. Tel: +1-716-586 8770. Fax: +1-716-586 7154. Filtrors diffusers consist of porous ceramic materials in the shape of tubes, plates, discs and domes. Diffuser tube and disc assemblies are offered for connection into an air supply to provide small-bubble aeration for sewage treatment. Porous ceramic filter plates are used for underdrains in water filtration facilities.

FORCE FLOW EQUIPMENT,
3467 Golden Gate Way, Lafayette, CA 94549. USA. Tel: +1-415-284 2200. Fax: +1-415-284 5945. Manufacture chlorine scales for 1 ton containers, primarily for the waste water and water treatment industries. Also manufacture scales for stationary 30-60,000 pound tanks.

H B FULLER CO MONARCH DIV,
311 109th Avenue Nw, Minneapolis, MN 55421. USA. Tel: +1-612-782 1724. Manufactures cleaners and sanitizers for RO/UF membranes and systems used in water purification, biotechnology, food processing and other specialised applications. Products supported by customised programmes, technical assistance, analytical testing and consulting.

GENERAL FILTER CO,
600 Arrasmith Trail, Ames, IA 50010. USA. Tel: +1-515-232 4121. Fax: +1-515-232 2571. Manufacture water and waste water equipment: softeners, clarifier, packaged filter plants and gravity filter parts and controls.

GULDAGER SYSTEM,
Højrevang 1-3, Allerød DK-3450. Denmark. Tel: +45-42-273100. Fax: +45-42-271504. Production, installation and service of electrolysis systems for the protection against corrosion and scaling in domestic water systems, process water systems and filters for swimming pools, anti-fouling and cathodic protection.

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KDF 55-D REMOVES LEAD, CHLORINE AND OTHER HEAVY METALS WITHOUT DRAINING YOUR BUDGET!

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P.O. Box 277
Constantine, Michigan 49042
(616) 435-8421 FAX: (616) 435-7167



In Europe Call:
AQUAFRESCA INNOVATIONS LTD.
London House
26-40 Kensington High Street
London WB 4PF
Telephone: 01 - 938-2222
Fax: 01 - 937-8797

HAGUE HYDRO-CLEAN,

4343 South Hamilton Rd, Groveport, OH 43125. USA. Tel: +1-614-836 2195. Manufacturer of the Hydro-Clean System, which includes a full line of water conditioning and filtering equipment using the exclusive Hague Gold Crown Valve. Also manufactures distillers, reverse osmosis systems and the micro-carbon filters.

HANS ASCHENBRENNER,

A-2500 Baden, Erzherzog-Wilhelm-Ring 21. Austria. Tel: +43-2252-89-1-70/80-15-13. By physical means the Kwabi water conditioner prevents furring in pipes, boilers, washing machines etc. No chemical additives are necessary and water thus retains its natural freshness. Of compact design, the device can be easily inserted in the water main. This method of water treatment saves money on energy and servicing.

HARVESTER STAINLESS LTD,

The Avenue, Rubury, Birmingham B45 9AG. UK. Tel: +44-21-453 6111. Telex: 339 190. Fax: +44-21-453 8435. Major manufacturers and suppliers of all stainless steel tubular and flat roll products, inclusive of specialised grades for the water and water treatment industry.

HAZLETON ENVIRONMENTAL PRODUCTS INC,

225 North Ceder St, Hazleton, Pennsylvania 18201-0488. USA. Tel: +1-717-455 7711. Telex: 831881. Fax: +1-717-459 2586. Contact Name: Mr Randy Galgon. Manufacturers of a patented air stripping system. Based on a hydraulic venturi principle, the stripper is not affected by iron or biofouling. HEP also manufactures large aerators, hydraulic mixers and static sludge withdrawal systems.

HETHON INTERNATIONAL BV,

PO Box 40, Barchemseweg 40, Ruurlo 7260 AA. The Netherlands. Tel: +31-5735 1350. Fax: +31-5735 2866. Hethon International, NL represents manufacturers of fluid and solid handling equipment as GRI, Accurate, Spiroflow, Duff Norton, Gorman Rupp etc. Hethon is specialised in combining products into complete systems for fluid and/or solid handling.

HICK HARGREAVES & CO LTD,

Crook St, Bolton, Lancs BL3 6DB. UK. Tel: +44-204 23373. Telex: 63244. Fax: +44-204 395261. Hick Hargreaves blowers are used extensively to provide oil free

air for effluent and water treatment. The 2000 and 4000 Series cover capacities from 35 to 9000m³/hr and larger blowers can be supplied for capacities up to 45,000m³/hr. Standard packages and custom built installations can be supplied to meet particular requirements.

HOWDEN WADE LTD,

Crowhurst Rd, Brighton, Sussex BN1 8AJ. UK. Tel: +44-273 506311. Telex: 87511. Fax: +44-273 557123. Reputable blower manufacturer represented through the world. Equipment utilised extensively for filter air scour and waste water aeration by many potable water authorities and purification plant contractors.

ROBERT HUDSON (EFFLUENT EQUIPMENT) BECORIT LTD,

Hollam Fields Rd, Ilkleson, Derby DE7 4BS. UK. Tel: +44-602 302603. Telex: 37526. Fax: +44-602 329683. Design, manufacture and installation of a range of rectangular tank scrapers, circular tank scrapers and mechanical screens for water, effluent and sewage treatment plants.

HYDRANAUTICS,

PO Box 3690, Santa Barbara, CA 93130. USA. Tel: +1-805-964 0765. Manufactures spiral wound cellulosic and non-cellulosic type membrane products and FRP pressure tubes. Designs complete systems for municipal and industrial water treatment applications.

HYDRO-MASTER PARTS CO INC,

27 Stone Hill Rd, Oswego, IL 60543. USA. Tel: +1-312-554 9192. Provide water treatment industry with custom options for their slotted riser, lateral needs and other plastic parts for OEM requirements.

HYDROTECHNIK GMBH,

Alpenstraße 54, PO Box 14, A-5033 Salzburg. Austria. Tel: +662285310. Telex: 633821. Fax: +6622853110. Hydrotechnik Austria have come to hold worldwide a leading position in the field of water treatment, waste water treatment and water desalination. There are many different application possibilities of their plants eg treatment of surface water (eg lakes, rivers) to provide communities, municipalities, camps etc with drinking water. Depending on the required capacity, Hydrotechnik Austria provides either conventional plants or their HYDROCOMPACT-Plants, which are completely prefabricated and tested in Austria. Thereof results very short and simple erection work.

SPECIALISED EQUIPMENT & PROCESSES

HYPERFIL INDUSTRIES INC,
1170 Van Horne Way, Anaheim, CA 92806. USA. Tel:
+1-714-630 4381. Fax: +1-714-630 2366. Contact
Name: Gene Gilley. Gene Gilley, President of Hyperfil
Industries has over 25 years of experience and
research in Reverse Osmosis Hyperfiltration Technology
from membranes research to desalination of spe-
cialised Governmental projects. Research conducted of
Cellulose Acetate, Cellulose Tri-Acetate and Thim Film
Composite membranes. Elements available of each
type for drinking water applications and water puri-
fying systems.

IMI OPELLA - A DIVISION OF I M I
MOULDINGS,
Twyford Rd, Rotherwas Industrial Estate, Hereford
HR2 6JR. UK. Tel: +44-432 57331. Telex: 35114.
Fax: +44-432 264014. Manufacturers of IMI 400
Series of in-line water filters for domestic and general
purpose applications. Basic models available include
sediment removal, sediment taste and odour removal,
fine sediment removal and bacteriological and fine s
ediment removal.

INDUSTRIAL FILTER & PUMP
MFG CO,
5900 Ogden Avenue, Cicero, IL 60650. USA. Tel: +1-
312-656 7800. Fax: +1-312-656 7806. Manufacturer of
filters, demineralisers and pumps used in the water treatment
industry.

INFILCO DEGREMONT INC,
PO Box 29599, Richmond, VA 23221. USA. Tel: +1-804-
281 7600. Manufacture industrial and municipal water and
wastewater treatment equipment.

INTERTUBE SYSTEMS LTD,
Estover Rd, Plymouth, Devon PL6. UK. Tel: +44-752
775781. Telex: 45260. Fax: +44-752 777316.
Automatic and manual lubrication systems for water treat-
ment and associated plants. Also metering pumps for
antifoam suppression.

JENOLITE LTD,
Unit 19, Vincent Works, Vincent Lane, Dorking, Surrey. UK.
Tel: +44-306 740474. Telex: 268006. Fax: +44-306
740378. Jenolite Ltd - serving the water industry worldwide.
Aldecon T is formulated specifically for cleaning stainless-
steel filters in water-supply undertakings. It removes a wide

variety of contaminants, such as hard-water scale, without
adversely affecting the stainless-steel substrate.

KATADYN PRODUCTS INC,
Industriestrasse 27, Wallisellen, CH 8304.
Switzerland. Tel: +41-18-303677. Telex: 826267 Fax:
+41-18-307942. Developing and manufacturing of
economical, user-friendly and environmentally com-
patible methods of water disinfection and
preservation.

LASERTRIM LTD,
Unit 1, Argyle St Industrial Estate, Hull HU3 1HD. UK. Tel:
+44-482 215335. Telex: 597619. Lasertrim design and
manufacture the CCS - coagulant control system, providing
clients with reliable and repeatable water quality. Can also
supply project engineering services and additional instrumen-
tation to operate in conjunction with the CCS.

LEOPOLD,
227 South Division St, Zelenople, PA 16063. USA. Tel:
+1-412-452 6300. Telex: 866474. Fax: +1-412-452
1377. Leopold manufacture, supply, install and service filter
equipment, (clarifiers, filter control systems, instrumentation,
fiberglass, wash troughs, valves and agitators).

LINK-O-MATIC,
PO Box 148600 North 6th St, Richmond, IN 47375. USA.
Tel: +317-962 1538. Fax: +317-966 0674. Link-O-Matic
is an OEM selling a complete line of water conditioners, fil-
ters, aerators, chlorinators, RO and DI equipment for
residential, commercial and industrial applications. It also
sells a patented 3ins opening rim-plated brass DI exchange
tank adapter and accessories as well as various miscella-
neous products related to the water treatment industry.
Link-O-Matic was established in 1951.

MATT-SON INC,
28 West 005 Industrial Avenue, Barrington, IL 60010.
USA. Tel: +1-312-628 8766. Supplier, manufacturer and
distributor of plastic components. Fiberglass tanks, resins and
filtration media, brine tanks and accessories, cartridges and
filter housings, pipe and pipe fittings and a wide variety of
third faucet components including UV equipment.

MET-PRO CORPORATION,
PO Box 144, 160 Cassell Rd, Harleysville, PA 19438.
USA. Tel: +1-215-723 6751. Telex: 244903. Fax: +1-
215-723 6758. Keystone Filter Division - manufactures

cartridge filtration equipment for removal of sediment, taste and odour, lead, nitrates and other undesirable contaminants in drinking water supplier. Systems Division - manufactures packaged water purification systems, clarifiers, carbon treatment systems and gravity and pressure filtration equipment.

MID AMERICA WATER TREATMENT,

901 West Lake St, IL 60101, USA. Tel: +1-312-289 6400. Water treatment components for industrial, commercial and residential use, which includes all kinds of filters, reverse osmosis, drinking water, control valves and different types media.

NEPCCO,

2140 North East 36th Avenue, Suite 300, Ocala, Florida 32670. USA. Tel: +1-904-867 7482. Fax: +1-904-867 1320. Manufacturers of recovery well pump systems and air-stripper towers, multi-well pump controllers, soil venting systems and catalytic converter systems.

NIAGRA PRODUCTS,

4 Gold Mine Rd, NJ 07836. USA. Tel: +1-201-347 3700. Fax: +1-201-691 2225. Manufacturers of water conservation programmes and products.

WALTER NOLD CO INC,

24 Birch Rd, Natick, MA 01760-1696. USA. Tel: +1-617-653 1635. Researched and discovered new process for degasification of fluids which can degas water, for instance, to boilerwater purity. Has opened many fields: nuclear, medical, geotechnical, wastewater treatment, chemical, ultrapure water and electronics. Fas: degasification without use of heat.

NORTHERN GRAVEL CO,

PO Box 307, Muscatine, IA 52761. USA. Tel: +1-319-263 2711. Fax: +1-319-263 2857. Producers of sand and gravel for use in filtration and suppliers of most related process media.

OLSEN CHEMICAL CO INC,

62 East 26th St, Paterson, NJ 07514. USA. Tel: +1-201-525 2600. Manufacturer of boiler water treatment for business.

OMNI FILTER CORP,

PO Box 2246, Hammond, IN 46323. USA. Tel: +1-219-989 9800. Contact Name: Jeff Rosenzweig.

Manufacturers a full line of residential and light industrial water filtration products and water conditioning products to remove lead, chemicals, tastes, odours, rust and sediment and other contaminants from water, as well as replacement cartridges for major brands of filters.

OSMONICS INC,

5951 Clearwater Drive, Minnetonka, MN 55343. USA. Tel: +1-612-933 2277. Telex: 029-0847. Fax: +1-612-933 0141. Manufacturers of filtration and separation equipment.

PANNONPLAST WORKS

PO Box 30, Budapest 1400. Hungary. Tel: +36-1-225-849. Telex: 223066 PJPJK H. Fax: +36-1-229 228. Production, design and supply of plastic tube settler modules for clarifier intensification. The hydraulic load can be increased up to 6-7 m/h. Smaller surface, less construction costs.

PENFIELD LIQUID TREATMENT SYSTEMS,

8 West St, Plantsville, CT 06479. USA. Tel: +1-203-621 9141. Fax: +1-203-621 2380. Manufacturers of filtration, softening, ion exchange, reverse osmosis and water filtration equipment.

PLENTY FILTERS (A DIVISION OF PLENTY LTD),

Hambridge Rd, Newbury, Berks RG14 5TR. UK. Tel: +44-635 42363. Telex: 848023. Fax: +44-635 49758. Manufacturers of a wide range of basket and edge type protection strainers and filters. The range goes from single basket type up to automatic backflushing type for pipework sizes 1in and above. The strainers and filters are designed to protect pumps, heat exchangers etc by removing solid particles down to 50 micron in size.

POREX TECHNOLOGIES,

500 Bohannon Rd, Fairburn, GA 30213. USA. Tel: +1-404-964 1421. Manufacturer of Porex™ porous plastics used in applications requiring filtering, diffusing, aerating, wicking, venting, muffling, fluidizing and supporting system.

PREMIER COLLOID MILLS LTD,

Hersham Trading Estate, Walton-on-Thames, Surrey KT12 3PZ. UK. Tel: +44-932 26305. Telex: 25539. Fax: +44-932 253234. Manufacturers of flocculators, mixers and

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agitators specially designed for the effluent and water treatment industries. Range - 0.25kw to 25kw, direct drive or geared.

PUK WATER TREATMENT LTD,

Unit 11, Whetynton Close, Riverside, Medway City Estate, Strood, Rochester, Kent ME2 4DP. UK. Tel: +44-634 290142. Telex: 966539. Filtration: Rotary filters for primary or sole filtration and for polishing sewage.

PURITAN WATER CONDITIONING INC,

216 Lafayette Avenue, Crawfordsville, IN 47993. USA. Tel: +1-317-362 6340. Manufacturer of water conditioning and iron filtering equipment.

QPS PLASTICS,

New York Industrial Estate, Summerbridge, Harrogate, North Yorks HG3 4LA. UK. Tel: +44-423 780389. Fax: +44-423 781516. QPS Plastics are suppliers of the 'Q-Cap'TM range of sewage distributor-arm end caps. Cast in EnthaneTM polyurethane, 'Q-Caps' offer many advantages over conventional metal end caps and bungs, including speed of 'flushing' and/or 'rodding out', no corrosion, less weight, greater resilience, reduced handling, etc. A full range of sizes of 'Q-Caps' is available in both BSP threaded and plain tapered.

RUSCO CORP,

13360 Chambord St, Brooksville, FL 34613. USA. Tel: +1-904-596 4200. Fax: +1-904-596 9489. Manufacture plastic spin down sediment filters - operating from one to 100 gallons per minute.

SELECTO INC,

1000 Cobb Place Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000[®] media and leadOUT[®] filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale applications, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE[®] 'add-on' solid-state ultraviolet

water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

STRANCO,

Box 389, Bradley, IL 60915. USA. Tel: +1-815-932 8154. Telex: 703480. Fax: +1-815-932 0674. Manufacture polymer injection equipment for potable and waste water applications.

SULZER (UK) LTD,

Westmead, Farnborough, Hants GU14 7LP. UK. Tel: +44-252 544311. Telex: 858771. Fax: +44-252 518636. Engineers and distributors of mixers for the water and allied industries.

SUNROC CORP,

Rt 452, Glen Riddle, PA 19037. USA. Tel: +1-215-459 1100. Manufacturers of bottled water coolers.

SUTCLIFFE POLCON LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 844509. Provides turnkey solutions for waste water purification including Hycor milli screens for sea outfalls and industrial applications, PCL belt dewatering presses and MEYN dissolved air equipment.

SYBRON CHEMICALS INC,

PO Box 66, Birmingham Rd, Birmingham, NY 08011. USA. Tel: +1-609-894 8211. Fax: +1-609-894 8641. Sybron Chemicals Inc manufactures and markets ion exchange resins under the Ionac brand name for water softening, demineralisation and waste treatment; they also manufacture a complete line of biochem engineered bacteria for waste treatment.

WATCON INC,

2215 South Main, South Bend, IN 46613. USA. Tel: +1-219-287 3397. Water treatment surveys, testing, chemicals, equipment for industrial, commercial, municipal and institutional requirements.

WATER CONDITIONING CONTROLS INC,

418 Division St, Madison, WI 53704. USA. Tel: +1-608-249 5001. Manufacture regeneration and backwash valves for the water conditioning industry.

WATER SYSTEMS WAREHOUSE,
789 West Michigan Avenue, Saline, MI 48176. USA. Tel:
+1-313-429 1846. Wholesale assembly and distribution of
the original patented Paterson Iron Filter which requires no
salt or chemicals for regeneration.

WATERINE SA,
Postfach 23, Mezzovico CH-6849. Switzerland. Tel: +41-
91-95-20-62. Telex: 79-559 WATER CH. Holders of a
worldwide patent for the treatment, conservation and pack-
aging of potable water into sterile polyethylene bags, which
can be stored for up to five years. The water is kept in per-
fect condition with no regermination possible.

WCP SYSTEMS,
245 South Quince St, Escondido, CA 92025. USA. Tel:
+1-619-745 8383. Software for water conditioning indus-
try.

WEAVERBROOK LTD,
12 Draycott Rd, Upper Tean, Staffs ST10 4JF. UK. Tel: +44-
538 723777. Telex: 36523. Fax: +44-538 723723.
Design and manufacture chemical process plant for the
water treatment industry and effluent treatment.

DEVELOPING WORLD

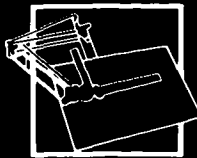
W A T E R

Entries ending in WT are taken from Water Technology Magazine's
Planning & Purchasing Handbook. The subscription Magazine, 13 Century
Hill Dr, Latham, NY 12110, USA. Telephone (518) 783-1281.

WATER ENGINEERING LIMITED

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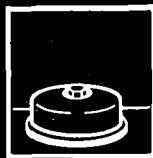
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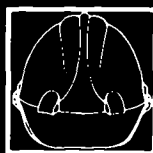
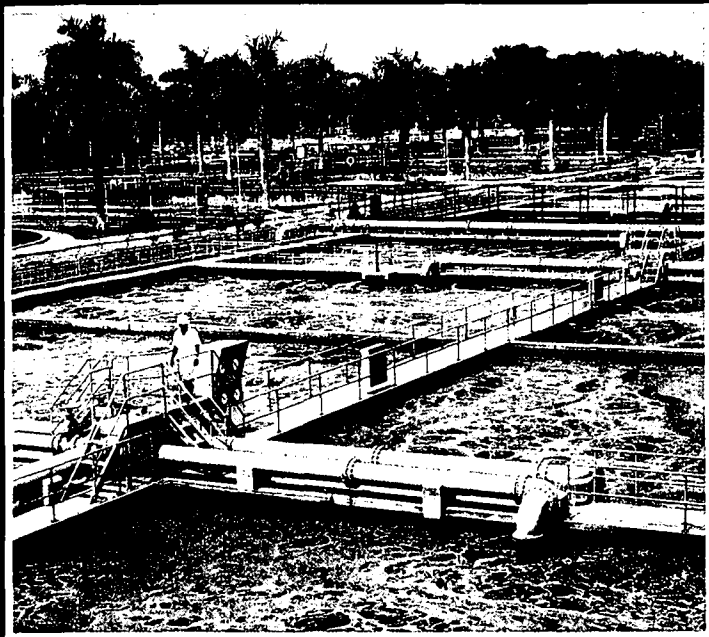
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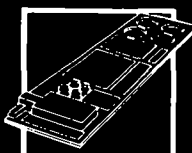
Project Management



Products & Processes



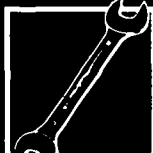
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Aynho Road, Banbury, Oxon OX17 3NL, England. Tel: Banbury (0295) 810581 Telex: 8365
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WAS JEWELLER
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THE IMPORTANCE OF WASTEWATER TREATMENT

by Michael D Smith, Water, Engineering and Development Centre (WEDC).

In many countries wastewater treatment is taken for granted, yet the importance of such treatment can only be fully appreciated if people are aware of the harm that would result from a lack of treatment.

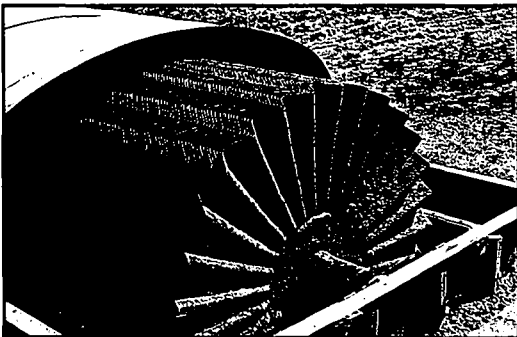
Wastewater treatment is an important form of protection against pollution of the environment and contamination of water resources in all countries, but especially in urban and industrial areas. A survey by the World Health Organisation in 1975 revealed that 75 per cent of urban dwellers in the developing countries did not have adequate sewage disposal facilities. The remaining 25 per cent had no system of any kind.

Domestic wastewater, or sewage, consists almost entirely of water, with solids only comprising about 0.1 per cent (by weight) of the total.

Sewage treatment, in very simple terms, involves separating the solids from the liquids. The solids are likely to contain a range of different materials, including coliform bacteria, pathogenic organisms, dissolved chemicals, organic matter and inorganic matter. The digestive systems of mammals are the exclusive habitat for the coliform bacteria; pathogens are responsible for the spread of diseases; dissolved chemicals may affect plants or animals; organic matter (from dead or decaying plants and animals) will decompose, usually requiring oxygen to do so; and inorganic matter

BELOW LEFT: *The rotating biological contactor (shown here with a cover removed) is a popular form of treating domestic wastewater from small communities in Europe.*

BELOW RIGHT: *Pollution of the River Chari in Chad caused by the discharge of untreated blood from an abattoir.*





Sewers being provided for a densely populated refugee camp in the Israeli-occupied West Bank.

will not decompose. In order for the organic matter to decompose, any atmospheric oxygen dissolved in the water will be used up, but there will be competition with fish and other forms of aquatic life that also need oxygen.

The two major reasons for treating wastewaters can be explained fairly simply, and are to produce a reduction in the potential harm that may be caused by the contents of the sewage. First of all, treatment is needed to reduce the possible spread of disease associated with pathogens that may be present in the wastewater. Secondly, treatment reduces the demand for oxygen needed for decomposition of the organic matter present in sewage, because this oxygen demand will create pollution of the environment. Forms of treatment that are more sophisticated and specialised than normal may be introduced either to treat specific pollutants or to reduce the extent of possible pollution yet more. Waste materials that are present in water can decompose naturally; this process being termed 'natural purification'. This process is relatively slow, and problems arise when the rate at which polluting material is created exceeds the rate at which it may be treated naturally. Organic matter can decompose either aerobically (in the presence

of oxygen) or anaerobically (in the absence of oxygen). Beneficial bacteria are responsible for the decomposition; some bacteria being aerobic, some being anaerobic, some being facultative (able to be either aerobic or anaerobic). The end-products of aerobic decomposition are much simpler chemicals than those from anaerobic decomposition.

If sewage were to be discharged to a river or stream without treatment, some or all of the dissolved oxygen present in the water would be used by the aerobic bacteria to break down the organic matter. Fish and plants will start to die if the dissolved oxygen level drops below about 5.0mg/l; and decomposition would then become anaerobic, creating unpleasant smells, if dissolved oxygen levels were to drop further. The amount of atmospheric oxygen that can be dissolved in water reduces as the temperature rises. Up to 10.1mg/l of oxygen can be dissolved in water at a temperature of 15°C but this reduces to 9.1mg/l at 20°C and 8.3mg/l at 25°C. The presence of other dissolved materials in water reduces the amount of oxygen that may be dissolved, and thin films of oil on the surface of water can significantly reduce the rates at which oxygen is dissolved. Ammonia, which is also present in wastewater, can be bro-

ken down by certain bacteria to nitrates and nitrites. Nitrates encourage growth of plants and algae, but ammonia at concentrations of more than about 0.02 or 0.025 mg/l can be toxic to fish.

Wastewater treatment processes try to utilise natural treatment methods, and to improve upon them. Processes generally involve both physical treatment (settlement and removal of solids) and biological oxidation (decomposition of organic matter). Provision of wastewater treatment facilities allows treatment to occur prior to discharge of the end-products to the environment. By providing treatment within a confined environment, the natural purification processes can be encouraged, controlled and monitored. The advantages of this are many:

- Fish and plants can be excluded from the confined environment within which treatment is effected, so that there need be no competition for the available oxygen;
- Numbers of pathogenic bacteria can be reduced to a safe level, prior to discharge, in an environment where people are unlikely to come into contact with wastewater;
- Within a confined environment processes can be carefully controlled to provide ideal conditions for treatment to take place;
- Within a confined environment the effectiveness of the treatment processes can be monitored;
- Ideal living conditions are provided for the bacteria that feed on organic matter, to ensure rapid treatment; and
- Facilities can be provided to ensure that conditions remain aerobic (where this is necessary) and do not become anaerobic.

A significant proportion of wastewater flows in some areas comes from industries of various kinds which discharge waste materials to sewers. These wastes from manufacturing processes and industries, such as soft drinks bottling plants, dairies, food processing units and chemical works, are known as trade effluent.

Some of the chemicals in trade effluent may be toxic or harmful to humans, animals and the micro-organisms responsible for wastewater treatment. Some trade effluents may also contain corrosive materials (strong acids and alkalis) which could attack equipment and sewer linings. The amount of such potentially dangerous chemicals needs to be carefully controlled to safeguard

the men who may work in sewers and to protect the bacteria that purify the wastewater. Some industries attempt to discharge dangerous chemicals to the sewers either illegally or in excessive amounts; yet other industries may provide their own treatment facilities to reduce the strength of their discharges to sewers or to fully treat the sewage on-site.

Networks of sewers to collect and convey wastewater may be either separate or combined. Separate sewers convey only domestic and industrial wastewaters to treatment, whereas combined systems also carry stormwater collected from rain falling on roofs, streets and the ground.

In areas that are served by separate systems, stormwater is collected in separate sewers or open-channel drains and discharged to local natural drainage routes. The stormwater entering the sewers and drains of a combined system after a period of rain will significantly increase the volumes of sewage flowing in a given time.

Suitable sewage treatment techniques have been developed for use in different situations and countries. For any situation, the most appropriate methods may be chosen from consideration of such factors as: capital and recurrent costs, treatment needs, and availability of land, skills and energy resources.

Both aerobic and anaerobic treatment processes may be used in suitable situations to treat, or partially treat, wastewaters. Both treatment processes break down organic matter into simpler chemicals, but anaerobic methods provide only partial treatment. Anaerobic processes occur when the rate of oxygen supply is insufficient, and are suitable for use with high-strength wastes: aerobic methods lend themselves to effective treatment of domestic wastewaters. The relative costs of each form of treatment need to be considered, and some of the major features of the two types of process are compared in Table 1.

The extent to which treatment is required depends upon whether the treated wastewater is to be discharged to a water body (such as rivers or seas) or whether it is to be re-used (eg for irrigation). In many countries the parameters that are most commonly used for comparing the strengths of raw sewage and treated effluents are suspended solids and Biological Oxygen Demand (BOD). Concentrations of dissolved nitrates are now also

Type of treatment process	
Aerobic	Anaerobic
Breaks down organic matter to very simple products.	Breaks down organic matter to relatively simple products.
Provides full treatment and produces good-quality effluent.	Provides only partial treatment.
Suits domestic wastewaters.	Suitable for partial treatment of high-strength wastes.
Requires a steady supply of oxygen.	Occurs when the rate of oxygen supply is insufficient for aerobic processes.
Produces little smell.	Usually produces unpleasant smells.

ABOVE: Table 1. Comparison of Aerobic and Anaerobic Treatment Processes. Parameters for raw and treated wastewater

receiving greater attention as indicators of pollution. In hot climates, and in countries where people are likely to come into contact with rivers and lakes containing raw or treated sewage, the numbers of bacteria is likely to be the most important measure of water quality. It is not desirable to adopt quality standards from other countries, but to consider local conditions and to set realistic targets, giving due consideration to treatment costs, treatment methods and the means of disposal or re-use of the treated sewage.

In developed countries, attention has concentrated on reducing the amount of organic matter and solids in wastewater, and reduction of the numbers of bacteria present is generally given a low priority. Most conventional sewage treatment works in developed countries therefore reduce bacterial numbers by about 90 per cent. This may appear to be an impressive amount, but it means that bacterial numbers in a typical wastewater are only reduced from about 200 million per litre to about 20 million per litre. Disinfection of treated wastewaters is used in some countries, but it is both expensive and capable of producing dangerous chemicals. The importance of reducing bacterial numbers is much greater in developing countries, where people are more likely to come into contact with water, and to use rivers and

lakes as sources of water for washing and drinking. Treatment of sewage in waste stabilization ponds, which consist of several large man-made lagoons in series, can reduce the numbers of bacteria from about 200 million per litre to less than 500 per litre. Waste stabilization ponds require large areas of land, and only require energy from the sun to assist with the purification process. Hot climates therefore assist the operation of the ponds, which are the most appropriate wastewater treatment option for use in hot countries where land is readily available. The low construction and operating costs, the ease of operation and maintenance, the good bacteria removal possible and the freedom from use of expensive energy sources are all advantages that mean that waste stabilization ponds are usually the most suitable form of sewage treatment for developing countries.

Careful consideration needs to be given, in any situation where wastewater requires treatment, to all aspects of operation and maintenance for each treatment option in order to establish which of the alternatives is most suitable. Whatever option is selected, it should satisfy the two principle reasons for treating wastewaters, namely to reduce the spread of diseases and to reduce environmental pollution.

BIOLOGICAL TREATMENT

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AERATION INDUSTRIES INTERNATIONAL INC,

4100 Peavey Rd, Chaska, Minnesota 55318. USA. Tel: +1-612-448 6789. Telex: 910-5780838. Fax: +1-612-448 7293. Aire-02: A patented aspirator aerator. Mixes and circulates the water in a horizontal fashion, a necessary factor in the biological treatment of wastewater.

AQUA-AEROBIC SYSTEMS INC,
PO Box 2026, 6306 North Alpine Rd, Rockford, Illinois 61130-0026. USA. Tel: +1-815-654 2501. Fax: +1-815-654 2508. Aqua-Aerobic Systems Inc is a designer/manufacturer of equipment used in the biological treatment of water and wastewater. Equipment includes: direct drive aerators, direct drive mixers, automatic backwash filters and a sequencing batch reactor (SBR) system.

AQUAMECH CORPORATION SDN BHD,

5 Jalan Segambut Pusat, Segambut, Kuala Lumpur 51200. Malaysia. Tel: +60-3-62699306298296262524. Fax: +60-3-6215642. A Malaysian incorporated Ltd company specialising in designing process, manufacturing and installing equipment particularly suited to the developing countries, with emphasis in biological treatment; activated sludge package sewage and wastewater treatment plants, mechanical screens, clarifier and sludge thickener, scraper drives, bridge mounted and floating low speed mechanical surface aerator.

AUREPA FAHRZEUGWERKE HEITGER GMBH & CO,

11 Industriestrasse or PO Box 14 80, Hockenheim-Talhaus D-6832. West Germany. Tel: +49-6205/2006-0. Fax: +49-6205/8324. Supply of Biofiltromat compact units for biological cleaning of waste water in particular from industrial productions with special filter and oxygen supply for activating the biological process. By adding further fine filters, purified water can be used for industrial or drinking water. The Biofiltromat process is environmentally beneficial.

BIOFLOW (ENVIRONMENTAL CULTURES) LTD,

Unit 18, Raleigh Industrial Estate, Eccleshall, Staffs ST21 6JL. UK. Tel: +44-785 851573. Telex: 36136. Environmental laboratory supplying bacteria cultures for various wastewater

treatments including biological and hydraulic overloads, grease, odour, sludge-improvement and specific applications.

BIOLOGISCHE VERFAHRENS-TECHNIK GESELLSCHAFT MBH,

Arlbergstrasse 139F9Bregenz, A-6900. Austria. Tel: +43-557437-7-002. Telex: 57430 MANAL A. BVT have developed an up-to-date high-economy digester for the anaerobic treatment of the highly polluted waste water and sludges occurring in the agro-industry and for the liquid and solid manure from farms and intensive livestock raising enterprises. The production of methane, the high waste water cleansing rate and the high quality of the manure make the digester a paying proposition and ensure maximum environmental protection. Designed to operate without energy requirements or mechanical parts, the patented BIMA three-chamber mixing system is of rugged design and easy to service.

BIOSCIENCE MANAGEMENT INC,

1530 Valley Center Parkway Suite 120, Bethlehem, PA 18017. Tel: +1215-974 9693. Fax: +1215-691 2170. Bioscience Management Inc is an environmental biotechnology company, manufacturing and marketing specialised bacterial products for enhancement of industrial wastewater treatment (biological). We also carry a line of respirometric instrumentation for monitoring of biological degradation. BMI also has a fully equipped laboratory which is capable of performing biodegradation feasibility studies for organic contamination in soil and/or groundwater.

BOC LTD,

24 Deer Park Rd, London SW19 3UF. UK. Tel: +44-81-543 3911. Telex: 263490. Fax: +44-81-540 6557.

Manufacturers and suppliers of oxygen and other industrial gasses and of gas manufacturing plant. Processes include: Primox - oxygen injection equipment for pumped and gravity sewers; Vitox - high efficiency oxygenators for sewage treatment.

BRINECELL MANUFACTURING CORP,

2109 West 2300 South, Salt Lake City, Utah 84119. USA. Tel: +1-801-973 6400. Fax: +1-801-973 6463. This well established US manufacturer markets its multi-patented water treatment, Brinecells. The equipment operates using salt (NaCl) as the source of sewage treatment. Electrolysis of the water and salt liberates nascent ozone, nascent chlorine and their respective hydroxyl/free radicals. Produced simultane-

ously and working synergistically, these agents have proven to destroy PCB's and all oxidisable organics while sterilising and decolouring the effluent leaving it safe and legal to dispose of. Brinecells recirculate the effluent from 200 litres per minute to as high as 8m³ per minute using from 1 to 8 KWH. Maintenance requires only a five minute acid wash daily (per unit) and each has its own built-in-acid washer. Plain 35 per cent HCl is recirculated through the cells and reused rather than consumed. Four models are available.

BS FLOCOR LTD,

E5, Stafford Park 15, Telford TF3 3BB. UK. Tel: +44-952 290350. Telex: 35835. Fax: +44-952 290353. Suppliers of patented Flocor® plastics biofiltration media for sewage and effluent treatment, MAT Aerators and Cyclomat units for aeration of lagoons, fish farms, lakes and sewage treatment. Also Photozone activated air systems for sterilisation of water in cooling systems, swimming pools and other duties.

CARBORUNDUM ABRASIVE GB LTD,

PO Box 55, Trafford Park, Manchester M17 1HP. UK. Tel: +44-61-872 2381. Telex: 667344. Fax: +44-61-872 1471. Supply a range of vitrified effuser products used in the aeration technique of sewage management. Manufacture both domes and discs to exacting standards and to a precise permeability.

CWG GMBH,

Hasenacker Str 19-25, 6800 Mannheim-1. West Germany. Tel: +49-0621 817015. Fax: +49-0621 818990. Wholesalers for the following products for water treatment. Chemicals for wastewater treatment; Industrial wastewater treatment; Special purpose pumps, pipes and other equipment; Pumps - positive displacement and other special pumps; Analysers, electrodes and meters; Control equipment; Dosing systems and equipment; Meters - flow measurement and Cooling towers and equipment.

DAVIS-EMU,

1706 Metcalf Avenue, Thomasville, CA 31792. USA. Tel: +1-912-226 5733. Fax: +1-912-226 4793. Manufacturer of submersible sewage pumps and aeration equipment.

DEEP SHAFT TECHNOLOGY INC,

801 York Mills Rd, Don Mills, Ontario M3B 1X7. Canada. Tel: +1-416-391 5616. Fax: +1-416-391 1326. Deep Shaft Technology Inc, are a drilling company and process

engineering firm specialising in a unique wastewater treatment process. The Deep Shaft process is a biological treatment system utilising a totally enclosed steel cased reactor 200-500ft deep. This process treats both municipal and industrial wastewater.

ECOLOGICAL LABORATORIES INC,

Box 123, 123 Henry St, Freeport, NY 11520. USA. Tel: +1-516-379 3441. Fax: +1-516-379 3632. Manufacturer of bacterial products for the waste water industry.

EFLO INTERNATIONAL LTD,

Bath Rd, Padworth, Reading, Berks RG7 5HR. UK. Tel: +44-734 712648. Telex: 848673 EFLO G. Fax: +44-734 712901. Designers, suppliers and contractors to the waste water industry with both aeration and rbc based treatment systems. Suppliers of Sewpass sludge handling equipment and earth anchors.

ETA PROCESS PLANT LTD,

The Levels, Brereton, Rugeley Staffs WS15 1RD. UK. Tel: +44-889 576501. Telex: 36519 ETARUG G. Fax: +44-889 579856. ETA Process Plant manufactures random plastic media for high rate biofilters as replacement for existing rock media. In new installations we also supply support decking and distributors to complete the system. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

FILTROS PLANT FERRO CORP,

603 West Commercial St East, Rochester, NY 14445. USA. Tel: +1-716-586 8770. Fax: +1-716-586 7154. FilTROS diffusers consist of porous ceramic materials in the shape of tubes, plates, discs and domes. Diffuser tube and disc assemblies are offered for connection into an air supply to provide small-bubble aeration for sewage treatment. Porous ceramic filter plates are used for underdrains in water filtration facilities.

GENERAL ENVIRONMENTAL SCIENCE CORPORATION,

PO Box 22294, Beachwood, Ohio 44122. USA. Tel: +1-216-795 4733. Fax: +1-216-795 1311. Manufacturer of the LUMO® system products which are bacterial suspensions used in waste and wastewater treatment systems to enhance efficiency, reduce and/or remove sludge from treatment plants and lagoons, used where grease and fats are a par-

BIOLOGICAL TREATMENT

ticular problem and for nitrification and denitrification in wastewater treatment and aquaculture.

HAZLETON ENVIRONMENTAL PRODUCTS INC,
225 North Cedar St, Hazleton, Pennsylvania 18201-0488.
USA. Tel: +1-717-455 7711. Telex: 831881. Fax: +1-717-459 2586. Contact Name: Mr Randy Galgon. Hazleton Environmental Products Inc is a designer/manufacturer of aspirating submerged turbine aerator/mixers.

HICK HARGREAVES & CO LTD,
Crook St, Bolton, Lancs BL3 6DB. UK. Tel: +44-204 23373. Telex: 63244. Fax: +44-204 39526. Hick Hargreaves blowers are used extensively to provide oil free air for effluent and water treatment. The 2000 and 4000 Sseries cover capacities from 35 to 900 M³/hr and larger blowers can be supplied for capacities up to 45,000 M³/hr. Standard packages and custom built installations can be supplied to meet particular requirements.

HOWDEN WADE LTD,
Crowhurst Rd, Brighton, Sussex BN1 8AJ. UK. Tel: +44-273 506311. Telex: 87511. Fax: +44-273 557123.
Reputable blower manufacturer represented through the world. Equipment utilised extensively for filter air scour and waste water aeration by many potable water authorities and purification plant contractors.

ICI BIOLOGICAL PRODUCTS,
PO Box 1, Billingham, Cleveland TS23 1LB. UK. Tel: +44-642 523786. Telex: 587443 ICIAGH G. Fax: +44-0642 522676. ICI has a worldwide network of licensees who can provide design, construction and commissioning of its Deep Shaft process technology. The Deep Shaft process is increasingly used to treat a range of effluents including domestic, industrial/food, alcohol, pulp and paper etc. Low running cost, low capital cost, high on transfer rate and low land area are just some of the advantages.

ICI PROFESSIONAL PRODUCTS,
Woolmead House East, Woolmead Walk, Farnham, Surrey GU9 7JB. UK. Tel: +44-252 724525. Telex: 858347.
Actellic M20 insecticide for use against chironomids, sylvicola and psychoda on sewage filter beds. Midstream and caseron aquatic herbicides for weed control in waterways.

INFOLCI ESPANOLA SA,
Avenida De Burgos, 19, Madrid 28036. Espana SpA.

Tel/Fax: +34-766-34-00. Treatment plants for waste and drinking water.

INNOVA-TECH INC,
PO Box #920, Valley Forge Corporate Center, Valley Forge, Pennsylvania 19481. USA. Tel: +1-215-666 9080. Fax: +1-215-666 1766. Full line capabilities: Whether you're interested in a complete waste treatment proposal or a modification of your existing facility, you can count on Innova-Tech to meet your needs. We can provide flow equalisation systems, dissolved air flotation, aeration, biological treatment and clarification. Nutrient removal can be obtained with our Total Barrier Oxidation Ditch (TBOD).

INTERNATIONAL BIOCHEMICALS LTD,
Galvin Rd, Slough, Berks SL1 1DL. UK. Tel: +44-753 71551. Fax: +44-753 694201. Contact Name: Rob Scott. Manufacturers and suppliers worldwide of the Bioyte. Ecolyte range of microbial products. For use in waste water treatment plants to biologically treat common problems like start-up, breakdown of complex organics, bulking sludge, filamentous growth, odours, ponding filters, organic overload, lack of nitrification and loss of biomass. Consultancy and site inspection, design advice and troubleshooting a speciality.

JONES & ATTWOOD LTD,
Titan Works, Stourbridge, West Midlands DY8 4LR. UK. Tel: +44-384 392181. Telex: 338120. Fax: +44-384 371937. Jones & Attwood founded 1876, pioneered activated sludge treatment process in early 1900s. Since 1950s has concentrated on the pre-treatment phase, specialising in the removal/processing of non-biodegradable solids in municipal/industrial effluent treatment plants.

MASS TRANSFER INTERNATIONAL,
Haversham, Cumbria LA7 7EB. UK. Tel: +44-4482 3851. Telex: 65145. Fax: +44-4482 2729. World leaders in the design and supply of low-energy, anaerobic and nitrification effluent treatment plant. Over 2,000 plants worldwide, treating an extensive range of industrial and municipal effluents.

NORTHEY ROTARY COMPRESSORS LTD,
Alder Rd, Parkstone, Dorset BH12 4BB. UK. Tel: +44-202 741725. Telex: 41444. Oil-free gas compressors for the recirculation of Bio Gas in anaerobic digestion. Oil-free

compressors for aeration purposes, and oil-free vacuum pumps.

NSW ENVIRONMENTAL SYSTEMS,
PO Box 1464, Nordenham D-2890. West Germany. Tel: +49-4731-82-224. Telex: 238315 NSW D. Fax: +49-4731-82-301. Biological sewage treatments for domestic and industrial wastewaters; stripping towers for water and process engineering industries; biological denitrification systems; air pollution control equipment for acidic oil and elimination.

PANNONPLAST WORKS,
PO Box 30, Budapest 1400 Hungary. Tel: +36-1-225-849. Telex: 223066 PUPKK H. Fax: +36-1-229-228. Production, design and supply of plastic modules for biological trickling, filter towers and rotating biological contactors. The company has four plants and 1800 staff.

POLIMEX - CEKOP LTD,
7/9 Czackiego Str, Warszawa 00-950. Poland. Tel: +48-26-80-01. Telex: 814231. Fax: +48-26-04-93. Polimex Cekop Ltd fights pollution of the environment and ensures clean water, offering: services of our specialists in research and design works of wastewater processing methods; deliveries of biological sewage treatment plants for campsites, hotels and municipal agglomerations. Our projects feature high purity of water after treatment, low power consumption and minimum area requirement.

POLIMEX - CEKOP LTD,
7/9 Czackiego Str, Warszawa 00-950. Poland. Tel: +48-26-80-01. Telex: 814231. Fax: +48-26-04-93. Polimex Cekop Ltd fights pollution of the environment and ensures clean water, offering: services of our specialists in research and design works of wastewater processing methods; deliveries of biological sewage treatment plants for campsites, hotels and municipal agglomerations. Our projects feature high purity of water after treatment, low power consumption and minimum area requirement.

POLYBAC CORPORATION,
954 Marcon Boulevard, Allentown, PA 18103. USA. Tel: +1-215-264 5740. Fax: +1-215-264 8013. Biomass engineering firm providing services to commercial, industrial and municipal clients. Develop, manufacture, distribute and sell specialised microbes and related biochemicals, equipment and speciality chemicals for pollution control, pre-treatment, detoxification and degradation of industrial and municipal wastes.

PURAC AB,
PO Box 1146, Luna S-22105. Sweden. Tel: +46-46-135100. Telex: 8305083. Fax: +46-46-14 6988. Low-energy two-stage biological systems applicable to many wastewater treatment problems to economically meet stringent effluent standards. Some plants have as much as 20 tons BOD+OAD PER DAY.

PURATOR KLARANLAGEN,
Goldegasse 2, Wien A-1040. Austria. Tel: +43-222-65-67-85. Telex: 132716. Purator specialist in: sewer, separator and sewage clarification engineering. The line-up embraces: installations for conveying waste water from point of origin to sewer (eg manhole covers, gullies etc), petroleum, grease and starch separators, biological clarification plants for sewage, industrial and municipal waste waters (eg activated-sludge plants, bio filters, trickie filters, etc).

PWT PROJECTS LTD,
632-652 London Rd, Isleworth, Middlesex TW7 4EZ.
UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.
Fax: +44-81-568 5479. Activated sludge processes for treatment of domestic sewage and biodegradable industrial effluents. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

SHERIDAN PRODUCTS,
4591 West Overlook Drive, Williamsville, NY 14221. USA. Formulator of specially selected bacterial cultures for pollution abatement and order control.

SOCIETE D'AMENAGEMENT URBAIN ET RURAL,
Challenger 1, Avenue Eugene Freyssinet, Saint Quentin Yvelines, Cedex 78064. France. Tel: +33-1-30602260. Telex: 689292 SAUR F. Fax: +33-1-30602289. SAUR is capable of collection, processing and recycling of solid wastes; utilities operator; design engineer and contractor for water pumping, sewage treatment and solid wastes recycling plants.

SOLMAR CORP,
625 West Katella Avenue Suite 5, Orange, CA 92667. USA. Tel: +1-714-538 0881. Manufactures of advanced bio cultures for enhancing wastewater treatment, controlling malodors and degrading fats and oils. Heavily involved in degradation of organic hazardous wastes.

CHEMICALS FOR WASTEWATER TREATMENT

SUTCLIFFE POLCON LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 841503. Provides turnkey solutions for waste water purification including Hycor milli screens for sea outfalls and industrial applications, PCL belt dewatering presses and MEYN dissolved air equipment.

SYBRON CHEMICALS INC,

PO Box 66, Birmingham Rd, Birmingham, NY 08011. USA. Tel: +1-609-894 8211. Fax: +1-609-894 8641. Sybron Chemicals Inc manufactures and markets ion exchange resins under the ionac brand name for water softening, demineralisation and waste treatment; they also manufacture a complete line of biochem engineered bacteria for waste treatment.

TECH-LINE INSTRUMENTS/ARTECH INTNT'L,

Tri Campus Park PO Box 1236, Fond du Lac, WI 54936. USA. Tel: +1-414-922 6970. Fax: +1-414-922 1085. Manufactures and sells automated laboratory and on-line respirometers that provide real time biological information used in monitoring and controlling the wastewater process. Applications include process control, troubleshooting of biological processes, toxicity-treatability testing, anaerobic digestion-short term BOD testing, compost testing and plant design. Sample chambers from 250ml - 10L and up.

WAAGNER-BIRÉ,

Stadlauer Strasse 54, Wien, Aktiengesellschaft A-1220. Austria. Tel: +43-222 2244. Telex: 134827 AVVBWA. The environmental engineering division of Waagner-Biré offers the following: biological waste water treatment, sewage purification systems for municipal and industrial effluents.

WATER ENGINEERING LTD,

Aynho Rd, Adderbury, Banbury, Oxon OX17 3NL. UK. Tel: +44-295 810581. Telex: 83655. Fax: +44-295 811997. Design and supply of municipal effluent and water treatment plants worldwide, either on a project management basis or as individual products and process - extending to installation and commissioning.

CHEMICALS FOR WASTEWATER TREATMENT

ALLIED COLLOIDS LTD,

PO Box 38 Low Moor, Bradford, West Yorks BD12 0JZ. UK.

Tel: +44-274 671267. Telex: 51646. Fax: +44-274 606499. Suppliers of high efficiency chemicals specifically designed for solids/liquid separation processes within the potable water, sewage and industrial waste water fields. The unit processes which can benefit both technically and economically from the application of these products include sedimentation, flotation, thickening and dewatering.

AMERICAN INTERNATIONAL CHEMICAL INC,

27 Strathmore Rd, Natick, MA 01760. USA. Tel: +1-617-655 5805. Suppliers of chemicals for the water and waste water treatment industries: potassium permanganate, sodium fluoride, sodium hexametaphosphate, copper sulphate, sodium chlorite and more.

AMERICAN NORIT CO INC,

420 Agmac Avenue, Jacksonville, FL 32205. USA. Tel: +1-904-783 6406. Manufacturer of a wide range of activated carbons designed to deodorise, decolourise, clarify or purify water, waste water or process stream. A wide variety of unique pore size carbons are available to solve tough treatment problems.

ANGLO-DUTCH CARBONS LTD (50% OWNED),

Guest St, Leigh, Lancs WN7 2HE. UK. Tel: +44-942 672101. Telex: 67555. Fax: +44-942 677136.
Distributes specialist water-treatment carbons in the UK.

AQUARIUS WATER PURIFICATION LTD,

Unit 12, Craven Court, Winwick Quay, Warrington, Cheshire. UK. Tel: +44-925 445144. Telex: AQUA 627151. Fax: +44-925 413524. Aquarius 150 for recycling waste water.

BIOMECHANICS ENVIRONMEN- TAL LTD,

1 Station Rd, Four Ashes, Wolverhampton WV10 7DQ. UK. Tel: +44-902 791616. Telex: 335684. Fax: +44-902 791772. Specialise in the design, supply, installation and commissioning of plants for waste and water purification and for the treatment of toxic and non-toxic waste embracing the latest technology. Biomechanics specialise in the anaerobic treatment of effluent for the food and allied beverage industries and offer turnkey package services to clients.

BK LADENBURG,

Dr Albert-Reimann-Strasse 2, Ladenburg D 6802. West Germany. Tel: +49-6203-77-4307. Fax: +49-6203-1-2818. The use of Labulloc®, a series of organic high-molecular flocculants, improves the economical and technical quality of the following water or waste water purification: sedimentation, flotation, static and pressure filtration, sludge thickening and dewatering.

BLUE CIRCLE INDUSTRIES PLC,

2 Hassell St, Newcastle Under Lyme, Staffs ST5 1AG. UK. Tel: +44-782 618668. Telex: 367119. Clarifloc is Blue Circle's inorganic coagulant for the physico-chemical treatment of sewage and polluted wastewaters. It can be used as an aid to conventional settlement processes, and is capable of achieving significant reductions in contamination levels. Its versatile properties are being used to control and eliminate odours and treat industrial wastes. It has the added advantage of being delivered to site ready to use, for direct dosing into the wastewater stream under treatment.

BOLIDEN WATER TREATMENT,

PO Box 902, Helsingborg S-25109. Sweden. Tel: +46-42-171000. Telex: 72185 BOLIDV5. Fax: +46-42-130570. Boliden Water Treatment Divisions business is to develop, manufacture and market precipitants for treating drinking water and sewage water as well as systems for storage and dosing of these products. Boliden Water Treatment takes responsibility for the entire treatment process with process engineering knowhow, precipitants, transport systems, equipment for storage, dosing and mixing of the products - all to achieve an optimum combination of cost and best results. Precipitation products for water and waste water treatment include: aluminium sulphate, ferric aluminium sulphate, ferric chloride/sulphate, polymerised chloride or sulphate based liquid and solid precipitants. The company also provides research and development, technical knowhow on new treatment processes for chemical waste water treatment, pre-precipitation, removal of phosphorus and nitrogen. Water and waste water equipment includes: centrifuges, dosing pumps, scrapes, silos and dosing equipment.

BRENCO INTERNATIONAL,

30 Kirkham Industrial Court, St Louis, Missouri 63119. USA. Tel: +1-314-968 0404. Fax: +1-314-968 2465. Brenco International produces and markets, on a worldwide basis, wastewater treatment chemicals for industrial and commercial use.

CARMEUSE SA,

Rue de Chateau 13, 5210 Seieles. Belgium. Tel: +32-85-82-50-09. Telex: 59608. Fax: +32-85-82-63-02. **CARMEUSE is a producer of calcium carbonate, calcium oxide and calcium hydroxide, in Belgium, the Netherlands and France. In the water treatment area, the calcic products are used for: Flocculation of impure water, remineralisation of drinking water, softening of industrial and potable waters, pH correction of drinking waters and industrial waters, residual mud conditioning before dessication, disinfection and pasteurisation of residual muds, dephosphatation of waters. A recent development is a ready-made lime milk with a dry content of 30 per cent, delivered to local water treatment plants. As some of the lime qualities are very pure, Carmeuse lime is often used in the area of drinking water treatment. Due to its excellent geographical position, close to the harbour of Antwerp and Rotterdam, Carmeuse exports large quantities of lime to all countries of the world, especially to Africa and the Middle East.**

CARUS CHEMICAL CO,

1500 Eighth St, La Salle, IL 61301. USA. Tel: +1-815-223-1500. Manufacturer of potassium permanganate, chemical for water treatment, air pollution control and wastewater treatment.

CHEMOLIMPEX HUNGARIAN TRADING CO FOR CHEMICALS, H-1805 Budapest, PO Box 121. Hungary. Tel: +36-1-1640240. Telex: 226333. Fax: +36-1-1640078.

Chemolimpex handles the export of the ion-exchange resins which are manufactured by Nitrokemia and marketed under the brand-name VARION. Ion-exchange resins are widely used for water treatment in all fields of industry. We have developed specific ion-exchange resin types for the following main applications: conventional industrial water treatment, decontamination of radio-active waste, household-water treatment, micro-ion-exchange resin (more effective than powder resin).

DEPUREX 88 SRL,

Via R Colpi 33, Limena - Padova 35010. Italy. Tel: +39-049 768255. Production of chemicals and devices for water treatment for industrial and civil usages.

EES CORP,

12850 Bournewood Drive, Sugar Land, Texas 77478.

CHEMICALS FOR WASTEWATER TREATMENT

USA. Tel: +1-713-240 6770. Telex: 795459. Fax: +1-713-240 6762. The Sanuril® 115 formulated wastewater disinfection tablet contains 70 per cent available chlorine. These large, 2.625ins diameter, 145 gram tablets are also the safest form of chlorine. The tablets are dispensed in one of EES tablet feeders, which are capable of disinfecting up to 50,000 gallons per day. Disinfection is done with no moving parts or electricity. D-Chlor® tablets in EES feeders are available to remove chlorine prior to discharge.

GOLDCREST CHEMICAL LTD,
Armitage Bridge Mills, Armitage Bridge, Huddersfield, West Yorks HD4 7NR. UK. Tel: +44-484 666606. Telex: 517243. Manufacturers and suppliers of chemicals and equipment for water, sewage and effluent treatment. The product range includes inorganics, synthetic polymers starch derivatives and enzymes plus equipment for their efficient application.

GRACE DEARBORN LTD,
Wianes, Cheshire WA8 8UD. UK. Tel: +4451-424 5351. Fax: +4451-423 2722. Suppliers of speciality chemicals and consultancy for treatment of steam raising plants; cooling water systems, air conditioning plants and waste water treatment.

GUARDIAN CHEMICAL SPECIALITIES,
PO Box 1743, 1225 West Princess St, York, PA 17405. USA. Tel: +1-717-848 2570. Develop and market products and consultation services for industrial influent to effluent water treatment requirements. This includes clarification, pre-treatment equipment, boiler water chemical treatment, cooling water chemical treatment, fuel additives and waste water programme.

HUNGALU TRADING CO,
PO Box 63, Budapest 1388. Hungary. Tel: +36-1-494750. Telex: 22-54-71. Fax: +36-1-402-723. Granulated aluminium sulphate for water purification and sewage purification.

INTEROX CHEMICALS LTD,
PO Box 7, Warrington, Cheshire WA4 6HB. UK. Tel: +44-925 51277. Telex: 82221. Chemical manufacture with water, sewage, industrial effluent, gas scrubbing and disinfection as speciality areas.

JOSHUA GREAVES & SON LTD,
PO Box 2, Garden St, Ramsbottom, Nr Bury, Lancs. UK. Tel:

+44-706 824193. Telex: 635265. Joshua Greaves & Son Ltd manufacture a complete range of fluid mixers and offer chemicals for use in the water and sewage industry.

KING LEE CHEMICAL CO,
PO Box 146, Del Mar, California 92014. USA. Tel: Tel/Fax: 1-619-693 1358. King Lee offers safe and highly effective microbiological additives for the Secondary Treatment of municipal sewage. Additives provide complete break down of sewage into non-hazardous simple end products for the safe processing of sewage. In addition, additives eliminate Hydrogen Sulphide and other undesirable end products by controlled microbiological reactions. Distributor inquiries are welcome.

KRONOS TITAN-GMBH,
PO Box 100720, Leverkusen 1, D-5090. West Germany. Tel: +49-214 3560. Telex: 8510823. Fax: +49-214 356481. KRONOS Water Treatment Chemicals based on iron salts for the treatment of drinking water, process water and cooling water; for purification of industrial and municipal waste water; for dewatering of sewage sludge; and for the pre-treatment for seawater desalination by RO and odour control for waste water collection systems. Many years of successful experience in water treatment and waste water purification qualify KRONOS TITAN-GmbH for a leading position in this field. KRONOS-TITAN GmbH is a subsidiary of NL Chemicals Inc, Hightstown/USA a company with an annual turnover of over 1,000 million US-\$. KRONOS Water treatment chemicals are sold worldwide and produced in Leverkusen and Nordenham, West Germany and in Fredrikstad, Norway.

MELCHEMIE HOLLAND BV,
Jansbuicingsingel 20, Arnhem. The Netherlands. Tel: +31-85451251. Telex: 4501945523. Fax: +31-85-425-093. Dry Chlorine Products (calcium hypochlorite and other disinfectants), flocculants (aluminium sulphate, ferrous sulphate, polyelectrolytes), pH regulating agents (hydrated lime, sodium carbonate and sodium bicarbonate), sanuril 115, aquaward (easy chlorination system), melqu'ick (effervescent chlorine tablets) and swimming pool chemicals.

MISAN CHIMICA SPA,
Loc Ponte Riccio, Qualiano, Napoli 80019. Italia. Tel: +39-081 8181611. Fax: +39-081 8183387. Manufacture and sale of chemicals for the treatment of water-waste water-fuels.

OLIN CHEMICALS,
120 Long Ridge Rd, Stamford CT 06904. USA. Tel: +1-203-356 2000. Telex: 4750119. Fax: +1-203-356 3541. Manufacturer of HTH® Calcium Hypochlorite in granular and tablet forms and Isocyanurates in granular, powder and tablet forms. Applications in water treatment, beverage plants, industrial plants, food plants, sewage disposal.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61. Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

SELECTO INC,
 1000 Cobb Place Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000® media and leadOUT® filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale applications, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE® "add-on" solid-state ultraviolet water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

STRANCO LTD,
 Commercial Rd, Eastbourne, Sussex BN21 3XE. UK. Tel: +44-323 370111. Fax: +44-323 646035. STRANCO'S industrial division manufactures polyelectrolyte preparation plant for the sewage and waste water industries.

SUTCLIFFE INDUSTRIAL SERVICES LTD,
82 Silverdale Rd, Ecclesall, Sheffield, South Yorks S11 9JL. UK. Tel: +44-742 360530. Fax: +44-742 361154. Handles all types of media for the water and sewage industry and refurbishes filtration systems.

SUTCLIFFE SPEAKMAN CARBONS,
Guest St, Leigh, Lancs WN7 2HE. UK. Tel: +44-942 672101. Telex: 67555. Fax: +44-942 677136.

Operates one of the largest activation and regeneration kilns. Our specialist carbons are used worldwide for air and water.

SYBRON CHEMICALS INC,
 PO Box 66, Birmingham Rd, Birmingham, NY 08011. USA. Tel: +1-609-894 8211. Fax: +1-609-894 8641. Sybron Chemicals Inc manufactures and markets ion exchange resins under the Ionic brand name for water softening, demineralisation and waste treatment; they also manufacture a complete line of biochem engineered bacteria for waste treatment.

TECATOR AB,
PO Box 70, S-263 21 Höganäs. Sweden. Tel: +46-42-361500. Fax: +46-42-340349. Tecator is the world's leading company for automated routine analysis in water. Tecator is a world-wide supplier of analytical instruments for water and environmental analysis. Standard manual methods cannot meet today's requirements for speed, accuracy and safety. Therefore there is an increasing demand for automated and flexible water analysers, which are easy to start up, simple to use and provide fast and accurate results. Tecator offers a broad range of automated, flexible and accurate analysers fulfilling various needs and requirements in the water laboratory. Tecator provides complete application information and specialist support with each instrument. Ask for more information today.

WALLACE & TIERNAN LTD,
 Priory Works, Tonbridge, Kent TN11 0QL. UK. Tel: +44-732 771777. Telex: 95278. Fax: +44-732 771800. Manufacturers and suppliers of chlorinators and associated metering and control equipment for the chemical treatment of water including: dosing pumps/dry chemical feeders; gas control units for chlorine, sulphur dioxide and ammonia; on-site electrolytic chlorinators for generating sodium hypochlorite from brine; controllers and monitors for maintaining a chlorine residual.

WESTERN WATER MANAGEMENT INC,
 PO Box 7469, 1345 Toney, North Kansas City, MO 64116. USA. Tel: +1-816-842 0560. Fax: +1-816-842 6388. Wastewater treatment chemicals and equipment.

INDUSTRIAL WASTEWATER TREATMENT

ABWASSERTECHNIK WERNER PROCHASKA,

Dammgasse 18, Wolfpassing A-3424, Austria. Tel: +43-2242 71434. The stored-program waste treatment and detoxification plant from Abwassertechnik Werner Prochaska is of compact design and can be used for handling all the waste waters occurring in industry. The waste water is collected in holding tanks provided by the customer and pumped automatically in set quantities from the treatment unit into the reaction tank.

AQUA-AEROBIC SYSTEMS INC,
PO Box 2026 6306 North Alpine Rd, Rockford, Illinois 61130-0026, USA. Tel: +1-815-654 2501. Fax: +1-815-654 2508. Aqua-Aerobic Systems Inc is a designer/manufacturer of equipment used in the biological treatment of water and wastewater. Equipment includes: direct drive aerators, direct drive mixers, automatic backwash filters and a sequencing batch reactor (SBR) system.

AQUA-CHEM INC,
210 West Capitol Drive, PO Box 421, Milwaukee, Wisconsin 53201, USA. Tel: +1-414-961 5060. Telex: 26679 AQM MIL. Fax: +1-414-961 2723. Aqua-Chem Inc engineers and manufactures custom designed packages and field-erected evaporator and crystalliser systems. MVR, Thermocompression and multiple-effect designs available in falling film, forced circulation, and natural circulation. Systems are used for concentration of aqueous and non-aqueous process and waste streams in chemical, petrochemical, metal plating and food and beverage industries.

ARTECO SAS,
Pacini 99, Lucca, LU 55100, Italy. Tel: +39 583 952394. Fax: +39 583 952395. Industrial wastewater treatment with particular emphasis on metal finishing (galvanisation and aluminium anodising), stone industry, food and dairy products and marine effluents.

BEWT (WATER ENGINEERS) LTD,
Alcester, Warks B49 6QT, UK. Tel: +44-789 763669/764065. Telex: 312501. Fax: +44-789 400274. BEWT Manufacture, install and commission a comprehensive range of processes designed to minimise pol-

lution caused by manufacturing industries. Particular emphasis is made on recovery techniques for a variety of metals utilising the patented Chemelec electrolytic process.

BIO TREATMENT LTD,
5 Chiltern Close, Cardiff Industrial Park, Cardiff CF4 5DL, UK. Tel: +44-222 766802. Telex: 497244. Fax: +44-222 766945. Service based company offering services in the treatment and reclamation of surface and sub-surface contaminated land; the treatment of ground waters and solid and liquid industrial arisings through the application of biological, chemical and engineering processes.

BIRD ENVIRONMENTAL SYSTEMS INC,
1 Dedham Place, Westwood, MA 02090, USA. Tel: +1-617-461 1414. Telex: 924428. Fax: +1-617-668 6855. Development, installation and servicing of systems for treatment of industrial waste water.

BRECHÜHL AB KUNSTSTOFF-APPARATEBAU,
Industrieweg 32-35, Steffisburg, Canton Bern CH-3612, Switzerland. Tel: +41-033 376565. Fax: +41-033 376526. Engineering, manufacture and sales of treatment plants to remove solvents from water, and solvent recovery systems especially chlorinated hydrocarbons, such as methylene chloride, and 1,1,1 trichloroethane.

BURT SEPARATORS,
45-47 South St, Bishops Cleeve, Hereford CM23 3AG, UK. Tel: +44-279 53221. Fax: +44-279 757232. Burt offer a design and construction service of unique patented oil and other chemicals separator at home and abroad. Particularly applicable to palm oil industry and airport operations.

BWK GMBH,
Ingenieurgesellschaft für Wasserwirtschaft
Körnerstraße 3 - PO Box 1144 - D-6140 Bensheim,
West Germany. Tel: +0049-6251 6007. Fax: +0049-6251 4752. Contact Name: Mr Manfred Wagner.
Design, engineering and delivery of the BWK-Automatic-Valveless-Gravity-Filter system for the third-stage to reduce suspended solids, phosphor, COD and BOD, also with inline flocculation. Capacity from 6 - 2400m³/h per unit.

CADAGUA SA,
Mayor 23-20, PO Box 47, Las Arenas, Vizcaya 48930.

Spain. Tel: +4-463-48-22. Fax: +4-464-89-71. Design, construction and operation of all types of water treatment plant including: sewage, industrial, drinking and desalination.

**CHEMIE - UND ANLAGENBAU
DIPL - ING H ZEBISCH & CO
KG,**

Scharding am Inn A-4780. Austria. Tel: +43-7713-321-6921. Telex: 27360 CAUF A. *Cauf-Caprex Compact High-speed Clarifiers* are intended for cleaning surface water and the waste water occurring in mining and in gravel and sand washing. They are also used for neutralisation, residual concrete handling and emulsion splitting.

CLEARWATER SYSTEMS,

Riverway Estate, Portsmouth Rd, Guildford GU3 1JZ. UK. Tel: +44-483 33831. Telex: 859-356. Fax: +44-483 34888. Clearwater Systems produce water, wastewater and sewerage treatment systems. Our standard products include packaged sewage treatment plants and packaged potable water treatment plants. Exporting to over 30 countries for simple installation on site.

W S CRASTER (PV) LTD,

Engineers & Founders, PO Box 336 Harare. Zimbabwe. Tel: +263-4-67676/7/8. Telex: 22547 CRASTR ZW. Fax: +263-4-66697. *Manufacturers of Costermatic swimming pool filtration units, High pressure sand filters, Caster Compact water treatment plants for drinking water, industrial effluent treatment, sewage treatment, valve industries, pumps, mining equipment.*

**CTP CHEMISCH - THERMISCHE
PROZESSTECHNIK**

GESELLSCHAFT MBH,

A-8010 Graz, Stiftingstrasse 165 d. Austria. Tel: +43-316-31404-0. Telex: 116540. *Extraction plants for separating chemicals from waste waters and reducing pollution in outfalls (purification of waste water). Applications include phenol extraction, metal salt extraction and the cellulose industry.*

CWG GMBH,

Hasenacker Str 19-25, 6800 Mannheim-1. West Germany. Tel: +49-0621 817015. Fax: +49-0621 818990. Wholesalers for the following products for water treatment. Chemicals for wastewater treatment; Industrial wastewater treatment; Special

purpose pumps, pipes and other equipment; Pumps - positive displacement and other special pumps; Analysers, electrodes and meters; Control equipment; Dosing systems and equipment; Meters - flow measurement and Cooling towers and equipment.

DEEP SHAFT TECHNOLOGY INC,

801 York Mills Rd, Don Mills, Ontario M3B 1X7. Canada. Tel: +1-416-391 5616. Fax: +1-416-391 1326. Deep Shaft Technology Inc, are a drilling company and process engineering firm specialising in a unique wastewater treatment process. The Deep Shaft process is a biological treatment system utilising a totally enclosed steel cased reactor 200-500ft deep. This process treats both municipal and industrial wastewater.

DEWPLAN (ET) LTD,

Beechwood Hall, Kingsmead Rd, High Wycombe, Bucks HP11 1LA. UK. Tel: +44-494 35671. Telex: 837139. Fax: +44-494 465489. *Undertake design and installation of large and small industrial effluent treatment plant.*

DORR-OLIVER CO LTD,

NLA Tower, 12-16 Addiscombe Rd, Croydon, London CR9 2DS. UK. Tel: +44-81-686 2488. Telex: 27118. *Dorr-Oliver Co Ltd design, supply and install a complete range of equipment and systems for the treatment of municipal and industrial wastes, including screw pumps, screens, Detritors, circular and rectangular sedimentation scrapers, biofilter, distributors, surface aerators, digesters, Bio Systems, Membrane water-re-use systems and sludge incineration.*

ENVIRO-CHEMIE AG,

Eschenbach, SG, CH 8733. Switzerland. Tel: +41-55-84-11-51. Telex: 875263. Fax: +41-55-86-31-59. *Enviro-Chemie specialise in manufacturing and selling standardised waste water treatment plants (SPLIT-O-MAT-emulsion splitting, ultrafiltration, charcoal adsorption). Also in projecting and constructing individual, customised waste water treatment plants for all kinds of industrial waste waters.*

FLYGT AB,

Box 1309, Solna 171 25. Sweden. Tel: +46-8-7336500. Telex: 43887. Fax: +46-8-295816. Flygt is the world's leading manufacturer of submersible heavy-duty pumps for contaminated and abrasive liquids. The annual sales for 1988 was approx SEK 2.8 billion. With over 1,500,000 installations in more than 100 countries throughout the world, Flygt submersible products encompass an awesome

INDUSTRIAL WASTEWATER TREATMENT

range of pumps, mixers and hydro turbine generators for small scale hydro electric power stations. The main office is situated in Solna, just outside Stockholm, with manufacturing facilities in Lindas. Flygt has subsidiaries in 16 countries and 3,400 employees of which 1,500 are in Sweden.

GEC ELECTRICAL PROJECTS LTD,

Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-788 542144. Telex: 311335. Fax: +44-788 60767.
Contact Name: Mr F W Ballard or Mr S W G Cheshire.
Mechanical, electrical and control engineering company with experience in water and sewage pumping stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor convertor equipment particularly suited to the control of pumps, compressors and fans.

GLASFORMEN UND MASCHINEN GES MBH (GMA),

Judenburger Strasse 176, Kufiach A-8580. Austria. Tel: +43-3144-22-50. Telex: 312047 GMA A. The water purification plants supplied by GMA operate on the mechanico-chemical absorption principle. Intended for cleaning highly polluted industrial waste water, they are used mainly by paper and pulp mills, leather producers, tanning and dyeing works, battery factories, metalworking firms and the chemical industry.

W R GRACE & CO, DEARBORN DIV,

300 Genesee St, Lake Zurich, IL 60047. USA. Tel: +1-312-438 8241. Telex: 2-2428. Fax: +1-312-540 1588.
Leader in development of solutions for industrial water treatment problems. For 100 years has provided products and services to meet industry's boiling water, cooling water and waste water treatment needs.

GRAVER WATER INTERNATIONAL,

2720 US Highway 22, Union, NJ 07083. USA. Tel: +1-201-964 2554. Telex: 6853093. Fax: +1-201-964 7770. Graver designs and manufactures a complete line of water and waste treatment equipment to fit the needs of industrial corporation and electric generating utilities.

GROUNDWATER TECHNOLOGY INTERNATIONAL LTD,

St Andrews House, 22-28 High St, Epsom, Surrey KT19 8AF, UK. Tel: +44-3727 42055. Telex: 948104. Fax: +44-3727 432100. Primarily specialise in the restoration of contaminated soil and groundwater. A professional staff of approx 900 is dedicated to groundwater restoration and a manufacturing division produces specialised equipment for the recovery of contaminants and for the treatment of contaminated soil and ground water.

GUARDIAN CHEMICAL SPECIALTIES,

PO Box 1743 1225 West Princess St, York, PA 17405. USA. Tel: +1-717-848 2570. Develop and market products and consultation services for industrial influent to effluent water treatment requirements. This includes clarification, pre-treatment equipment, boiler water chemical treatment, cooling water chemical treatment, fuel additives and waste water programme.

HAGER & ELSASSER GMBH,

PO Box 800540, Stuttgart 80 7000. West Germany. Tel: +49-711 78660. Fax: +49-711 7866-202. Water treatment plants for treatment of fresh water (sea and brackish-water, ultra-pure-water for electrical and pharmaceutical industry, boiler-feed water) and waste-water (metalworking industry, textile industry, power plants and seepage water).

HAGER & ELSASSER GMBH

PO Box 80 05 40, Stuttgart 80, Baden, Wurtemberg 7000. West Germany. Tel: +49 711 7866 0. Fax: +49 711 7866 202. The company designs, manufactures and installs treatment plants to customer specifications, using the latest technology. It has particular expertise in membrane technology (reverse osmosis, ultra filtration) and ion exchange technology. The product range includes fresh water treatment plants (for boiler feed water, ultra pure water for the pharmaceutical and electronics industries, water for brewing and beverage industries, and desalination of sea and brackish water); industrial waste water treatment plants (for metal and textile industries, power plants, seepage water and highly polluted water); and recycling of metals. In all situations the company endeavours to keep both fresh water use and waste levels at a minimum.

HAZLETON ENVIRONMENTAL PRODUCTS INC,

225 North Cedar St, Hazleton, Pennsylvania 18201-0488. USA. Tel: +1-717-455 7711. Telex: 831881.

Fax: +1-717-459 2586. Contact Name: Mr Randy Galgon. Designers and suppliers of patented neutralisation and metals removal process. As pirated reactor can also remove dissolved gases, volatile organic compounds, trihalomethanes and BTEX while precipitating iron and manganese.

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COLLIKG, L**

Zentral: Pettenbacher Strasse 66, Vorchdorf A-4655.
Austria. Tel: +43-7614-83-01-02. Telex: 24466 HESON
A. Hesonwerk deal with many waste water problems occurring in the metalworking industry. The firm's products also include plants for the purification of waste waters in the electroplating and textile industries, for laboratory waste and solvents, as well as recycling and membrane filtering. The Hesonwerk line-up covers other sectors of environmental engineering, eg water treatment and ventilation installations and sewage construction.

HYDROTECHNIK GMBH,

Alpenstrabe 54, PO Box 14, A-5033 Salzburg. Austria.
Tel: +662285310. Telex: 633821. Fax: +6622853110.
Hydrotechnik Austria was founded in 1970 and originally concerned with the design of waste water treatment plants for the paper, pulp and textile industry. During the following year, working with leading Austrian enterprises, a water conditioning plant as well as what were then the largest biological sewage works in the world were supplied to the Middle East. Hydrotechnik Austria can draw on 19 years of experience in the offering of a wide range of conventional turn-key water treatment plants of in the acting as a supplier of mechanical and electrical equipment. In order to meet the specific requirements of an international clientele, new process methods for the reutilisation of treated water have been developed.

ICI BIOLOGICAL PRODUCTS,

PO Box 1, Billingham, Cleveland TS23 1tB. UK.
Tel: +44-642 523786. Telex: 587443 ICIAGH G.
Fax: +44-0642 522676. ICI has a worldwide network of licensees who can provide design, construction and commissioning of its Deep Shaft process technology. The Deep Shaft process is increasingly used to treat a range of effluents including domestic, industrial/food, alcohol, pulp and paper etc. Low running cost, low capital cost, high on transfer rate and low land area are just some of the advantages.

**INDUSTRIEANLAGEN - PLANUNGS
UND HANDELSGES M B H,**

Willibald Nr 36, ST A-4762. Austria. Tel: +43-7762-33-81
33-82. Telex: 27393 IPH A. The firm plans and builds special waste disposal plants for contaminated soil, air and water. Combinations of various processes are widely used, eg fixed-bed electrolysis, centrifugal separation, special extraction, reverse osmosis and hyperfiltration, depending on the job.

INFILCO DEGREMONT INC,

PO Box 29599, Richmond, VA 23221. USA. Tel: +1-804-
281 7600. Manufacture industrial and municipal water and wastewater treatment equipment.

INNOVA - TECH INC,

PO Box #920, Valley Forge Corporate Center, Valley Forge, Pennsylvania 19481. USA. Tel: +1-215-666 9080. Fax: +1-215-666 1766. High strength food waste? Innova-Tech has experience in the meat, poultry, milk, candy and specialty food industries. Industrial pre-treatment or final stream discharge. We can help in either area! The Total Barrier Oxidation Ditch (TBOD) for final treatment. Flow equalisation basins, bioflocculation units, dissolved air flotation units for industrial pre-treatment.

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PO Box 100 Eitingshall, Wolverhampton, West Midlands WV4 6JY.UK. Tel: +44-902 353353. Telex: 337412. NEI TOM G. Fax: +44-902 405500. Over 80 years' experience of design and contracting water and industrial effluent treatment plant. Product range includes: clarification, filtration, dealkalisation, softening, deionisation, condensate polishing, oil/water separation, flotation, deaeration, degassing, reverse osmosis, ultrafiltration, liquid radioactive waste treatment, chemical dosing, potable/package water treatment plant and electrochlorination systems.

KRONOS TITAN - GMBH,

PO Box 100720, Leverkusen 1, D-5090. West Germany. Tel: +49-214 3560. Telex: 8510823. Fax: +49-214 356481. KRONOS Water Treatment Chemicals based on iron salts for the treatment of drinking water, process water and cooling water; for purification of industrial and municipal waste water; for dewatering of sewage sludge; and for the pre-treatment for seawater desalination by RO and odour control for waste water collection systems. Many years of successful experience in water treatment and waste water

INDUSTRIAL WASTEWATER TREATMENT

purification: qualify KRONOS TITAN-GmbH for a leading position in this field. KRONOS-TITAN GmbH is a subsidiary of Nl. Chemicals Inc, Hightstown/USA a company with an annual turnover of over 1,000 million US-\$. KRONOS Water treatment chemicals are sold worldwide and produced in Leverkusen and Norderham, West Germany and in Fredkstad, Norway.

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Alwath Division, Raglan House, 8-24 Stoke Rd, Slough, Berks SL2 5AG. UK. Tel: +44-753 824621. Telex: 849834 KVEN G. Fax: +44-753 77029. Part of the Kvaerner Group, process contractor in the turnkey supply of water and industrial effluent plants. Protein and fat recovery, dissolved air flotation, physico-chemical/biological treatment of oil, metallurgical, petrochemical and sludge handling.

LENZING AG,
lenzing A-4860. Austria. Tel: +43-7672/25-11. Telex: 26606 LENFA A. Liquid membrane permeation (LMP) is a combined extraction-reextraction process for the economical removal and recovery of metals from industrial waste waters. The heavy-duty LMP plant put into operation in lenzing reduces the zinc content from 500 mg/l to less than 5 mg/l and yields a concentrated zinc solution of over 50 g/l. lenzing AG and Prof Dr Marr of Graz Technical University offer worldwide: preliminary lab tests, on-site tests with mobile plant, and planning, production and installation of large-scale LMP recycling plants.

LIGHT SOURCES INC,
PO Box 410, Main St, Ansonia, CT 06401. USA. Tel: +1-203-736 9961. Telex: 643266. Fax: +1-203-736 2879. Manufacturers of ultra-violet lamps for waste water, potable water and high purity water treatment.

MERCATUS AB,
Boc 129, Hultsired S-577 00. Sweden. Tel: +46-0495 12110. Fax: +46-0495 11035. Engineering company that develops, manufactures and services waste water plants for industrial applications. Speciality: microfiltering, ultra-filtering, reverse osmosis and neutralisation.

PAQUES BV,
PO Box 52, Balk, AB 8560. The Netherlands. Tel: +31-5140 3441. Telex: 46417 PAQUE NL. Fax: +31-5140 3342. Anaerobic (UASB) waste-water treatment technology. Full-scale plants and know-how. Marketing via licence partners in 14 countries. Application for food, beverage and

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THE PERMUTIT CO,
East 49 Midland Avenue, Paramus, NJ 07652. USA. Tel: +1-201-967 6000. Manufacture water and wastewater treatment equipment (industrial).

PORTALS WATER TREATMENT LTD,
Odfield Lodge, 156 Bridge Rd, Maidenhead SL6 8DG. UK. Tel: +44-628 771444. Telex: 849067. Fax: +44-628 771567. PWT has four business sectors related to water: waste service and contracting: major projects up to \$500 million in value; specialty chemicals for boiler, cooling and process water applications; products and services including standard industrial treatment plants, plant rehabilitation, customisation and packaged systems; special products including pump sets, cooling towers, mass transfer systems and screening presses.

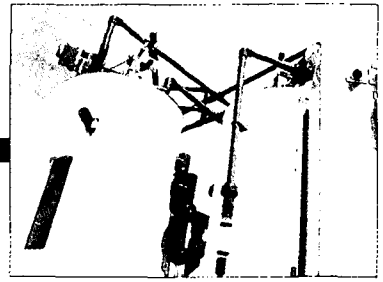
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PO Box 1320, Heinrich-Hertz-Strasse 23, Hemmingen 1, D-3005. West Germany. Tel: +49-511 4206-0. Telex: 923523. Fax: +49-511-4206-359.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.

PROTECHT INTERNATIONAL PLC,
Kiln Acre, Wickham, Ra, Poreham, Hants PO16 7H8. UK. Tel: +44-329 239951. Fax: +44-329 823111. Contact Name: Leslie McClurg, Group Sales & Marketing Director. The group has developed and engineered a range of 'state of the art' processes in the area of nutrient removal and industrial waste treatment. Impressive customer references include a significant number of government departments, municipalities, water service companies and multi-national organisations. The company is expanding rapidly and is active in a variety of market sectors including aid relief, water supply, sewage treatment, textile, food, paper, chemical and leisure industries.

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PO Box 146, Lund S-22105. Sweden. Tel: +46-46-135100. Telex: 8305083. Fax: +46-46-14-6988. Proven dissolved air flotation systems where Purac's extensive devel-

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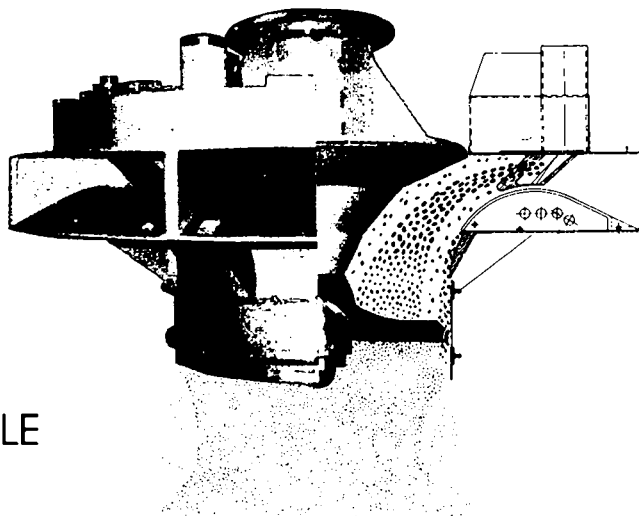
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opments and its construction of some 400 plants for sewage, as well as potable water, are proof of Purac's world leadership in flotation.

PWT (HOLLAND) BV,

Industrieweg 13, Assendelft 1566, The Netherlands. Tel: +31-75-285651. Telex: 19159. Fax: +31-75-28619. Piekenrood Water Treatment is specialised in water purification. PWT has a complete range of systems and installations for the treatment of industrial effluent and process and surface water. Our systems are tailor-made and suited to upgrade existing systems.

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RESOURCES CONSERVATION CO,

3006 Northrup Way, Bellevue, WA 98004. USA. Tel: +1-206-828 2400. Fax: +1-206-828 0526. World leader in the design of energy efficient evaporator systems for industrial wastewater treatment. These systems recover pure water for recycling, reduce waste volume and help industry meet strict 'zero liquid discharge' water pollution control regulations. RCC specialises in reliable systems for difficult waste chemistries.

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PO Box 12, Weston Rd, Crewe, Cheshire CW1 1DE. UK. Tel: +44-270 584012. Telex: 36421. Fax: +44-270 589863. Designers and suppliers of a wide range of standard and engineered industrial water and waste water treatment plants and pumping systems.

SELECTO INC,

1000 Cobb Place Boulevard, North West Building, 370 Kennesaw, GA 30144. USA. Tel: +1-404-590 1015. Telex: 251739 ATL GA. Fax: +1-404-590 0915. Ed Levy, manufacturer and Supplier of the proprietary ABA-2000® media and LeadOJT® filtration products which remove lead and heavy metals from water economically. Due to the ABA-2000's high absorption capacity for heavy metal removal, it can also be packed in large columns for large scale appli-

cations, such as municipal water treatment plants, waste treatment plants, as well as residential, institutional, industrial, and commercial applications including water coolers, beverage dispensers and a variety of other applications where the removal of lead and heavy metals are necessary. Manufacturer of the SunBLUE® 'add-on' solid-state ultraviolet water steriliser used to rid water of microorganisms which can be used alone or in conjunction with RO or other filtration products.

STOISER UND WOLSCHNER,

Bahnstrasse 87 + 93, Klagenfurt, Postfach 309 A-9021. Austria. Tel: +43-4222-321-09. Telex: 422902 STOWO A. Stoiser und Wolschner (SW) Compact Oil-absorber Plants are designed for the cleaning of waste water contaminated with mineral oil in a series of cleaning steps. The compact basin is made of steel fibre and Tor steel-reinforced concrete with corrosion-proof inner lining.

SUTCLIFFE POLCON LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 841503. Provides turnkey solutions for waste water purification including Hycor milli screens for sea outfalls and industrial applications, PCL belt dewatering presses and MEYN dissolved air equipment.

TECATOR AB,

PO Box 70, S-263 21 Höganäs. Sweden. Tel: +46-42-361500. Fax: +46-42-340349. Tecator is the world's leading company for automated routine analysis in water. Tecator is a world-wide supplier of analytical instruments for water and environmental analysis. Standard manual methods cannot meet today's requirements for speed, accuracy and safety. Therefore there is an increasing demand for automated and flexible water analysers, which are easy to start up, simple to use and provide fast and accurate results. Tecator offers a broad range of automated, flexible and accurate analysers fulfilling various needs and requirements in the water laboratory. Tecator provides complete application information and specialist support with each instrument. Ask for more information today.

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for wastewater treatment plants for domestic and industrial applications. Equipment range includes aeration systems, biological filters, rotating biological contractors, package filter plants, screenings and grit removal, sedimentation tank scrapers and thickeners.

VERBUND-PLAN GMBH,
Am Hof 6A - A-1010 Vienna, Austria. Tel: +43-1-0222-53113 4800. Telex: 115978 VPLWN A. Fax: +43-1-0222-53113 4848. Verbund-Plan renders consultancy services in the field of water-treatment plants for refineries, paper and pulp industry, food industry, car industry, textile leather and chemical industry, power plants.

WATER ENGINEERING LTD,
International Division, Aynho Rd, Adderbury, Banbury, Oxon OX17 3NL UK. Tel: +44-295 810581. Telex: 83655. Fax: +44-295 811913. Contact Name: Ken Brearley. The treatment of industrial effluent is becoming increasingly important as modern manufacturing techniques produce vast quantities of contaminated waste water during the production process. This effluent must be detoxified before it can be discharged into public waterways or recycled for further use. Water Engineering Ltd handles and neutralises industrial effluents containing a wide variety of organic and inorganic materials and resolves all disposal and reclamation problems.

WEBER SENSORTECHNIK GMBH,
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+966-2-637-4337. Al Kawther provides a wide range of consultancy, design and O & M services as well as supplying: packaged water/wastewater treatment plants, filters and sterilisers, custom built water/wastewater treatment plants.

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Management of sewage planning, operation, and collection and treatment plants.

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Mayor 23-20, PO Box 47, las Arenas, Vizcaya 48930. Spain. Tel: +4-463-48-22. Fax: -4-464-89-71. Design, construction and operation of all types of water treatment plant including: sewage, industrial, drinking and desalination.

CLEARWATER,
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CONDER GROUP PLC,
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Tel: +49-451 8820 Telex: 268070. Fax: +49-451-882 2080. Gas Analysis Division. In order to reduce the number of potentially hazardous situations at the workplace and minimise any damage resulting from these hazards, many different gases, vapours, and aerosols must be monitored. For that purpose Drager offers easy-to-handle and economical measuring systems. With more than 200 different Drager-Tubes, over 350 separate hazards can be determined in air, soil and water samples.

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**HYDROTECHNIK GMBH,
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Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.**

**PURAC LTD,
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 874921. Rosewater designs, manufactures and installs pro-
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 dard and engineered industrial water and waste water
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 dling to the wastewater and water industry. Manufacturer of
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841503. Provides turnkey solutions for waste water
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 Bell Ltd designs, manufactures and installs sewage purifi-
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 tems and package sewage treatment plants.

WATER TECH INC,
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 +1-206-573 7176. Manufacture potable and industrial
 water treatment packaged plants; also industrial wastewater
 treatment packaged plants.

**PRELIMINARY TREATMENT -
 SCREENS &
 DISINTERGRATORS**

BIRTLEY,
 Avenue de Tervueren 32-36, Boite 11-12, Brussels B1040.
 Belgium. Tel: +32-2-73-60037. Telex: 24-747. Fax: +32-2-
 736 4476. Self-cleaning water intakes for rivers, canals or
 main pipes have an opening of 1mm without moving parts;
 automatic filters and strainers are remote controlled or not,
 have no moving parts, and a filtration size ranging from
 100 to 800 microns, pressure goes up to 20 bars (about
 300 psi); separators, remote controlled or not, are fully auto-
 matic. There are no moving parts. They have a separation
 level ranging from 10 to 100 microns and deal with all
 pressures and require practically no maintenance.

PRELIMINARY TREATMENT _ SCREENS & DISINTERGRATORS

BRACKETT LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Manufacturer of rotating drum and travelling band screen, micro screens, front and back raked bar screens, isolating gates, manual and automatic pipeline strainers and Rotostrainers for liquid/solids separation, for installation on power, industrial and municipal plants.

BRACKETT LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 844509. Manufacturers and installs screens for cleaning water in water intakes, water treatment schemes and power stations.

ENVIRO-CARE CO,

56 1/4 West Grand Avenue, Chicago, IL 60639. USA. Tel: +1-312-745 7773. Fax: +1-312-745 8383. Enviro-Care manufacturers of comminutors and bar screens that are revolutionary in their design and performance. The uniqueness of these products is a result of three components: simplicity in design, ease of operation and maintenance and competitive pricing. World wide installations are testimony to their high quality. Products that are built to perform and last.

EVANS UNIVERSAL LTD,

Millshaw, Leeds LS11 8EQ. UK. Tel: +44-532 711888. Telex: 557885. Fax: +44-532 718188. Evans Universal Ltd is the UK's largest supplier of incineration equipment for all markets particularly hospitals, governments, armed forces and water industry. Its sewage screening incinerators are used successfully in the UK and are unique in that they have no moving parts to cause high maintenance costs.

WILLIAM GREEN LTD,

Gate ST, Blackburn BB1 3AJ. UK. Tel: +44-254 56401. Telex: 63454. Fax: +44-254 582216. Designers and manufacturers of water and sewage screening plants and associated mechanical handling equipment. The product range includes cup and drum screens, band screens, coarse and fine screens, curved bar screens, screw pumps, fabricated sluice gates and stop logs.

HAIGH ENGINEERING CO LTD,

Alton Rd, Ross-on-Wye, Herts HR9 5NG. UK. Tel: +44-989 763131. Telex: 35388. Fax: +44-989 766360. The Haigh Engineering Co manufacture, design and install water borne sewage control systems. Individually designed, the

emphasis is on quality of design and materials for a long working life. Products include sludge pumps, macerators, pensocks and pumping stations.

HAWKER SIDDELEY BRACKETT LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 844509. Hawker Siddeley Brackett manufacture a complete range of screens and pipeline strainers/filters for raw water intakes to power and industrial plants and for waste water treatment for primary and full treatment.

INKA SYSTEMS LTD,

7 Watt Rd, Hillington, Glasgow G52 4RY. UK. Tel: +44-41-882 5395. Telex: 778210 INKA G. Fax: +44-41-810 5387. Design and supply of effluent and sewage treatment plants and equipment including: screens, presses, grit removal, clarifiers, aerators, mobile and static sludge dewatering plant, sludge thickener and tertiary treatment.

JOHNSON-PROGRESS LTD,

PO Box 103, Wright St, Broadheath, Altrincham, Cheshire WA14 5EF. UK. Tel: +44-61-928 6388. Fax: +44-61-941 7309. Complete plants for filtering slurries and sludges from water and from domestic/industrial effluent treatment. Product range includes filter presses, filter media, pumps pre-treatment and cake handling equipment.

JONES & ATTWOOD LTD,

Titan Works, Stourbridge, West Midlands DY8 4LR. UK. Tel: +44-384 392181. Telex: 338120. Fax: +44-384 371937. Manufacturers of sewage treatment equipment, specialising in pre-treatment plant involving screening, screenings dewatering, Screezers, comminutors, grit extraction and screw pumps; grease removal plant and submersible dewatering pumps; contracting work including complete gas recirculation sludge digestion projects; Puraflo systems for odour control and corrosion protection of electrical switchgear.

LONGWOOD ENGINEERING CO LTD,

Parkwood Mills, Longwood, Huddersfield, West Yorks HD3 4TP. UK. Tel: +44-484 642011. Telex: 51422 PARKVWD. Fax: +44-484 642935. Screening specialists. Manufacturers of the 'Parkwood' range of screens for industrial effluents, sewage works, pumping stations, stormwater overflows, water intakes etc. Screenings washer/dewaterer

unit. Individually designed screens for all purposes. Brushed fine screens and raked bar screens.

FRANKLIN MILLER,

60 Okne Parkway, Livingston, NJ 07039, USA. Tel: +1-201-535 9200. Telex: 177-472. Fax: +1-201-535 6269. Complete range of size reduction machinery for operation in fluid or gas pressure systems, vacuum conditions or gravity flow conditions. Also comminutors and sludge grinders.

PWT PROJECTS LTD,

632-652 London Rd, Isleworth, Middlesex TW7 4EZ. UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G. Fax: +44-81-568 5479. Screenings disposal equipment including dewatering presses, storage systems and incinerators. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

WASTE-TEC,

Barton Rd, Heaton Mersey Industrial Estate, Stockport, Cheshire SK4 3EE. UK. Tel: +44-61-443 1333. Telex: 669707WTECG. Fax: +44-61-443 1444. Manufacture and service of 'he' grinder/dsintegrator for sewage, sludges and screenings - the 'Mono Muncher', sewage pumps, sludge pumps and packaged stations.

**WILLIAM GREEN LTD,
(INCORPORATING
BLAKEBOROUGH & LEDWARD &
BECKETT),**

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 844509. Is a specialist designer and manufacturer of mechanical screens for treatment of water, effluent and sewage in both the UK and overseas markets.

**SEDIMENTATION; SOLID/
LIQUID SEPARATION**

BIRD MACHINE CO,

100 Neponset St, South Walpole, MA 02071 USA. Tel: +1-617-668 0400. Telex: 924428. Fax: +1-617-668 6855. Manufacturers and suppliers of a highly efficient range of industrial centrifuges for dewatering sludge and solid liquid separation in waste treatment plant.

BRACKETT FILTRATION LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel:

+44-206 852121. Telex: 98391. Fax: +44-206 751239. Offers versatility in Filtration Technology with a range of liquid/solid filtration and separation equipment including Rotary Vacuum Filters, Horizontal Vacuum Band Filters, Fully Automatic Filter Presses and Multi Roll Belt Presses for application in the Process Industry and Effluent Water and Sewage Industries.

BWK GMBH,

Ingenieurgesellschaft für Wasserwirtschaft Körnerstraße 3 - PO Box 1144 - D-6140 Bensheim, West Germany. Tel: +0049-6251 6007. Fax: +0049-6251 4752. and delivery of the BWK-Automatic-Valveless-Gravity-Filter system for the third-stage to reduce suspended solids, phosphor, COD and BOD, also with inline flocculation. Capacity from 6 - 2400m³/h per unit.

DORR-OLIVER EUROPE BV,

Baden Powellweg 305, Amsterdam, LH 1069, The Netherlands. Tel: +31-20-5107911. Telex: 12367. Fax: +31-20-5107293. Design, supply and erection of equipment and systems for solid/liquid separation, sewage and industrial wastewater treatment. Specialists in dewatering and incineration of sludges. Oxitron and anitron systems for treatment of wastewater.

**FARROW (A DIVISION OF
WRIGHT RAIN LTD),**

Crow Arch Lane, Ringwood, Hants BH24 1PA. UK. Tel: +44-425 47251. Telex: 41206. Fax: +44-425 472258. Pumps for handling solids in suspension, dewaterers for the separation of sludges into solid and liquid fractions.

**HAZLETON ENVIRONMENTAL
PRODUCTS INC,**

225 North Cedar St, Hazleton, Pennsylvania 18201-0488. USA. Tel: +1-717-455 7711. Telex: 831881. Fax: +1-717-459 2586. Contact Name: Mr Randy Galgon. Designers and manufacturers of static sludge removal equipment for mining and industry. Designs are available for handling flocculated sludges to fly-ash and mining refuse sludges. Low initial cost; simple installation; made to fit most basin designs; and easy to maintain.

INKA SYSTEMS LTD,

7 Watt Rd, Hillington, Glasgow G52 4RY. UK. Tel: +44-41-882 5395. Telex: 7782:O INKA G. Fax: +44-41-810 5387. Design and supply of effluent and sewage treatment

plants and equipment including: screens, presses, grit removal, clarifiers, aerators, mobile and static sludge dewatering plant, sludge thickener and tertiary treatment.

LENSER

Kunststoff-Presswork GmbH & Co KG, D-7913 Senden, West Germany. Tel: +49-07307 8010. Telex: 712459. Fax: +49-07307 33275. Lenser is a worldwide leader in solid-liquid separation by producing membrane and chamber plates for filter presses, along with other thermoplastic filter elements. If you would like a lenser brochure or additional information about the company or its products please contact the above address.

OSMONICS INC,

5951 Clearwater Drive, Minnetonka, MN 55343, USA. Tel: +1-612-933 2277. Telex: 029-0847. Fax: +1-612-933 0141. Manufacturers of filtration and separation equipment.

PANNONPLAST WORKS,

PO Box 30, Budapest 1400, Hungary. Tel: +36-1-225-849. Fax: +36-1-229-228. Production, design and supply of plastic tube settler modules for clarifier intensification. The hydraulic load can be increased up to 6-7 m/h. Smaller surface, less construction costs.

PAXMAN PROCESS PLANT DIVISION GEC DIESELS LTD,

PO Box 8, Paxman Works, Colchester CO1 2HW, UK. Tel: +44-206 575151. Telex: 98151. Fax: +44-206 577869. Paxman filtration offers versatility in filtration technology with a range of products specialising in liquid/solid separation. Paxman engineers are specialists in sludge dewatering having a long and broad history of experience.

PREUSSAG ANLAGENBAU GMBH,

Karl-Wiechert-Allee 4, D-3000 Hannover 61. Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

PWT PROJECTS LTD,

632-652 London Rd, Isleworth, Middlesex TW7 4EZ. UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G. Fax: +44-81-568 5479. Filtration equipment including tertiary and biological activated filters. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

RUSCO CORP,

13360 Chambord St, Brooksville, FL 34613, USA. Tel: +1-

904-596 4200. Fax: +1-904-596 9489. Manufacture plastic spin down sediment filters - operating from one to 100 gallons per minute.

SCREENING & APPLICATION ENGINEERS LTD,

SAE House, 409 Hagley Rd West, Quinton, Birmingham B32 2AD, UK. Tel: +44-21-421 6331. Fax: +44-21-421 2468. Rotary separators for the removal of suspended and floating solids from liquid flow.

STOCKDALE FILTRATION SYSTEMS LTD,

Stockdale House, Waters Green, Macclesfield, Cheshire SK11 6LF, UK. Tel: +44-625 616109. Telex: 66885. Fax: +44-625 34678. A types of liquid/solid separation equipment including: rotary vacuum, pressure leaf, sand filters, cartridge filters and oil/water flotation separators. Main applications: effluent, sludge dewatering and water polishing.

STOCKHAUSEN GMBH,

Bakerpfad 25, D4510 Krefeld 1, West Germany. Fax: +02151391632. Chemische Gabrik Stockhausen has fulfilled the requirements for environmentally acceptable and economical sludge dewatering. The new FLOCTRONIC systems and its components ensure that the metered polymer quantities and mixing power are continuously adapted to the composition of the sludge ingredients. This results in constant, easily filterable sludge flocculation, and a sludge feeding system which is exactly adjusted to the particular throughput rate of the filter press (absorption capacity) at that instant. This prevents too high compaction of the solids layer on the filter cloth, which is particularly important with compressible solids, since a too highly compacted solids layer leads to poor throughput rates, long feeding times and a low dry substance content in the filter cake. This results since high compaction reduces the capillary effect directly on the filter cloth.

XENTEX INC,

14902 Wes: 117th St, Olathe, KS 66062, USA. Tel: +1-913-764 3800. Fax: +1-913-764 1743. Supplier to capital construction projects; water stills for hospitals and laboratories, water demineralizers and water softeners. Equipment for wastewater projects such as liquid solid separators, filtration equip, water recycle equip, pond and pit plastic liners etc.

SLUDGE TREATMENT & DISPOSAL

ALFA-LAVAL SHARPLES LTD,
(Formerly Pennwal Ltd), Doman Rd, Camberley, Surrey GU15 3DN. UK. Tel: +44-276 63383. Telex: 858283. Fax: +44-726 61088. A range of centrifuges designed and manufactured at Camberley is available for the dewatering and thickening of water treatment, municipal and industrial sludges and effluents, also a range of vibrating screens for coarse dewatering. Complete packaged automatic systems are available including installation and erection.

AMSTON EQUIPMENT PTE LTD,
Blk 16 Pandan Loop Unit 105, Singapore 0512 Republic of Singapore. Tel: +65-7787826. Fax: +65-7781065. Manufacturer of filter presses for application in solid-liquid separation of sludges from industrial waste water treatment plant and municipal sewage treatment plant. Capacity of presses ranges from 20 litres to 1500 litres.

ATRITOR LTD,
PO Box 101, Edgwick Park Trading Estate, Canal Rd, Coventry CV6 5RD. UK. Tel: +44-203 662266. Telex: 312337 AIRLTD G. Fax: +44-203 665751. A combined drying and pulverizing machine, its an airswept attrition machine for drying and grinding digested sewage sludge, industrial sludge and lime from water purification processes.

BABCOCK JENKINS LTD,
Retford, Notts DN22 7AN. UK. Tel: +44-777 706777. Telex: 56122. Fax: +44-777 708141. The Andritz continuous belt press is widely applied for the dewatering of sludges in sewage and effluent treatment plants. The design of the press, established from practical experience and development derived from many years of working in this particular field, presents an economic and efficient method of dewatering sludge on a continuous basis. The details of construction ensure a high level of reliability with a low level of maintenance in the most adverse operating conditions. Units are available for treatment of sludge with flow rate from 1 to 60m³/hour, depending upon application.

BIRD MACHINE CO,
100 Neponset St, South Wapole, MA 02071. USA. Tel: +1-617-668 0400. Telex: 924428. Fax: +1-617-668 6855. Manufacturers and suppliers of a highly efficient

range of industrial centrifuges for dewatering sludge and solid liquid separation in waste treatment plant.

BK LADENBURG,
Dr Albert-Reimann-Strasse 2, Ladenburg D 6802. West Germany. Tel: +49-6203-77-4307. Fax: +49-6203-1-2818. BK Ladenburg (Benckiser-Knapsack GmbH) - a Benckiser GmbH - a fifty/fifty joint venture of Hoechst AG and Benckiser GmbH - has been successful for over twenty years in international markets. The Labuffloc® range enables the economical treatment (thickening and dewatering) of sludge by bandfilter presses, centrifuges, filter presses, vacuum pressure filters and sludge beds.

BRACKETT FILTRATION LTD,
Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 751239. Offers versatility in Filtration Technology with a range of liquid/solid filtration and separation equipment including Rotary Vacuum Filters, Horizontal Vacuum Band Filters, Fully Automatic Filter Presses and Multi Roll Belt Presses for application in the Process Industry and Effluent Water and Sewage Industries.

BROWN BEAR CORPORATION,
PO Box 148, Lenox, Iowa 50851. USA. Tel: +1-515-333 4551. Fax: +1-515-333 2592. Diesel powered tractors with auger attachments used to dewater sludge as an aid to solar drying. Reduces drying time up to 50 per cent. Also used for mixing amendment such as flyash and composting for volume reduction and stabilisation.

CARMEUSE SA,
Rue du Chateau, 13 Seilles 5210. Belgium. Tel: +31-85-825009. Telex: 59608. Fax: +31-85-826302. CARMUESE is a producer of calcium carbonate, calcium oxide and calcium hydroxide, in Belgium, the Netherlands and France. In the water treatment area, the calcic products are used for: Flocculation of impure water, Remineralisation of drinking water, Softening of industrial and portable waters, PH correction of drinking water and industrial waters, Residual mud conditioning before dewatering, Disinfection and Pasteurisation of residual muds, Dephosphatation of waters. As some of the lime qualities are very pure Carmuese lime is often used in the area of drinking water treatment. Due to its excellent geographical position, close to the harbour of Antwerp and Rotterdam. Carmuese exports large quantities of lime to

all countries of the world, especially to Africa and the Middle East.

CHARLESTOWN ENGINEERING,
(Incorp Osprey Separation), Charlestown, St Austell,
Cornwall PL25 3NW. UK. Tel: +44-726 67973. Telex:
45526. Fax: +44-726 623019. Provision of complete
plants including filter belt presses and decanting centrifuges;
the mechanical thickening of sludges using rotating drum
thickeners and gravity drainage belt thickeners; flocculant
preparation units; chemical dosing equipment; and centrifu-
gal air compressors for diffused aeration of activated sludge.

DE LANGE PLASTIC LININGS,
Neptunusweg 4, 8939 AA Leeuwarden, Holland. Tel:
+31-58-884240. Fax: +31-58-884264. De Lange
Plastic Linings provide a wide range of plastic linings
with many applications in the storage and distribution
of water and wastewater. The service includes supply,
assembly, testing, certification and delivery.

DORR-OLIVER EUROPE BV,
Baden Powellweg 305, Amsterdam, LH 1069. The
Netherlands. Tel: +31-20-5107911. Telex: 12367. Fax:
+31-20-5107293. Design, supply and erection of equip-
ment and systems for solid/liquid separation, sewage and
industrial wastewater treatment. Specialists in dewatering
and incineration of sludges. Oxitron and anitron systems for
treatment of wastewater.

EDWARDS & JONES INC,
1515 Route 10, Parsnippany, NJ. USA. Tel: +1-201-428
2828. Fax: +1-416-661 9620. Provide primary sludge or
dewatering process systems.

EDWARDS & JONES LTD,
Globe Engineering Works, Uttoxeter Rd, Meir, Stoke-on-
Trent, Staffs ST3 7QD. UK. Tel: +44-782 599000. Telex:
36397. Municipal and industrial sludge treatment special-
ists. Design and manufacture sludge dewatering plants,
incorporating filter and belt presses, sludge feed and transfer
pumps, cake breakers, conveyors, chemical conditioning,
lime silos and dispersion equipment, flow metering and elec-
trical control panels. Also design and manufacture sludge
stirrers and thickeners.

EFLO INTERNATIONAL LTD,
Barth Rd, Padworth, Reading, Berks RG7 5HR. UK. Tel: +44-
734 712648. Telex: 848673 EFLO G. Fax: +44-734

712901. Designers, suppliers and contractors to the waste
water industry with both aeration and rbc based treatment
systems. Suppliers of Sewpass sludge handling equipment
and earth anchors.

**ENERGY & WASTE SYSTEMS
LTD**,
EWS House, Station Rd, Westbury, Wilts BA13 4HT. UK.
Tel: +44-373 858090. Telex: 445672. Fax: +44-373
827223. Sewage and sludge treatment contractors.
Specialists in packaged sludge digestion plants. Range of
products and processes includes the Blue Circle Clariflow
sewage treatment system for marine discharge and inland
works uprating, the Rotamat sewage and sludge screen and
the Messner aeration system.

**FARROW (A DIVISION OF
WRIGHT RAIN LTD)**,
Crow Arch Lane, Ringwood, Hants BH24 1PA. UK. Tel:
+44-425 47251. Telex: 41206. Fax: +44-425 472258.
Pumps for handling solids in suspension, dewaterers for the
separation of sludges into solid and liquid fractions.

FASTEK - A KODAK CO,
7120 Henry Clay Boulevard, Liverpool, NY 13088. USA.
Tel: +1-315-451 0592. Committed to research in both filtra-
tion and separation technology. Product line includes reverse
osmosis membrane elements, disposable cartridge filters for
liquids and gases, inline ceramic filters for specialty gases
and microparticle spheres for filter testing.

**GEC ELECTRICAL PROJECTS
LTD**,
**Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-
788 542144. Telex: 311335. Fax: +44-788 60767.**
Contact Name: Mr F W Ballard or Mr S W G Cheshire.
**Mechanical, electrical and control engineering com-
pany with experience in water and sewage pumping
stations and treatment plants, power generation and
combined heat and power systems. Also a manufac-
turer of a range of HV and LV thyristor convertor
equipment particularly suited to the control of pumps,
compressors and fans.**

HAIGH GROUP LTD,
Alton Rd, Ross-on-Wye, Herefordshire HR9 5NG. UK. Tel:
+44-989 763131. Telex: 35388 HAIGH G. Design and
manufacture of macerators and specialised waste processing
equipment. Products include: Row Sewage - in flow, side

SLUDGE TREATMENT & DISPOSAL

flow macerators, pumps and pumping sets; Sludge - in line and submersible macerators, pumping macerators and automatic desludging equipment; Screenings - sump macerators, pumping macerators, autoscreening conditioning equipment.

IMB,

Mathias-Brüggen Strasse 17, Cologne 30, Bikendorf D-5000. West Germany. Tel: +49-221-580-40. Fax: +49-221 5880488. IMB have been building plant since they were founded over 20 years ago. The company provides waste water purification by various filtration and make up systems. IMB are able to provide several services, from projecting to commissioning of water treatment plants.

INKA SYSTEMS LTD,

7 Watt Rd, Hillington, Glasgow G52 4RY. UK. Tel: +44-41-882 5395. Telex: 778210 INKA G. Fax: +44-41-810 5387. Design and supply of effluent and sewage treatment plants and equipment including: screens, presses, grit removal, clarifiers, aerators, mobile and static sludge dewatering plant, sludge thickener and tertiary treatment.

JOHNSON-PROGRESS LTD,

PO Box 103, Wright St, Broadheath, Altrincham, Cheshire WA14 5EF. UK. Tel: +44-61-928 6388. Fax: +44-61-941 7309. Complete plants for filtering slurries and sludges from water and from domestic/industrial effluent treatment. Product range includes filter presses, filter media, pumps pre-treatment and cake handling equipment.

KASKAD IRRIGATION,

Kaskad Engineering Ltd, 26-30 Station Rd, Epworth, Nr Doncaster, South Yorks DN9 1JU. UK. Tel: +44-427 873034. Fax: +44-427 874260. We manufacture 11 different sludge-reel models with hose lengths up to 400 metres. They cater for flows up to 16,000 gallons per hour or more according to sludge consistency. Sludge to land operations can continue all year round, even on frozen ground where injection systems are impracticable. Please telephone for brochure pack and further details. (See main advertisement).

KOMLINE-SANDERSON,

12 Holland Avenue, Peapack, NJ 07977. USA. Tel: +1-201-234 1000. Telex: 136328. Fax: +1-201-234 9487. Manufacturers of thickening and sludge dewatering equipment.

KRONOS TITAN-GMBH,

PO Box 100720, Leverkusen 1, D-5090. West Germany.

Tel: +49-214 3560. Telex: 8510823. Fax: +49-214 356481. KRONOS Water Treatment Chemicals based on iron salts for the treatment of drinking water, process water and cooling water; for purification of industrial and municipal waste water; for dewatering of sewage sludge; and for the pre-treatment for seawater desalination by RO and odour control for waste water collection systems. Many years of successful experience in water treatment and waste water purification qualify KRONOS TITAN-GmbH for a leading position in this field. KRONOS-TITAN GmbH is a subsidiary of NL Chemicals Inc, Hightstown/USA a company with an annual turnover of over 1,000 million US-\$. KRONOS Water treatment chemicals are sold worldwide and produced in Leverkusen and Nordenham, West Germany and in Fredrikstad, Norway.

KVAERNER ENGINEERING LTD,

Alwatch Division, Raglan House, 8-24 Stoke Rd, Slough, Berks SL2 5AG. UK. Tel: +44-753 824621. Telex: 849834 KVEN G. Fax: +44-753 77029. Part of the Kvaerner Group, process contractor in the turnkey supply of water and industrial effluent plant. Protein and fat recovery, dissolved air flotation, physico-chemical/biological treatment of oil, metallurgical, petrochemical and sludge handling.

MAGYAR ACELARUGYAR TISZA-SZALKAI GYARA,

PO Box 291, Budapest 62, H-1399. Hungary. Tel: +36-1-371 526. Manufacture and export the System Gyulavari container sewage treatment systems which reduce or entirely eliminate the bulking sludge. The plants are standard pre-engineered packages suitable for either above or below ground installation. Ideal for communal or industrial waste water applications.

MAROLF INC,

15500 49th St North, Clearwater, FL 33520. USA. Tel: +1-813-536 5991. Manufacture of water and wastewater treatment equipment for use in subdivisions and municipalities.

MASCHINENFABRIK ANDRITZ AKTIENGESELLSCHAFT,

A-8045 Graz, Statteggerstrasse 18. Austria. Tel: +43-316-602-0. Telex: 311313 ANTZ. Dewatering engineering - dehydration of various sludges occurring in process engineering. The CPF continuous pressure filters designed for the purpose operate on the mechanical pressure filter principle.

NASH ENGINEERING (GB) LTD,
Rd One Industrial Estate, Winsford, Cheshire. UK. Tel: +44-606 594242. Fax: +44-606 551994. Supply Liquid Ring compressors for gas recirculation in sludge digestors. This type of compressor has the ability to handle wet corrosive gas as well as liquid slugs and semi-solid carry over. These compressors can be supplied as complete packages.

NORWEGIAN WATER & ENERGY TECHNOLOGY,
Box 172, Stavanger, Rogaland, 4033 Forus. Norway. Tel: +47 4 571488. Fax: +47 4 571750. Consultants in the design and manufacture of plants for water and waste water treatment. Special emphasis on membrane technology and membrane based unit operations. Also sludge treatment.

NOXON AB,
Box 10024, 434 21 Kungsbacka. Sweden. Tel: +46-300 19602. Fax: +46-300 19604. Manufacturers of a decanter centrifuge.

PAXMAN PROCESS PLANT DIVISION GEC DIESELS LTD,
PO Box 8, Paxman Works, Colchester, CO1 2HW. UK. Tel: +44-206 575151. Telex: 98151. Fax: +44-206 577869. Paxman filtration offers versatility in filtration technology with a range of products specialising in liquid/solid separation. Paxman engineers are specialists in sludge dewatering having a long and broad history of experience.

PENNWALT LTD (SHARPLES DIVISION),
Doman Rd, Camberley, Surrey GU15 3DN. UK. Tel: +44-276 63383. Telex: 858283. Fax: +44-276 683615. Pennwalt Ltd are manufacturers of centrifuges for thickening and dewatering of both municipal and industrial sludges. The Sharples Maximiser gives a remarkable 50 per cent better throughput with 40 per cent less energy.

PIERSON & CO (ADPEC) LTD,
Thrift St, Wollaston, Wellingborough, Northants NN9 7QJ. UK. Tel: +44-933 663246. Telex: 311463. Fax: +44-933 664061. Design, manufacture and install worldwide a horizontal vacuum belt filter.

PURAC AB,
PO Box 1146, Lund S-22105. Sweden. Tel: +46-46-135100. Telex: 8305083. Fax: +46-46-14 6988. The unique BIAV composting system treats sludge and separated

compostable fractions from solid waste in an aerobic composting reactor which produces valuable compost, rich in nutrients, suitable for parks, gardens and farms.

RUND-STAHL-BAU GMBH,
Am Brand 8, Bregenz A-6900. Austria. Tel: +43-557-25-5-98. Telex: 57-400. Rund-Stahl-Bau is engaged in the production and sale of special formwork for the construction of cylindrical and funnel-shaped buildings, such as water towers, reservoirs, silos, sewage clarification plants, sludge digestion towers, fermentation gas plants, etc. The complete system incorporates working, supporting and safety frames and thus requires no extra scaffolding.

SEPARATION AS (ALFA-LAVAL),
5 Maskinvej, Soborg DK-2860. Denmark. Tel: +45-167-03-11. Telex: 22201. Manufacturers of fully-engineered plant and equipment for surplus activated sludge thickening and sludge dewatering using decanter centrifuges.

STOCKDALE FILTRATION SYSTEMS LTD,
Stockdale House, Waters Green, Macclesfield, Cheshire SK11 6LF. UK. Tel: +44-625 616109. Telex: 66885. Fax: +44-625 34678. All types of liquid/solid separation equipment including: rotary vacuum, pressure leaf, sand filters, cartridge filters and oil/water flotation separators. Main applications - effluent, sludge dewatering and water polishing.

SUBMERGED COMBUSTION (ENGINEERING) LTD,
Station Rd, Donnington, Telford TF2 8JZ. UK. Tel: +44-952 670371. Telex: 35170. Fax: +44-952 607571. Design, supply and installation of process engineering plant incorporating submerged combustion and other specialised combustion processes. Work includes recarbonation plant and heating sewage sludge for efficient anaerobic digestion.

SUBURBIA SYSTEMS INC/INNOVATIVE MATERIAL SYSTEMS,
PO Box 2987, Olathe, KS 66062. USA. Tel: +913-829 2900. Fax: +913-829 2989. Manufacturer of dredges, pumps and pumping systems for sludge removal and handling to the wastewater and water industry. Manufacturer of package treatment plants, clarifiers, gravity filters for the wastewater industry.

GENERAL EQUIPMENT & PROCESSES

SULZER BROTHERS LTD,

CH-8401 Winterthur, Switzerland. Tel: +41-52-81-11-22. Telex: 896-060. Fax: +41-52-23-42-83. Sulzer water treatment and wastewater purification plants meet the special requirements associated with all kinds of municipal and industrial applications. In addition, pumps are supplied for communal and industrial water supply and irrigation installations. Furthermore, pumps, decanters and fluid-bed driers required for the treatment of waste waters and sewage sludges.

SUTCLIFFE POLCON LTD,

Severalls Lane, Colchester, Essex CO4 4PD. UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 841503. Provides turnkey solutions for waste water purification including Hycor milli screens for sea outfalls and industrial applications, PCL belt dewatering presses and MEYN dissolved air equipment.

TRANSORGANICS LTD,

Lotherton Way, Garforth, Leeds LS25 2JY. UK. Tel: +44-532 872722. Telex: 667737. Fax: +44-532 870190. Specialists in recycling of agricultural land, organic waste products from water authorities and the food industry. Provide vacuum tanker services.

UNOX EFFLUENT TREATMENT SYSTEMS (WIMPEY ENGINEERING),

27 Hammersmith Grove, London W6 7EN. UK. Tel: +44-81-748 2000. Telex: 25666. Fax: +44-81-748 6083. Specialists principally in UNOX oxygen activated sludge, oxygen generation, sludge digestion, and oxygen injection systems. Wimpey Engineering provide a complete service for design, manufacture, installation and commissioning on turnkey, project management or sub-contract basis and offer comprehensive pilot plant facilities.

VOEST-ALPINE AG,

Postfach 2, A-4010 Linz. Austria. Tel: +43-732/585-1. Telex: 2208-600 VA A. The company's water engineering activities form only part of the varied range of products and services. They include: drinking-water treatment of surface and ground water; service water treatment; treatment of circuit, cooling and process water; mechanical, biological and chemical treatment of sewage and industrial waste; stabilisation, digestion, thickening, draining, drying, composting, disposal and incineration of sludge; and sludge draining using screen belt presses.

WAB - WASSERAUFBEREITUNGSANLAGEN GMBH,

Leberstrasse 118, Wien A-1111. Austria. Tel: +43-222-74-35-60-0. Telex: 132291 WAB A. The Messner Aeration Panel (MPB) is a system for the uniform fine-bubble aeration of activated sludge tanks of municipal or industrial sewage treatment plants. Thanks to their small size the air bubbles travel very slowly to the surface. This results in a long retention time and a high transition rate, thus ensuring maximum oxygen dispersion.

WEBER SENSORTECHNIK GMBH, 2201 Kollmar. West Germany. Tel: +49-04128 591. Telex: 218326. Fax: +49-04128 593. The flow-captor Eurocard system finds extensive application in the central monitoring and panelling of drainage systems. The flow-captor can be applied to liquid or semi-solid media and provides high resistance to aggressive media due to a stainless steel sensing surface.

GENERAL EQUIPMENT & PROCESSES

AL KAWTHER INDUSTRIES LTD, PO Box 7771, Jeddah 21472. Saudi Arabia. Tel: +966-2-636 0644. Telex: 602907 KAWTHR SJ. Fax: +966-2-637 4337. Al Kawther provides a wide range of consultancy, design and O & M services as well as supplying: packaged water/wastewater treatment plants, filters and sterilisers, custom built water/wastewater treatment plants.

AQUA TECH,

Ferdinand Porsche Strasse 1, Salzburg 85020. Austria. Tel: +43-662 77130. Telex: 632618. Fax: +43-662 7713077. Aqua Tech design and manufacture small treatment plants for drinking water, process water and waste water.

ARLAT TECHNOLOGY INC,

150 East Drive, Bramalea, Ontario L6T 1C1, Canada. Tel: +416-458 8220. Fax: +416-458 8224. Arlat Technology Inc is a Canadian based manufacturer and representative of engineered process equipment for the water and wastewater treatment market. Arlat Technology Inc offers complete engineering and design capabilities along with products such as ultraviolet disinfection systems, ozonation equipment, plate settlers, clarifier mechanisms and static mixers.

ARTECO SAS,

Pacini 99, Lucca, LU 55100. Italy. Tel: +39-583 952394. Fax: +39-583 952395. Arteco designs and installs tailor-made wastewater treatment plants for industry and communities. Marichlor for marine use, Extabiol for biodegradable effluents and Drydry for galvanisation wastes are proprietary processes marketed worldwide.

**AWA SIGISBERT BOKAN
GESELLSCHAFT MBH,**

A-8010 Graz, Plüddemangasse 34A. Austria. Tel: +43-316/80-3-68. AWA are specialists in the planning and production of waste water and sewage treatment plants and have developed a rotary pumping system (Bokan). Plants operating on this principle are used for petroleum, sludge and grease separation. Other products include plants for residual oil separation (by coagulation and active carbon filtration), percolating plants with sludge retention and biological clarification plants.

BIO TREATMENT LTD,

5 Chilern Close, Cardiff Industrial Park, Cardiff CF4 5DL. UK. Tel: +44-222 766802. Telex: 497244. Fax: +44-222 766945. Service based company offering services in the treatment and reclamation of surface and sub-surface contaminated land; the treatment of ground waters and solid and liquid industrial arisings through the application of biological, chemical and engineering processes.

BIOMECHANICS ENVIRONMENTAL LTD,

1 Station Rd, Four Ashes, Wolverhampton WV10 7DQ. UK. Tel: +44-902 791616. Telex: 335684. Fax: +44-902 791772. Specialise in the design, supply, installation and commissioning of plants for waste and water purification and for the treatment of toxic and non-toxic waste embracing the latest technology. Biomechanics specialise in the anaerobic treatment of effluent for the food and allied beverage industries and offer turnkey package services to clients.

**BIOTECHNIK FORSCHUNGS-
UND PRODUKTIONSGELLSCHAFT
M B H,**

Rossakgasse 30, Wien A-1232. Austria. Tel: +43-222-67-6665. The KWA catalytic water cleaners are suitable for use with conventional sewage, liquid manure and water pumps. Without the use of chemicals certain waste and rain water can be clarified to drinking water quality, organic and anorganic substances precipitated, and germs neutralised.

BOLIDEN WATER TREATMENT,

PO Box 902, Helsingborg S-25109. Sweden. Tel: +46-42-171000. Telex: 72185 BOLIDVS. Fax: +46 42-130570. Boliden Water Treatment Divisions business is to develop, manufacture and market precipitants for treating drinking water and sewage water as well as systems for storage and dosing of these products. Boliden Water Treatment takes responsibility for the entire treatment process with process engineering knowhow, precipitants, transport systems, equipment for storage, dosing and mixing of the products - all to achieve an optimum combination of cost and best results. Precipitation products for water and waste water treatment include: aluminium sulphate, ferric aluminium sulphate, ferric chloride/sulphate, polymerised chloride or sulphate based liquid and solid precipitants. The company also provides research and development, technical knowhow on new treatment processes for chemical waste water treatment, pre-precipitation, removal of phosphorus and nitrogen. Water and waste water equipment includes: centrifuges, dosing pumps, scrapes, silos and dosing equipment.

**BRITE-TECH CORPORATION SDN
BHD,**

12, Jalan 27a, Kawasan 16, SG Rasa Industrial Area, Klang, Selangor Darul Ehsan 41300. Malaysia. Tel: +60-3-34289883-3424034/5. Fax: +60-3-3424033. Brite-Tech has been established as a company which specialises in total water management. The company provides a complete range of services and products in the field of water treatment, pollution control, process additives and fuel treatment. Its motto is 'make water treatment part of productivity'.

CARTER INDUSTRIAL PRODUCTIONS LTD,

Bedford Rd, Birmingham, West Midlands B11 1AY. UK. Tel: +44-21-772 4300. Telex: 339219. Fax: +44-21-772 3672. Manufacturers of industrial water cooling towers, water purification and effluent treatment plants.

**DARCHET ENGRG & WATER
TREATMENT PTE LTD,**

Blk 1001 Kim Chuan Light Industries Park, #01-2530 Hougang Avenue 1, 1953. Singapore. Tel: +65-3-2883566. Fax: +65-2841984. We specialise in water and waste water treatment and offer a total system approach: ultrapure water system; industrial waste/recycling system; package sewage treatment plant; package chemical injection plant; reverse osmosis desalination, package potable water system; ultrafiltration system; media filter; soft-

GENERAL EQUIPMENT & PROCESSES

ener; Iron/Mn filter and oil/water separator.

DAVCO,

1706 Metcalf Avenue, Thomasville, GA 31792. USA. Tel: +1-912-226 5733. Fax: +1-912-226 4793. Manufacturer of waste water treatment equipment for industrial, municipal or domestic applications.

DEGREMONT LAING LTD,

Page St, London NW7 2ER. UK. Tel: +44-81-959 3636. Telex: 8958741. Fax: +44-81-906 5164. Complete range of municipal/industrial water and waste treatment plant. Processes include: pulsator clarifiers, Aquazur filters, dissolved air flotation, ozone generation - sludge dewatering, desalination plants, turnkey contracts, pressure filters and biological treatment.

EBARA CORPORATION,

11-1 Haneeda Asahicho, Onto-Ku, Tokyo 144. Japan. Tel: +81-3-743 6716 London: +44-81-892 8971. Telex: EBARATYO J 22988. Fax: +81-3-745 3576 London: +44-81-891 6730. London Office: Regal House, London Rd, Twickenham, Middlesex TW1 3QS. Pollution control and environmental protection, cleansing potable water, sewage and effluent.

EMCO ENGINEERING INC,

25 North St, Canton, MA 02021. USA. Tel: +1-617-828 7340. Telex: 924326. Fax: +1-617-828 1714. The Emco group of companies is an international organisation incorporated in the state of Massachusetts, in 1974, specialising in the manufacture of water and waste treatment equipment, including: reverse osmosis, brackish and sea-water desalting plants, ultrafiltration systems, sewage treatment systems, water softeners, reclamation systems, deionisation lime treatment, swimming pool equipment and water storage tanks.

ENVIRONMENTAL ELEMENTS CORP,

3ox 1318, Baltimore, MD 21203. USA. Tel: +1-301-368 7272. low headless rapid gravity sand filters for removal of suspended solids and turbidity from water and waste water.

ESMIL WATER SYSTEMS LTD,

Stewart House, Hillbottom Rd, Sands, High Wycombe, Bucks HP12 4HJ. UK. Tel: +44-494 446435. Telex: 837249 ESMILUK G. Design, engineer and supply water and wastewater treatment equipment, including: demineralisation, condensate polishing, deaeration, dissolved air

flotation, atmospheric and pressure oil/water separators, activated carbon, single and dual media filters, MP effluent process, sea water filters and deaerators.

FOSPUR LTD,

Aifreton Industrial Estate, Somercotes, Derby DE55 4LR. UK. Tel: +44-773 604321/6. Telex: 377150. Fax: +44-773 606901. Manufacture and supply water treatment chemicals and equipment. Specialists in all forms of water and effluent treatment in industrial and domestic fields.

GEC ELECTRICAL PROJECTS LTD,

Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-788 542144. Telex: 311335. Fax: +44-788 60767.
Contact Name: Mr F W Ballard or Mr S W G Cheshire.
Mechanical, electrical and control engineering company with experience in water and sewage pumping stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor convertor equipment particularly suited to the control of pumps, compressors and fans.

HUBERT STAVOREN BV,

20 Kooyweg, Stavoren 8715 EP. The Netherlands. Tel: +31-51-49-1625. Telex: 46110 EHSTA NL. Fax: +31-51-49-2198. The company design, manufacture and install equipment for water treatment and waste water treatment.

JOHNSON MICROFLOC,

Johnson House, Browells Lane, Feltham, Middlesex TW13 7EQ. UK. Tel: +44-1-751 4424. Telex: 935479 USELON. Fax: +44-1-890 1533. Suppliers of advanced technology, High rate, water and wastewater treatment equipment including packaged portable water production systems.

KEE SERVICES,

College Rd, Aston Clinton, Aylesbury, Bucks HP22 5EZ. UK. Tel: +44-296 631499. Telex: 837545. Fax: +44-296 630263. Design, construction, maintenance and refurbishment of all forms of equipment for effluent and waste treatment.

KLARGESTER ENVIRONMENTAL ENGINEERING LTD,

College Rd, Aston Clinton, Aylesbury, Bucks HP22 5EZ. UK. Tel: +44-296 630190. Telex: 837545. Fax: +44-296 630263. Klargestester has pioneered the development of com-

compact sewage treatment equipment using modern corrosion-resistant materials. Klargest's products are marketed worldwide with clients including individual property owners, water authorities and major national companies.

LAKESIDE EQUIPMENT CORPORATION,

PO Box 8448, Bartlett, Illinois 60103. USA. Tel: +1-312-837 5640. Fax: +1-312-837 5647. Lakeside is a wastewater treatment equipment company with over 60 years of design and development experience. Offers a wide range of treatment equipment: clarifiers, oxidation ditches, rotor aerators, screw pumps, filter distributors, tertiary filtration, sewage samplers, grit collectors and package plants. Lakeside offers equipment and service for any size installation.

LANCY INTERNATIONAL INC,

PO Box 419, Pittsburgh, PA 15230. USA. Tel: +1-412-772 0044. Fax: +1-412-772 1360. Since its founding in 1945, Lancy has been a pioneer in the development of wastewater recovery and treatment technology. We are committed to technical excellence, quality products and marketing leadership in this field.

LEEDS & NORTHRUP CO,

Sunnyside Pike, North Wales, PA 19454. USA. Tel: +1-215-643 2000. Fax: +1-215-699 5245. Manufacturer of analytical instrumentation and sensors for water and waste water treatment. Also manufacture venturi meters and rate-of-flow controllers, liquid and dry chemical feeds equipment, filter bottoms, surface agitators, troughs, digital and analog control systems.

LOCHER & CIE AG,

Pelikan-Platz 5, Zurich 1, CH-8022. Switzerland. Tel: +41-1-211-5600. Telex: 813399. Fax: +41-1-221-2459. For sewage treatment plants - the deep shaft aeration.

LYONNAISE DES EAUX,

52 Rue de Lisbonne, Paris, Cedex 08 75008. France. Tel: +33-40-75-7000. Telex: 643407. Fax: +33-1-45624270. Lyonnaise serve communities in fulfilling long-term needs of municipalities and industry in the field of water supply and management, waste water treatment, drinking water distribution, sanitation and financial engineering.

MAHON & MCPHILLIPS (STRAFORD) LTD,

Holford Way, Witton, Birmingham, West Midlands B6 7AX.

UK. Tel: +44-21-356 7606. Telex: 334041. Fax: +44-21-356 892. Mechanical plant contractors, designers and manufacturers in the field of municipal and industrial water and waste water treatment.

MAROLF INC,

15500 49th St North, Clearwater, FL 33520. USA. Tel: +1-813-536 5991. Manufacture of water and wastewater treatment equipment for use in subdivisions and municipalities.

MASS TRANSFER INTERNATIONAL,

Haversham, Cumbria LA7 7EB. UK. Tel: +44-4482 3851. Telex: 65145. Fax: +44-4482 2729. World leaders in the design and supply of low-energy, anaerobic and nitrification effluent treatment plants. Over 2,000 plants worldwide, treating an extensive range of industrial and municipal effluents.

MECOLA MILIEUTECHNIEK BV,

Corn Drebbel Straat, Wijchen, BH 6603. The Netherlands. Tel: +31-8894 12176. Telex: 48769. Fax: +31-8894 21451. Sewage water treatment equipment, reverse osmosis equipment, pyrolyses, piping erection and welding, dissolved air flotation and radiation shielding.

MET-PRO CORPORATION,

PO Box 144, 160 Cassell Rd, Harleysville, PA 19438. USA. Tel: +1-215-723 6751. Telex: 244903. Fax: +1-215-723 6758. Keystone Filter Division - manufactures cartridge filtration equipment for removal of sediment, taste and odour, lead, nitrates and other undesirable contaminants in drinking water supply. Systems Division - manufactures packaged water purification systems, clarifiers, carbon treatment systems and gravity and pressure filtration equipment.

P & S WATER INDUSTRIES INC,

680 Waterloo St, London, Ontario N6A 4N8. Canada. Tel: +1-519-672 0330. Manufacture of domestic water pumps and wastewater treatment equipment for use in the home and business.

THE PERMUTIT CO,

East 49 Midland Avenue, Paramus, NJ 07652. USA. Tel: +1-201-967 6000. Manufacture water and wastewater treatment equipment (industrial).

PORTALS WATER TREATMENT,

Olafeld Lodge, 156 Bridge Rd, Maidenhead SL6 8DG. UK. Tel: +44-628 771444. Telex: 849067. Fax: +44-628

GENERAL EQUIPMENT & PROCESSES

771567. Process design and engineering of water, effluent sewage and process liquids treatment project. PWT undertake contracts of any size throughout the world, and supply their own fully proven range of pre-engineered products and protect systems with a comprehensive range of speciality chemicals.

PURATOR KLARANLAGEN,
Galaegasse 2, Wien A-1040, Austria. Tel: +43-222-65-67-85. Telex: 132716. Purator specialist in sewer, separator and sewage clarification engineering. The line-up embraces: installations for conveying waste water from point of origin to sewer (eg manhole covers, gullies etc), petroleum, grease and starch separators, biological clarification plants for sewage, industrial and municipal waste waters (eg activated-sludge plants, bio filters, trickle filters, etc).

ROSEWATER ENGINEERING LTD,
Stonebroom Industrial Estate, Stonebroom, Derby DE5 6LQ, UK. Tel: +44-773 875017. Telex: 378146. Fax: +44-773 874921. Rosewater designs, manufactures and installs process plant for the waste water treatment market including aeristatic pumps, fine bubble aerators, automatic desludging systems, package treatment plants, digester refurbishment and control panels.

SAUR (SOCIETE D'AMENAGEMENT URBAIN ET RURAL),
Challenger, 1, Avenue Eugene Freyssinet, 78064 Saint Quentin Yvelines Cedex. Tel: +1-33-30-60-22-60. Telex: 689 292 SAUR F. Fax: +1-33-30-60-27-89.
SAUR is the third largest water treatment and supply group in France where it serves 5,500 local authorities. It also handles waste water collection and treatment for 1.6 million people and collects and processes refuse from one-and-a-half million inhabitants. SAUR ensures the design and the execution of the plants necessary for the treatment of water and refuse (2,000 building references). The international activity of SAUR represents 38 per cent of the global activity. SAUR is present in Europe (Great Britain, Spain, Italy), in Canada and in Africa (15 countries) and serves 16 million people throughout the world.

SEE,
Rue de la Science 2 F9 Brussels, B 1040, Belgium. Tel: +32-2-230 9314. Telex: 25-237. Fax: +32-2-230 7613. Water treatment plants: drinking water, waste water, water for industry, swimming pool water. Chemical products for

water conditioning. Prefabricated units for the production of drinking water and waste treatment.

SELANEX LTD,
Langton House, Baitle, Sussex TN33 0AQ, UK. Tel: +44-4246 3404. Telex: 95460 SELNEX G. Fax: +44-4246 4878. Authorised stockists of valves, tanks, filters, control systems and accessories for water treatment trade use. Products marketed for Aquamaric, Fleck, Park International, Matt-Son, Rotoplast, Euroqua and Erie in UK and Ireland.

SERCK BAKER LTD,
Riga House, 380 Bristol Rd, Gloucester GL2 6XY, UK. Tel: +44-452 421561. Telex: 43567. Fax: +44-452 423414. Design, install and commission total water and effluent treatment systems. Specialists in filtration, aeration and chemical injection systems.

SOCLA INTERNATIONAL,
1 Rue Paul Sabatier, BP 300, Chalon Sur Saone Cedex, France. Tel: +33-85-46-23-58. Telex: 800259 CHALN. Fax: +33-85-41-49-31. SOCLA have available a range of self-cleaning full bore ball check valves designed specifically to handle waste water, sewage, thick viscous fluids and heavily contaminated liquids. Unique self-cleaning action reduces build-up of solids and incrustation, giving positive, effective sealing of the valve. Action of valve ensures extremely good headloss characteristics. Available in sizes from 1ins to 3ins and 50mm to 350mm diameter, the SOCLA ball check valves are rated at PN10 and temperature of +100°C.

SOUTHERN WATER CONDITIONING DIV ANDERSON CHEMICAL,
1840 Waterville Rd, Macon, GA 31206 USA.
Manufacture water and wastewater treating equipment and chemicals.

SUNBIRD SALES INC,
Box 125 Rt 68 Highway 107, Cullowhee, NC 28723, USA. Tel: +1-704-293 5912. Sales and distribution of water and wastewater treatment equipment.

SUTCLIFFE POLCON LTD,
Severalls Lane, Colchester, Essex CO4 4PD, UK. Tel: +44-206 852121. Telex: 98391. Fax: +44-206 841503. Provides turnkey solutions for waste water purification including Hycor milli screens for sea out-

falls and industrial applications, PCL belt dewatering presses and MEYN dissolved air equipment.

TFI INTERNATIONAL,
5675 Monaco St, Commerce City, Colorado 80022. Tel:
+1-303-288 6823. Fax: +1-303-288 6876. TFI
International is a producer of quality Custom
Fibreglass and Thermoplastic products as well as com-
plete electrical control system components for the
water and wastewater treatment industries. TFI's cus-
tom capabilities allow them to design and build
treatment systems to their customers specific needs.
This approach ensures that each project will receive
the personalised attention necessary to fulfill the
design requirements.

TRANSCONTINENTAL WATER
PURIFICATION,
 PO Box 846, Eugene, OR 97440, USA. Water and
 wastewater equipment. Contractors and manufacturers repre-
 sentatives.

UNOX EFFLUENT TREATMENT
SYSTEMS (WIMPEY ENGINEER-
ING),
 27 Hammersmith Grove, London W6 7EN, UK. Tel: +44-
 81-748 2000. Telex: 25666. Fax: +44-81-748
 0076/748 6083. Contractors and specialist process and
 equipment suppliers to the water and sewage treatment
 industry.

WAGNER-BIRÉ,
 Stadlauer Strasse 54, Wien, Aktiengesellschaft 54 A-1220,
 Austria. Tel: +43-222 2244. Telex: 134827 AWBWA. The
 environmental engineering division of Wagner-Biré offers
 the following: biological waste water treatment, sewage
 purification systems for municipal and industrial effluents.

WATER ENGINEERING LTD,
International Division, Aynho Rd, Adderbury, Banbury,
Oxon OX17 3NL. UK. Tel: +44-295 810581. Telex:
83655. Fax: +44-295 811913. Contact Name: Ken
Brearley. Domestic waste water must be rendered
safe before it is discharged into water courses. With
additional treatment, effluent can often be recycled or
used for land irrigation. Water Engineering Ltd has a
range of equipment, plant and services available,
together with all the technical skills required enabling
them to handle any size of project from rural applica-

tions to treatment facilities for large cities. The com-
pany is also expert in the treatment and handling of
effluent sludges.

WATER ENGINEERING SERVICES
LTD,
 Unit F, Kemerton, Halesfield 22, Telford TF7 4QX, UK. Tel:
 +44-952 290497. Telex: 35835. Fax: +44-952
 290353. Suppliers of packaged and purpose built
 water/effluent treatment plants including pressure filters,
 deionisation units, reverse osmosis and rotating biological
 contactors for sewage treatment.

WEBER SENSORTECHNIK GMBH,
2201 Kollmar, West Germany. Tel: +49-04128 591.
Telex: 218326. Fax: +49-04128 593. Flow-captor
switches and meters, especially in connection with the
flow-captor Eurocard system, find extensive applica-
tion in the central monitoring and panelling of
industrial cooling and wastewater systems. The flow-
captor can be applied to liquid or semi-solid media
and provides high resistance to aggressive media due
to a stainless steel sensing surface. The small, com-
compact and maintenance-free units without any moving
parts can be easily installed even in inaccessible
places.

WEMCO (GB) - DIVISION OF
BAKER HUGHES LTD,
 Mansarc Close, Westgate, Northampton NN5 5DL, UK.
 Tel: +44-604 52411. Telex: 311705. Fax: +44-604
 57256. Mineral processing engineers and effluent treatment
 specialists. Manufacturers and distributors of specialised
 pumps for water.

SPECIALISED EQUIPMENT &
PROCESSES

ADEQUATE PROCESS TECHNICS
APT,
 Belfaststraat 20, Kortrijk 8500, Belgium. Tel: +32-0562120
 8289. Fax: +32-0562120 3469. Sale of agitators in Europe.

ANDCO ENVIRONMENTAL PRO-
CESSES INC,
 595 Commerce Drive, Amherst, NY 14150, USA. Tel: +1-
 716-691 2100. Telex: 91-547. Fax: +1-716-691 7221.
 Manufacture and supply of waste water treatment systems for

SPECIALISED EQUIPMENT & PROCESSES

treatment of heavy metals, phosphates, fluorides and other water soluble organics.

AQUARIUS WATER PURIFICATION LTD,

Unit 12, Craven Court, Warwick Quay, Warrington, Cheshire. UK. Tel: +44-925 445144. Telex: AQUA 627151. Fax: +44-925 413524. Aquarius 150 for controlled chlorination of raw and municipal water.

ARI KFAR CHARUV WATER SUPPLY ACCESSORIES,

Kibbutz Kfar Charuv, Ramat Hagolan 12950. Israel. Tel: +972-6-763390. Telex: 6731 ARI IL. Fax: +972-6-763402. ARI Sewage Air Release Valve specially designed to release air and gasses during the filling of the line and to allow air to enter the line during emptying. The accumulated air and gasses at their high point are released when the pipe is under pressure. An air pocket which remains trapped inside the valve prevents contact between the sealing system and the sewage. A drainage opening on the side of the valve enables cleaning and draining of solids from the valve.

ARLAT TECHNOLOGY INC,

150 East Drive, Bramalea, Ontario L6T 1C1. Canada. Tel: +416-458 8220. Fax: +416-458 8224. Arlat Technology Inc is a Canadian based manufacturer and representative of engineered process equipment for the water and wastewater treatment market. Arlat Technology Inc offers complete engineering and design capabilities along with products such as ultraviolet disinfection systems, ozonation equipment, plate settlers, clarifier mechanisms and static mixers.

ARMFIBRE LTD,

Shortmead St, Biggleswade, Beds SG18 0BB. UK. Tel: +44-767 312619. Telex: 826322 ASPLTD G. Fax: +44-767 317443. Designers and manufacturers of standard purpose-made products in GRP for the effluent and water treatment industry. Standard activated carbon aeorisers both natural and fan-assisted. Complete purpose-made aeoriser systems. Tank and general purpose covers.

ASCO KOHLENSAEURE AG,

Industriestrasse 4, Romanshorn CH-8590. Switzerland. Tel: +41-71-63-33-33. Telex: 881 666 ASCO CH. Fax: +41-71-071-63-63-83. Manufacturer of all sorts of carbon dioxide equipment including fully automatic low-cost compact CO₂ water neutralisation plants. Also manufacturer of complete CO₂ and dry ice production systems.

BECKEL- EDELSTAHL,

PO Box 97, Bad Ischl A-4820. Austria. Tel: +43-6132-33-77-0. Telex: 68138. Beckel-Edelstahl supplies stainless steel equipment for water supply and sewage disposal. The line-up embraces: components for tanks, eg pressure doors, feed and delivery pipes (to give uniform spiral or parallel flow), extraction turbines, pipe fittings and complete pipe installations, double-walled doors, ventilation louvers of fixed and moveable design, manhole components, eg manhole covers, ventilation shafts, well heads and risers, intake strainers, components for sewers and sewage treatment plants, eg wall entrances, bulkheads, slide valves, overflows, ground water and backwash flaps etc.

BISANCO INC,

200 Rich Tex Drive, Lexington, SC 29072. USA. Tel: +1-803-796 9231. Fax: +1-803-796 1602. Manufacture floating diversion baffle systems for waste treatment lagoons. Can be used to create various flow patterns to improve efficiency. Suitable for industrial, biological or domestic applications.

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Suppliers of patented Floccor® plastics biofiltration media for sewage and effluent treatment, MAT Aerators and Cyclomat units for aeration of lagoons, fish farms, lakes and sewage treatment. Also Photozone activated air systems for sterilisation of water in cooling systems, swimming pools and other duties.

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CROWN AGENTS QUALITY ASSURANCE & INSPECTION SERVICE;

St Nicholas House, Sutton, Surrey SM1 1EL. UK. Tel: +4481-643 2211. Telex: 916205 GALOND G. Fax: +4481-770 9101. Contact Name: Roger Dane. For over 80 years our worldwide inspection service has protected the purchasing activities of our clients (public sector authorities and major international development agencies) by ensuring that goods ordered meet specified levels of quality, reliability and safety. The service operates at source and destination and covers all engineering plant and equipment and general stores commodities. See Groundwater Section for advertisement.

DE LANGE PLASTIC LININGS, Neptunusweg 4, 8939 AA Leeuwarden. Holland. Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

DENVER PROCESS EQUIPMENT LTD,
Stocks House, 9 North St, Leatherhead, Surrey KT22 7AX. UK. Tel: +44-372 379313. Telex: 23704. Fax: +44-372 379504. Produce machinery for the process industries, including slurry pumps, flotation machines, air pollution control units.

DREW INDUSTRIAL DIVISION,
One Drew Plaza, Boonton, New Jersey 07005. USA. Tel: +1-201-263 7600. Telex: 136444 DREWCHEMS BOON. Fax: +1-201-263 3323. Drew Industrial Division provides specialty chemical products and services for the management and treatment of water and fuel in steam generating, process cooling, air conditioning, clarification and process water systems. Industrial water treatment needs are covered by a broad range of products: corrosion and scale inhibitors, dispersants, microbiocides and defoamers.

DUALL DIVISION MET-PRO CORP,
700 South McMillan, Owosso, MI 48867. USA. Tel: +1-517-725 8184. Fax: +1-517-725 8188. Duall manufactures wet scrubbers utilised in control of

odours in wastewater treatment. Carbon units for lift station odour are also available.

EMERY CHEMICALS, OZONE TECHNOLOGY GROUP,
4900 Este Avenue, Cincinnati, OH 45232. USA. Tel: +1 513-482 2100. Manufactures ozone generation systems for potable water and wastewater treatment, odour control and chemical synthesis in industrial and municipal applications.

ETA PROCESS PLANT LTD,
The Levels, Brereton, Rugeley Staffs WS15 1RD. UK. Tel: +44-889 576501. Telex: 36519 ETARUG G. Fax: +44-889 579856. ETA Process Plant designs and supplies equipment for the elimination of odours from biofilters, sludge tanks and enclosed inlet balancing tanks. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

FILTROS PLANT, FERRO CORP,
603 West Commercial St, East Rochester, NY 14445. USA. Tel: +1-716-586 8770. Manufacture of porous ceramic products for water and wastewater applications. Specifically diffusers and filters.

FORCE FLOW EQUIPMENT,
3467 Golden Gate Way, Lafayette, CA 94549. USA. Tel: +1-415-284 2200. Fax: +1-415-284 5945. Manufacture chlorine scales for 1 ton containers, primarily for the waste water and water treatment industries. Also manufacture scales for stationary 30-60,000 pound tanks.

GENERAL FILTER CO,
600 Arrasmith Trail, Ames, IA 50010. USA. Tel: +1-515-232 4121. Fax: +1-515-232 2571. Manufacture water and waste water equipment: softeners, clarifier, packaged filter plants and gravity filter parts and controls.

HANBY ANALYTICAL LABORATORIES INC,
4400 South Wayside, Suite 107, Houston, Texas 77087. USA. Tel: +1-713-649 4500. Fax: +1-713-649 6237. HAL Inc has developed a sensitive, accurate Field Test Kit for the detection of aromatic contamination for wastewater treatment and water recovery systems. The Test Kit provides part-per-billion analyses for fuels, pesticides, solvents etc. It is easily taught to field personnel and comes complete for thirty analyses and video cassette instructions.

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HETHON INTERNATIONAL BV,
PO Box 40 Borchseweg 40, Rurlo 7260 AA. The Netherlands. Tel: +31-5735 1350. Fax: +31-5735 2866.
Hethon International, NL represents manufacturers of fluid and solid handling equipment as GR, Accurate, Siroflow, Duff Norton, Gorman Rupp etc. Hethon is specialised in combining products into complete systems for fluid and/or solid handling.

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KVK,
A-8551 Wies, Austria. Tel: +43-3465/25-13. Telex: 034342. The firm KVK has been engaged for years in the production of large capacity tanks for acids, lyes and waste water. In line with pollution control requirements it has developed a compact neutralisation plant for the treatment of used waters and acids.

MODULAR PRODUCTION EQUIPMENT INC,
13939 Northway Freeway, Ste 143, Houston, TX 77040. USA. Tel: +1-713-462 8607. Manufacturer of a unique non-clogging free flow oil coalescer - The SP Pack®. This can be used to enhance performance of existing API separa-

tor or flumes, CIP or tanks. Also can be used to separate free oil from waste water or any application where water effluent quality is important.

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PCI MEMBRANE SYSTEMS LTD,
Laverstoke Mill, Whitchurch, Hants RG28 7NR. UK. Tel: +44-256 896966. Telex: 858128 PCILAV G. Fax: +44-256 893835. Manufacturers and suppliers of membrane separation equipment for the treatment of industrial and chemical effluents. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

PCI OZONE CORP,
1 Fairlie Crescent, West Caldwell, NJ 07006. USA. Tel: +1-201-575 7052. Telex: 244067. Fax: +1-201-575 8941. PCI Ozone Corp provides ozone systems for use in water and wastewater treatment, odour control and chemical processes. Ozone in the presence of polluting compounds reacts rapidly to form environmentally safe byproducts. This process is particularly effective as a treatment for both potable water and wastewater disinfection.

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PRIDESA,
Aameda de Recalde, 27-50, 48009 - Bilbao, Spain. Tel: +4-4236446. Fax: +4-4246685. Pridesa is a company devoted to the study, procurement and performance of all kinds of water and waste water treatment plants.

PUK WATER TREATMENT LTD,
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SCHLUFF VACUUM SEWERAGE SYSTEMS LTD,

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Box 389, Bradley, IL 60915, USA. Tel: +1-815-932 8154. Telex: 703480. Fax: +1-815-932 0674. Manufacture polymer injection equipment for potable and waste water applications.

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8000. Manufacturer of chlorination and other
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GU12 5QR. UK. Tel: +44-252 513006. Telex: 858210
INSTCOG. Fax: +44-252 513855. YSI dissolved oxygen
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CURRENT TRENDS IN IRRIGATION

by Ian Smout, Water, Engineering and Development Centre (WEDC).

In the post colonial era, there has been a worldwide expansion of irrigated area, much of which has been undertaken through projects financed by international aid.

Despite technological advances in sprinkler and trickle irrigation, this expansion has mostly taken place through surface irrigation, which accounts for 95 per cent of the world irrigated area. These projects have covered most of the land which could be developed relatively easily, and the scope for further expansion is now limited in many countries (particularly in arid and semi-arid regions) by shortage of water or land resources. Egypt is an example of this: the Nile waters are fully utilised and agricultural land is being encroached for housing and business use (about 0.5 per cent of its best agricultural land is lost each year). The problems have been worsened in some countries by a decrease in rainfall in recent years which has reduced their water resources. It remains to be resolved whether this is the new norm resulting from permanent climatic change or just a temporary reduction.

As a result of the pressures on resources, new projects now tend to face more complex technical problems than were faced by past projects.

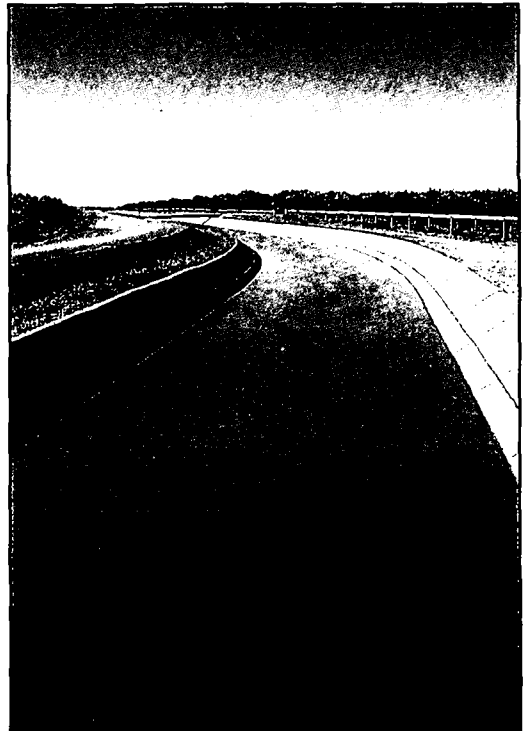
At the same time, awareness has grown of the poor performance of many of the schemes which were constructed in the last 30 years. In the 80s, increased attention was paid to improving the performance of existing schemes rather than constructing new ones, and this trend is likely to continue in the 90s, strengthened by two external factors:

- Greater pressure on the physical resources of water and land due to increasing populations and urbanisation;

- Increased concern about the environmental impact of water resource projects.

Attention to the shortcomings of existing schemes has led to greater awareness of the importance of the management of irrigation schemes, and

BELOW: Catchment transfer: the 50km long concrete-lined Canal de Rocade in Morocco.



of the institutions responsible for this. Irrigation is now more widely recognised as multi-disciplinary, rather than just an engineering activity. The establishment of the International Irrigation Management Institute (IIMI) in 1984 both reflected and strengthened this trend. Its work includes engineering aspects of irrigation such as water management, economic aspects such as financial management of schemes, and institutional aspects such as farmer participation.

Shortages of resources for irrigation operation and maintenance (O&M) have prompted a number of agencies to seek improvements in financial management and cost recovery. They seem to have reached a general conclusion that water charges collected from farmers for irrigation should be used directly to finance O&M expenditures, rather than being absorbed into general government revenue (as is often done at present). If there is a direct connection between the collection of funds and O&M work, both the farmers and the agency personnel have an interest in the satisfactory operation of the water charge system.

With the aims of improving performance and reducing costs, farmer participation has also been given greater attention. In Asia, many schemes are designed to be operated and maintained by farmers

at the tertiary level (below about 50ha). A project may therefore include the formation of Water User Associations (WUAs) to provide a structure for farmer management and liaison with the government.

Farmer participation is particularly important in small-scale irrigation projects, which is an area where involvement by government and development agencies has increased, and this trend is likely to continue. Much small-scale irrigation is still carried out by farmers independently, and this can be influenced by developments such as new pumps or changes in crop prices.

In areas where existing river flows are already fully utilised for part of the year, irrigation projects to develop new land are only possible if more water can be made available at the critical times. This may be done in one of the following ways, which are discussed below:

- Construction of reservoirs to store water;
- Construction of catchment transfer works to divert water from another river which is under-utilised;
- Use of groundwater;
- Use of wastewater.

Reservoirs and catchment transfer schemes are major water resource projects which need to be considered as part of an overall plan for the river basin,

BELOW: Groundwater: a deep tubewell with compacted earth canal, Bangladesh.





Small-scale irrigation: a farmer's open well and petrol engine pump in Kano, Nigeria.

rather than simply from an irrigation point of view. Moreover their costs are commonly higher than can be justified on irrigation benefits alone. In such cases irrigation then tends to become one component in a multi-purpose project which includes hydro-electricity and water supply for municipal and industrial demands.

The value of water for irrigation is often much less than its value for municipal and industrial purposes, so the latter would then get priority. However these other uses also require a higher reliability of supply than is normally allowed for irrigation (for example, design drought return periods are typically 20 to 100 years for urban water supplies, compared to five years for irrigation). As a result, water resources projects which ensure sufficient security of supply for municipal and industrial demands may normally be able to provide surplus water for irrigation relatively cheaply, and the different uses can be complementary.

Groundwater projects also require to be considered in a wide framework, for example to ensure that extraction is within safe limits from recharge and water quality criteria. Groundwater irrigation has expanded rapidly during the 70s and 80s, particularly on the great alluvial plains of South Asia. In Pakistan for example there are now

about 250,000 privately-owned shallow tubewells and 15,000 publicly-owned deep tubewells which supplement the long established canal systems from the major rivers.

Wastewater is going to be an increasingly important source of water for irrigation, as urbanisation leads to increases in the discharge of wastewater. Already this is a significant form of irrigation in the arid countries of west Asia. The main problems concern water quality, and include:

- Potential hazards to irrigators; these may be reduced by simple treatment of wastewater (eg in waste stabilisation ponds) before reuse;
 - Potential hazards to consumers of the produce; these may be controlled by simple treatment as described above; otherwise risks may be reduced by restricting wastewater irrigation to non-food crops or crops which are cooked before consumption;
 - Effects of poor quality water on crop growth.
- The main problems are likely to be sodium and boron in industrial wastes.

Rehabilitation projects are carried out to bring the irrigation infrastructure up to a satisfactory standard for sustained operation and maintenance. On long running schemes this can be seen as the renovation of a depreciated asset. However reha-

bilitation has also been carried out on some recently completed schemes to overcome deficiencies in the original design or construction of the scheme, or because of deterioration caused by *poor maintenance*. The need for rehabilitation is normally observable from the poor condition of the canals and structures, resulting in high losses of water and limited areas receiving irrigation supplies.

Rehabilitation is often coupled with upgrading of the original system to be more suitable for modern requirements, such as:

- To provide for changed cropping patterns or *diversified cropping*, for example by increasing the canal capacities, constructing tertiary and quaternary canals, and improving the flexibility of operation, including the use of on-demand systems;
- To reduce losses of water and thereby improve supplies to other areas (eg downstream users); lining canals has not proved as effective in reducing losses as expected, and other solutions are now being used, such as *improved earth canals* and use of pipe systems;
- To improve facilities for management of the irrigation system, particularly flow control and measurement, including use of telemetry, automatically controlled gates and computer models.

One activity which has met serious problems is the construction of tertiary and quaternary canals, sometimes under 'command area development (CAD)' or 'on farm development (OFD)' projects. These aim to improve the distribution of water and increase the area receiving irrigation, but in practice it is difficult to ensure that the new canals are acceptable to the farmers. For example the layout needs to fit their landholding boundaries and pattern of co-operation in distributing water, and farmers have destroyed many canals which took their land but failed to meet these requirements. The problems can be overcome through consultation between designer and farmers, and project design schedules need to allow for this.

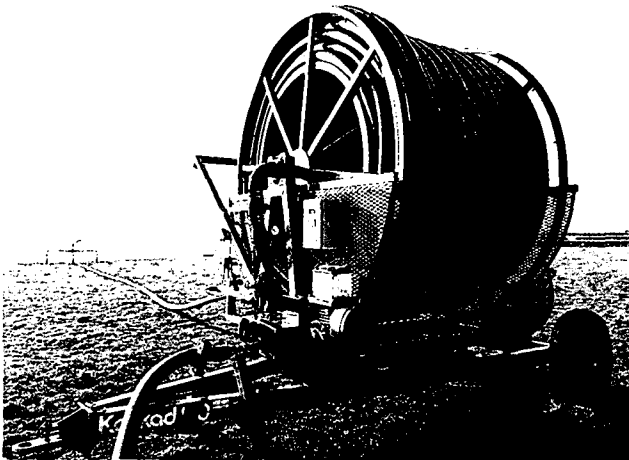
Irrigation schemes are intended to have an impact on the environment, and flying over irrigated areas such as the Sind in Pakistan or the Nile in Sudan and Egypt can give a vivid picture of the difference between the irrigated and unirrigated environments. Irrigation enables the production of food and cash crops which provide nutrition, employment and income for families who would otherwise be forced to seek their livelihood elsewhere.

On the other hand there can be environmental costs of irrigation development, and these may become particularly important if schemes are badly managed. One hazard is *physical deterioration: waste of water in over-irrigation and seepage* can result in rising water tables, waterlogging and salinity, and change productive fields into wastelands.

The disturbance to previous land use may also be important, whether this is grazing, forest, or intensive cultivation. Where a reservoir displaces people's homes and lands, it may provoke strong opposition, especially if land pressure prevents the *people being offered an acceptable alternative*. Examples of projects which have faced strong protests during the 80s include Bakolori in Nigeria, Narmada in India, and various proposed reservoirs in Java and Madura in Indonesia.

There are also serious health hazards of irrigation. Waterlogged areas can become breeding sites for malarial mosquitoes, and reservoirs and canal systems provide favourable habitats for the snails which spread schistosomiasis. Even if malaria and schistosomiasis are not currently found in the area, they can be introduced by construction workers and farmers moving into the area from outside. The diseases then soon become established unless concerted efforts are taken to control the vectors and to treat the people who are suffering from the disease and could pass it on to others. Major improvements in the performance of existing schemes is the appropriate aim for irrigation in the 90s, rather than further expansion of irrigated area. With the increasing pressure on resources and concern about the environment, more and more emphasis in irrigation is likely to be placed on the efficient management of existing schemes. This will require physical improvements to many schemes to correct past deficiencies in design and construction and upgrade them to meet current operating requirements. There is scope for technological innovation, for example in telemetry and computer modeling. However these improvements to the irrigation infrastructure are probably of less importance than strengthening the institutions which are responsible for managing irrigation schemes. This entails establishing improved O&M procedures and ensuring that staff are trained and supervised in following these. It also includes improved procedures for financial management and cost recovery, and farmer participation.

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30 Kirkham Industrial Court, St Louis, Missouri 63119, USA. Tel: +1-314-968 0404. Fax: +1-314-968 2465. Brenco International markets a line of agricultural chemicals, including chelated micronutrients, liquid and dry fertiliser, agricultural and greenhouse equipment.

CULTIVEX PTY LTD,

244 Larrobe Terrace, Geelong, Victoria 3220, Australia. Tel: +61-52-218394. Fax: +61-52-216313. Cultivex is a manufacturer and exporter of "cultisol" water soluble fertiliser suitable for drip irrigation application to vegetable crops, flower crops, fruit and vine crops. Cultisol is available in several different blends to suit crop types and growth stages of plant life.

**REGENAPLANT PRODUKTIONS -
UND VERTRIEBSGES MBH & CO
KG,**

Rossakgasse 30, WIEN A-1232, Austria. Tel: +43-222 67-66-65. Regenaplan-Combi is a microfertiliser with homeopathic catalyst and activator. Thanks to the carefully coordinated, minimised and directed application of all the constituents there is no pollution of soil, water or air but effective regeneration of soils and plants. The fertiliser is used for activating, regenerating and dressing of various plant cultures. It is based on a microanalysis system (backed by 12 years of experience) with which equally high if not higher yields can be achieved using considerably lower quantities of fertiliser and plant protection agents.

AGRICULTURAL MACHINERY

ABC HANSEN COMP AS,

Soenbergade 3, Randers 8900, Denmark. Tel: +45-642-11111. Fax: +45-6413622. ABC Hansen supply a manner of equipment for irrigation and agricultural applications, primarily to the newly industrialised and developing world.

AGROMACHINA IMPEX,

1st Stoyan Lepoev Str. Bulgaria. Tel: +211882. Telex: 22563. Fax: +209129. Agromachinaimpex FTO for Import, Export and Inland Trade with tractors, farming machines and equipment, dealing with engineering, technical attendance and service. The Export List of Agromachinaimpex Foreign Trade Organisation covers 16 pump families, each produced in many modifications, a range of irrigation equipment and drip irrigation.

CASE IH,

700 State St, Racine, Wisconsin 53404, USA. Tel: +1-414-636 6011. Telex: 264425. Worldwide manufacturer and marketer of Case IH agricultural and Case construction equipment. The international marketing division supports local marketing offices, manufacturing plants, parts depots and a dealer network operating in six continents. Case IH is an affiliate of Tenneco Inc, Houston.

CATERPILLAR DO BRAZIL SA,

Av Nacoes Unidas 22-540, Sao Davo Sp 04795, Brazil. Tel: +55-11-246 4880. Manufacture, assembly, importation and exportation of tractors and construction machinery, marine engines, generators, winches and related parts and equipment for the following markets: agriculture, earthmoving, road construction, industrial machinery and mining.

CAYWOOD TRACTOR INC,

PO Box 22445, Lexington, Kentucky 40522, USA. Tel: +1-606-268 2288. In the business of renting and selling cases and backhoes. Also international John Deeres Tractors.

JOHN DEERE,

400 Nineteenth St, Moline, Illinois 61265, USA. Tel: +1-309-765 3057. Telex: 468427. Fax: +1-309-765 3051. Complete line of agricultural production equipment including 20 tractors from 25 to 370 gross horsepower, primary tillage, seed bed-finishing and croc-care equipment; com-

CONTROL EQUIPMENT VALVES & GATES

bines, hay, forage and cotton harvesters. Three, four and six cylinder diesel engines, 58 to 315 SAE net hp, for powering pumping and irrigation systems. Track and wheel excavators, backhoe loaders, four-wheel-drive loaders, motor graders, scrapers and forestry equipment lines.

ECON GROUP,

Boroughbridge Rd, Ripon, North Yorks HG4 1UE. UK. Tel: +44-765 5321. Telex: 57493. Manufacturers of agricultural and municipal equipment. The all season self propelled sprayer and the MHD demountable sprayer. Suitable for all agricultural crop spraying.

HORSTINE FARMERY LTD,

North Newbald, York YO4 3SP. UK. Tel: +44-696 827330. Telex: 52470. Fax: +44-696 57132. Supply sprayers, fertiliser application equipment and hand-held equipment for the application of liquid and granular agricultural chemicals. Specialist equipment for granular insecticides. Specially relevant to new schemes.

KASKAD IRRIGATION,

Kaskad Engineering Ltd, 26-30 Station Rd, Epworth, Nr Doncaster, South Yorks DN9 1JU. UK. Tel: +44-427 873034. Fax: +44-427 874260. The high quality British Kaskad Hose Reels, together with the associated built equipment available combine the latest design features to give unmatched ease of operation and reliability. Our team of irrigation specialists provide a comprehensive service on all aspects of irrigation planning, installation & management, giving you on of the best, most cost-effective irrigation systems available today. (See main advertisement).

MOTORENFABRIK HATZ,

Ernst-Hatz-Strabe 16, D-8399 Ruhstorf/Rott, PO Box 1162. Federal Republic of Germany. Tel: +08531 3191. Telex: +57260. Fax: +08531 32716. Motorenfabrik Hatz GmbH & Co KG is by tradition an expert with over 100 years experience related to agricultural machinery, such as driving corn mills, rice shelling equipment, tractors, generating sets and pumping equipment. The Diesel engines are aircooled and range from 3.8/HP. Hatz is represented in over 100 countries worldwide.

SAPP,

PO Box 5513, Stockholm S-11485. Sweden. Tel: +46-8-783-85-00. Telex: 19620 EXPORT S. Fax: +46-8-662-90-93. SAPP is the semi-official organisation for

collaborating Swedish companies specialising in the provision of services, technology, plants and equipment for agro-industry and agriculture, including water resources assessment and water supply.

TIFI (CI) LTD,

50 Division Avenue, Millington, NJ 07946. USA. Tel: +1-201-647 4570. Fax: +1-201-647 2517/7338. Fly and mosquito control.

VALMONT INDUSTRIES INC,

Valley, Nebraska 68064. USA. Tel: +1-402-359 2201. Telex: 484459 VMYVLLY. Fax: +1-402-359 4429. Valmont Industries offers the 'Slurry Shooter' a specially designed center pivot for land application and treatment of slurry and effluent. The systems economically and efficiently apply waste from agricultural, industrial or municipal operations. A single system can cover up to 60 hectares and distribute over four million liters of waste per day. Valmont, through its associate company Rudolf Bauer of Voitsberg, Austria, also offers a complete range of specialised slurry pumps and Rainstar travelling guns suitable for wastewater application.

VARIETY CORPORATION,

35 Davies St, London W1Y 2EA. UK. Tel: +44-71-491 7000. Telex: 28346. Fax: +44-71-491 5271. Variety Corporation (formerly Massey-Ferguson Ltd), is a management holding company, based in Canada, whose operating business designs, manufactures and distributes farm machinery, industrial machinery, diesel engines, automotive and hydraulic components on an international scale.

VERMEER MANUFACTURING CO,

Box 200, New Sharon Rd, Pella, Iowa 50219. USA. Tel: +1-515-628 3141. Telex: 478-309. Fax: +1-515-628 9338. Manufacturers of track trenchers, rubber tyre trenchers, agricultural equipment and tree-moving equipment.

CONTROL EQUIPMENT VALVES & GATES

ARAD LTD DALIA,

Water Meter Works of Israel, Doar Dalia 18920. Israel. Tel: +972-4-897911. Telex: 46383. Fax: +972-4-897960. Arad - 50 years a pioneering force in the production of technologically superior water meters, hydraulic and electronic control systems and irrigation valves. Arad systems are designed to meet modern needs of municipalities, agriculture and industry.

BERMAD,

Kibbutz Evron, M P Ashrat, Israel. Tel: +972-4-929241.
Telex: 471606. Fax: +972-4-92946. A complete range of valves for all applications in water supply and irrigation. Automatic valves, air release valves, pressure reducing and sustaining valves etc.

BUCKNER,

PO Box 60016, 4381 North Brawley Avenue, Fresno, CA 93794-0018. USA. Tel: +1-209-275 0500. Telex: 910-350-6333. Fax: +1-209-275 3384. Manufacture a full line of products for the irrigation industry, including valves, sprinklers and controllers. Our products are applicable for the agricultural, residential, commercial, industrial and golf markets.

EAGLE SIGNAL CONTROLS,

8004 Cameron Rd, Austin, TX 78753. USA. Tel: +1-512-837 8300. Telex: 166975. Fax: +1-512-837 8486. Provide industrial and commercial timers and controls for water treatment and irrigation industries. Particularly repeat cycle timers and percentage timers.

GEORG FISHER +GF+,

CH-8201 Schaffhausen, Switzerland. Tel: +41-053-81-34-02. Telex: 89-70-70-40 GF CH. Fax:

+41-053-25-84-10. George Fisher +GF+ plastic fittings and valves for irrigation systems. The following points: ease, speed and economy of installation using modern jointing technology; highest operational safety and performance: no corrosion, no leakages, no incrustation; wide range of purpose-designed and proven products; minimal maintenance costs; savings in investment based on a particularly long life of the PVC gate valve, the fittings and - consequently - the pipeline itself are exactly the goals which are being achieved in a large number of important irrigation projects by means of our above-mentioned products throughout the world. Our POLYRAC compression fittings are reliable and simple to use. They have been specially designed to ensure fast and safe connections of PE pipes in irrigation networks even under extreme conditions.

HENDRIKSON BROS,

2931 Lester Avenue, Corona, CA 91719. USA. Tel: +1-714-737 6822. Fax: +1-714-737 91751. Manufacturers of water flow controls and pre-set pressure regulators for drip and low flow irrigation.

HYDRONAMIC ENGINEERING CORP,

PO Box 1736, 186 Viking Avenue, Brea, CA 92622. USA. Tel: +1-714-990 0583. Manufacturer specialising in flow control components for home RO systems. Also check valves, pressure relief valves, flow restrictors and complete flow control units.

IMPERIAL UNDERGROUND SPRINKLER CO,

13555 West 107th, Lenexa, Kansas 66215. USA. Tel: +1-913-469 5700. Manufacturers of underground sprinkler equipment for irrigation. Products include controllers, brass and plastic valves, heads and nozzles.

IRRIGATION COMPONENTS INTERNATIONAL INC,

PO Box 1063, 202 Congress St, Mobile, Alabama 36633. USA. Tel: +1-205-432 5085. Telex: 881262. Fax: +1-205-433 7467. IC manufacture the following items (for center pivots) gearboxes, gearmotors, sprinklers, drop pipes, main control panels, tower control panels, drive line couplings. Also a complete line of drip irrigation equipment, filters, valves, sprinkler irrigation equipment, (side rolls, aluminium fittings). Complete line of flowmeters, fertiliser/chemical injections pumps.

JEFFERY ELECTRONIC CONTROL P/L,

6 Pacific Highway, St Leonards, New South Wales 2065. Australia. Tel: +61-2-439 5982. Design and manufacture of 'J E C' electronic irrigation and mist propagation controllers. Especially 'COMPU-RAN' microprocessor irrigator and 'Weather Watcher' sensor automisters. Also cooling-humidifying units, filter flushing units, anemometer controls etc.

MILLARS WELLPOINT (INTERNATIONAL) LTD,

Barnham, Thetford, Norfolk IP24 2PD. UK. Tel: +44-842 89451. Telex: 81361. Fax: +44-842 89645. Suppliers of pumps, wellpoint dewatering, irrigation and sewerage control systems. Engineering consultancy service supplying turnkey engineering packages.

MOTOROLA COMMUNICATIONS ISRAEL LTD,

16 Kremenetzki St, Tel Aviv 67899. Israel. Tel: +972-3-388306. Fax: +972-3-388925. Motorola, a world leader in electronics has developed a large family of computerised

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irrigation controllers. Capable to control water and fertiliser applications on real quantity bases and on line real time flow monitoring, can act as a stand alone in the field, or as a remote of control centre

L R NELSON CORP,

7719 North Pioneer Lane, Peoria, Illinois 61615. USA. Tel: +1-309-692 2200. Telex: 882149. Fax: +1-309-692 5847. Manufacturer of high quality commercial and residential watering equipment. Oscillators, impact, nozzle, hose repair couplings and timers. Underground products include pop up sprinklers, controllers and valves.

NUOVO PIGNONE,

Via Tiburtina Km, Rome 12730. Italy. Tel: +06-40993-1. Fax: +06-4091239. Supervisory and remote control systems for water distribution, water treatment, wastewater treatment and water quality.

OCV CONTROL VALVES,

7400 East 42 Place, Tulsa, Oklahoma 74145. USA. Tel: +1-918-627 1942. Telex: 910-845 2227. Fax: +1-918-622 8916. OCV manufactures and internationally markets a complete line of automatic, hydraulically operated, diaphragm actuated, pilot controlled valves. Included in the line are models for pump control, on/off, pressure reducing and relief and rate of flow for irrigation systems.

P & R SURGE SYSTEMS INC,

PO Box 3070, Lubbock, Texas 79452. USA. Tel: +1-806-747 0065. P & R manufactures an extensive line of valves and controllers for surge irrigation. Surge is a low cost technique for improving surface irrigation uniformity and efficiency by cycling water between two irrigated sets. Low pressure diverter valves are available for pipe sizes from 4ins to 12ins diameter and all controllers are solar powered & automatic.

RAIN SPA,

Via Petrocchi 4, Milano 20127. Italy. Tel: +39-2-2610422. Telex: 324149 RAIN I. Fax: +39-2-2828721. Electric solenoid diaphragm valves, resistant to chemicals, incorporating a self-cleaning system, available in various sizes. Screen filters providing centrifugal vortex water distribution with screen filtration in polyester or stainless steel, resistant to chemicals, epoxy resin painted steel body, available in various sizes. Compensating emitter RAIN DR.P capacity 4 litres/hour.

RAVIT IRRIGATION SYSTEMS,

PO Box 9217, Tel Aviv 61091, Israel. Tel: +972-3-338405. Telex: 342630. Fax: 972-8-443445/972-55-79552. Portable aluminium irrigation equipment 2ins up to 10ins, couplings, valves, accessories, giant sprinkler system accessories, hydraulic control valves, low line system and accessories, turnkey projects.

SCHLUMBERGER INDUSTRIES,

Department Eau France, 50 Avenue Jean Jaures, PO Box 620-03, 92542 Montrouge Cedex. France.

Tel: +33-1-47-46-61-00. Telex: 270676F. Fax: +33-1-47-46-60-92. Contact: Irrigation Service.

Schlumberger manufacturers and supplies a complete line of irrigation equipment. Its hydrants, flow limiters, pressure regulators / stabilisers and irrigation water meters have gained a worldwide recognition for their long term reliability. Always in the process of ongoing improvement, Schlumberger is also involved in developing tomorrow's water management products (remote reading and control, electronic payment systems, etc). Often imitated, its unmatched quality standards set them at the top of Irrigation Engineers preference list.

SIGMA CONCERN,

Vaclavske Nam 60, 111 87 Praha 1. Czechoslovakia. Manufacture the SPS range of mobile seasonal pumping stations for delivering water to spray irrigation systems. Output ranges from 70 litres to 100 litres per second at a delivery head of 60 to 100m.

SOCLA INTERNATIONAL,

1 Rue Paul Sabatier, BP 300, Chalons Sur Saone Cedex. France. Tel: +33-85-46-23-58. Telex: 800259 CHALN. Fax: +33-85-41-49-31. An extensive range of foot valves is available for use in numerous irrigation purposes. Capable of operation in any positional attitude. Choice of poppet or membrane closing systems. Axially-guided foot valves offer bronze or cast iron bodies with polyethylene, lathene or galvanised steel strainers. Size ranges from 50mm to 350mm diameter. PN16/25. Membrane foot valves incorporate natural rubber membrane. Optional draining kits available. Size range from 40mm to 300mm diameter. PN6.

STUBENRUSS IRRIGATION SAS,

V Castellano 4, Bressanone, BZ I-39042. Italy. Tel: +39-472 35775. Telex: 400477. Fax: +39-472 34355.

SUPERIOR CONTROLS CO,
24950 Ave Kearny, Valencia, CA 91355, USA.
Tel: +1-805-257 3533. Telex: 194250. Fax: +1-805-
257 9472. Manufacture automatic irrigation controls
both electro/mechanical and electronic, brass control
valves for the irrigation industry from 0.75in to 3ins.

US EXPORT & TRADING CO,
848 Harding St, Escondido, California 92027, USA.
Tel: +1-619-743 8211. Telex: RCA
294277/TT4994245. Fax: +1-619-745 1314.
Specialists in landscape irrigation design.
Manufacturers of irrigation products (sprinklers, pipes,
fittings and valves), ultra-violet resistant PVC pipe.

WATERMAN IND INC,
PO Box 458, Exeter, CA 93221, USA. Tel: +1-209-592
3174. Fax: +1-209-562 2277. Manufacturer of surface
irrigation equipment, alfalfa valves, riser valves, flap valves,
penstocks, air vents, and pressure relief valves for drip and
sprinkler systems. Low pressure gate valves, penstocks for
turnout structures.

WEATHER-MATIC,
17 Moorlands Rd Westmoors, Wimborne, Dorset
BH22 0JN, UK. Tel: +44-202 897781. Fax: +44-
202 897780. Manufacturer of controllers, valves, sprin-
klers, bubblers and related accessories for landscape
and turfgrass irrigation. All products manufactured in the
USA.

**WEBER SENSORTECHNIK
GMBH,**
**2201 Kollmar, West Germany. Tel: +49-04128 591.
Telex: 218326. Fax: +49-04128 593. Flow-
captor switches and meters provide reliable and
accurate control of flow with high repeatability.
The compact, maintenance free flow-captors are
particularly suitable for the monitoring of low flow
rates. According to application, flow-captors can
be mounted either into pipe systems or fitted inline
and allow in all cases non-intrusive sensing, thus
not affecting flow profile. The output can be
selected between analog or digital, the latter
being suitable for connection to eg a PC
computer for further processing. Weber's latest
developments include the metering flow
switch with analog display of the actual flow r
ate and adjustable set-point.**

IRRIGATION SYSTEMS

ABC HANSEN COMP AS,
Soerberggade 3, Ranaers 8900, Denmark. Tel: +45-642-
11-11. Fax: +45-641-36-22. ABC Hansen supply all
manner of equipment for irrigation and agricultural applica-
tions, primarily to the newly industrialised and developing
world.

AGRIFIM,
236 West Portal Avenue, Suite 327, San Francisco, CA
94127, USA. Tel: +1-415-553 8048. Fax: +1-415-553
4110. Micro irrigation equipment: sale of equipment and
licensing of technology to manufacture a full range of micro
irrigation equipment.

AGRIFIM DE COLOMBIA,
PO Box 26864, Bogota, Columbia. Tel: +57-1-2680899.
Fax: +57-1-2447962. Agrifim manufactures drip and
microirrigation emitters, jets and sprinklers as well as valves,
filters, fertiliser injectors and all the fittings and accessories
required for a system installation.

AGROMACHINA IMPEX,
**1st Stoyan Lepoev Str. Bulgaria. Tel: +21 1882. Telex:
22563. Fax: +209129. Agromachinaimpex FTO for
Import, Export and Inland Trade with tractors, farm-
ing machines and equipment, dealing with
engineering, technical attendance and service. The
Export List of Agromachinaimpex Foreign Trade
Organisation covers 16 pump families, each produced
in many modifications, a range of irrigation equip-
ment and drip irrigation.**

AMES-TINSA SA,
Felix Cuevas No 120, Col Del Valle, CP 03100, Mexico.
Tel: +52-55-75-92-93. Fax: +52-5353166. Manufacture,
design and sale of portable and semi-portable agricultural
irrigation systems.

**AQUA PORE - DIVISION OF
NATIONAL PUMPS,**
PO Box 1599, Glendale, Arizona 85311, USA. Tel: +1-
602-979 3211. Telex: TWX 910950111. Fax:
+1-602-878 5923. Manufacture a sub-surface irrigation
system, low volume, low pressure. Delivers water
directly to the root; the product is made of rubber and
polyethylene.

IRRIGATION SYSTEMS

BANCILHON IRRIGATION,

21 Les Mourgues, Route D'Arles, Saint Gilles 30800. France. Tel: +33-66874155. Bancilhon manufacture a complete range of irrigation equipment, including centre pivot machinery, reel machinery, secondary and tertiary tubing and a solid set system of sprinklers.

RUDLOF BAUER GESELLSCHAFT MBH,

A-8570 Voitsberg, Austria. Tel: +43-3142-24-73. Telex: 03-13-41. The pipe and pump producer Rudolf Bauer GesmbH also turn out mobile and stationary sprinkling installations built to various designs. In the Solid Set System the whole field is densely covered with Bauer express-coupling pipes mounting closely spaced small-size sprinklers. In the Pipe Grid System sprinklers are fitted at only some of the points provided but can be operated under pressure to ensure the desired effect. In the Hose Pull System the distance between the sprinkler pipes is extended to as much as 100m.

BAYARD,

166 Rue de 4 Aout, Villeurbanne 69625. France. Tel: +33-7-868 8181. Fax: +33-7-868 8815. Bayard manufacture component parts for water irrigation and water relief networks.

BERMAD,

4070 Leaberton Court, Anaheim, CA 92807. USA. Tel: +1-412-429 0247. Fax: +1-714-666 2533. Manufacturer and supplier of a complete range of irrigation equipment and associated products.

AS BORDING MASKINFABRIK,

Klochsvej 67, Bording DK 7441. Denmark. Tel: +45-6861288. Telex: 16214. Fax: +45-6861520. Manufacturers and suppliers of self propelled irrigation machines, which employ a sprinkler system.

BOWSMITH INC,

PO Box 428, Exeter, CA 93221. USA. Tel: +1-209-592 9485. Fax: +1-209-592 2314. Bowsmith - 15 years of leadership in low volume irrigation products. The Bowsmith Non-Stop drip emitter is recognised worldwide as the most trouble-free emitter ever made. The first and only truly self-cleaning emitter. The Bowsmith Fan Jet sprinklers, too, have no equals. Fixed spray streams with 11 wetting pattern choices. Bowsmith products, often imitated, never duplicated. Peerless quality; consistent, accurate flow rates and unmatched dependability.

BUCKNER,

PO Box 60016, 4381 North Brawley Avenue, Fresno, CA 93794-0018. USA. Tel: +1-209-275 0500. Telex: 910-350-6333. Fax: +1-209-275 3384. Manufacture a full line of products for the irrigation industry including valves, sprinklers and controllers. Our products are applicable for the agricultural, residential, commercial, industrial and golf markets.

CARVELLE,

PO Box 2, St Denis Hotel, 45550. France. Tel: +33-38-59-02-10. Telex: 760786. Fax: +33-38-59-15-93. Pumps and sprayers for crop treatment.

CENTRAL SUPPLY INC,

31-A Makaan St, Hilo 96720. Hawaii. Tel: +1-808-961 5855. Central supply is in the supply house industry currently distributing industrial piping and supply, plumbing accessories, irrigation pipes and supply, irrigation systems design and sewer/drain pipes and fittings. Primarily wholesale.

CHAPIN WATERMATIC INC,

PO Box 490, 740 Water St, Watertown, New York 13601. USA. Tel: +1-315-782 1170. Telex: 494-4418 CHAP WTR. Fax: +1-315-782 1490. Manufacture drip irrigation products for nurseries, greenhouses and row crop.

COMMERCIAL IRRIGATION SYSTEMS,

PO Box 75027, Birmingham, AL, 35253. USA. Tel: +1-205-871 7054. Fax: +1-205-871 7054. Irrigation design, sales and construction, specialised in athletic fields, golf courses and commercial buildings.

COSMOPLAST INDUSTRIAL CO,

PO Box 6032, Sharjah, United Arab Emirates. Tel: +971-6-331264. Telex: 68578 COPOL EM. Fax: +971-6-331917. Contact Name: Ron Clayton. Low Density Polyethylene tube for drip irrigation is manufactured in sizes from 16MM through 4 inch supplied in coils up to 50 metre length.

DINENNA IRRIGATION,

3235 Pine Valley Drive, Sarasota, Florida 34239. USA. Tel: +1-813-924 8963. Fax: +1-813-644 9794. Irrigation specialist dealing in the service as designer, consultant and supervisor of irrigation systems for golf courses, playing fields and landscaping of commercial hotels. Also designs

and builds drip and mist systems for agriculture and nurseries. Well versed in all irrigation components.

EIN-DOR LTD,

PO Box 13129, 3 Haard St, Tel Aviv 61131 Israel. Tel: +972-3482231/2. Fax: +972-3-483171. Manufacturers of modern irrigation equipment. Wide range of modular emitters for low-volume irrigation in orchards, trees, vegetables, nurseries, flowers, hothouses, landscape gardening, for frost protection and cooling system. Sprinklers, minisprinklers, midisprinklers, low-pressure, anti-insect, half-circle, misters, sprayers, bubblers, pressure regulators, numerous assemblies press-fit design to fit all requirements and technical engineering advise.

ESSEBI PLASTIC SRL,

Via La Forma 1, Sirolo (Ancona) 60020. Italy. Tel: +39-71-73600145. Telex: 560606 MARRA I. Fax: +39-71-936787. Clamp saddles, Quick release joint from pm 16 to 63 diameter from 75-80-110 they are pm 10, PVC fittings jointed threading, Sprinklers - small rotating atomiser, Sprayers, Dripper.

EVEN PRODUCTS LTD,

Blayney's Lane, Evesham, Worcs WR11 4TS. UK. Tel: +44-386 41212. Telex: 337300. Evenproducts Ltd are suppliers of irrigation equipment, specialising in sprinkler, trickle, sprayline and most systems for small to medium sized farmers. They supply a full range of ancillary products such as tanks, pumps, PVC main, etc.

GEORG FISHER +GF+,

CH-8201 Schaffhausen. Switzerland. Tel: +41-053-81-34-02. Telex: 89-70-70-40 GF CH. Fax: +41-053-25-84-10. George Fisher +GF+ plastic fittings and valves for irrigation systems. The following points: ease, speed and economy of installation using modern jointing technology; highest operational safety and performance: no corrosion, no leakages, no incrustation; wide range of purpose-designed and proven products; minimal maintenance costs; savings in investment based on a particularly long life of the PVC gate valve, the fittings and - consequently - the pipeline itself are exactly the goals which are being achieved in a large number of important irrigation projects by means of our above-mentioned products throughout the world. Our POLYRAC compression fittings are reliable and simple to use. They have been specially designed to ensure fast and safe connections

of PE pipes in irrigation networks even under extreme conditions.

GILMOUR GROUP,

332 West Broadway, Louisville, KY 40202. USA. Tel: +1-502-587 5975. Fax: +1-502-587 5142. Irrigation and hose end (sprinklers, nozzles), pressurised tank sprayers in polythene and galvanised.

HARDIE IRRIGATION,

PO Box X, El Cajon, CA 92022. USA. Tel: +1-619-562 2950. Fax: +1-619-258 9973. Hardie Irrigation is the largest manufacturer of drip irrigation equipment in the world. An extensive product range in drip irrigation from emitters to filters, hose to valves. Distribution in many locations throughout the world.

HB-PLASTIC GESELLSCHAFT MBH,

A-2100 Korneuburg, Ungerweggasse 27. Austria. Tel: +43-2262-43-39. Telex: 132912 HBPLA. HB-Plastic specialise in the production of drip-irrigation plants. For water well construction a patented system has been developed. At a drilled well diameter of 100mm the corrosion-resistant pipes can be given a length of up to 15m and submersible pumps of appropriately high delivery inserted. The drilling unit is of mobile design and can be transported by lightweight truck.

HENDRY IRRIGATION INC,

PO Box 846 5005 Main St, Labelle, FL 33935. USA. Tel: +1-813-675 3355. Fax: +1-813-675 6094. Supplier and installer of drip and microjet irrigation, specialising in citrus crops. Whether you are looking for the right parts for the job, or the right people for the job, Hendry Irrigation is your wise choice.

HOBBS-ADAMS ENGINEERING CO,

PO Box 1833, Suffolk, Virginia 23434. USA. Tel: +1-804-539 0231. Telex: 494-8083. Fax: +1-804-934 3264. Hobbs-Adams Engineering Co manufactures reel rain traveler and center pivot irrigation.

IMPERIAL UNDERGROUND SPRINKLER CO,

13555 West 107th, Lenexa, Kansas 66215. USA. Tel: +1-913-469 5700. Manufacturers of underground sprinkler equipment for irrigation. Products include controllers, brass and plastic valves, heads and nozzles.

IRRIGATION SYSTEMS

IRRI-NAMIC INC,

PO Box 686, Randolph, MA 02368. USA. Tel: +1-617-986 2847. Manufacture's of sub-surface, modified drip irrigation products and accessories. The system is used in most applications in lieu of conventional upright systems.

IRRIDELCO CORPORATION,

PO Box 1615, Iridelco Plaza, 440 Syivan Avenue, Englewood Cliffs, NJ 07632. USA. Tel: +1-201-569 3030. Telex: 219240 1781 53 1781521. Fax: +1-201-569 9237. Design and distribute irrigation systems and equipment worldwide. Specialising in drip irrigation, sprinkler irrigation and mechanised irrigation.

IRRIGATION COMPONENTS

INTERNATIONAL INC,

PO Box 1063, 202 Congress St, Mobile, Alabama 36633. USA. Tel: +1-205-432 5085. Telex: 881262. Fax: +1-205-433 7467. We manufacture the following items (for center pivots) gearboxes, gearmotors, sprinklers, drop pipes, main control panels, tower control panels, drive line couplings. Also a complete line of drip irrigation equipment: filters, valves, sprinkler irrigation equipment, (side rolls, aluminium fittings). Complete line of flowmeters, fertiliser/chemical injection pumps.

IRRIGATION SYSTEMS CO,

West Lodge, Adsdoon, Funington, Chichester, Sussex, UK. Tel: +44-243 575708. Telex: 86333. Fax: +44 243 786930. Design, supply and installation of sprinkler and drip irrigation systems, for agriculture, horticulture etc. Turnkey contracting, management contracts, and feasibility studies.

IRRITECH,

20 Avenue 20-29, Zone 10, Guatemala City, Guatemala. Tel: +502-2-373228. Fax: +502-2-347360. Design installation and maintenance service for drip irrigation systems. Hardie irrigation products.

JOHNSTON IRRIGATION INC,

Post Office Box 2076, Fort Pierce, FL 34954. USA. Tel: +1-407-466 4500. Fax: +1-407-466 6081. Johnston Irrigation serves the US and the international marketplace with complete irrigation services including overhead and drip irrigation systems, engineering/design, project management/installation, wholesale materials, pump design, and consulting. Johnston Irrigation is one of the largest agricultural irrigation contracting companies in the United States.

K-RAIN,

1640 Austrian Avenue, Riviera Beach, Florida 33404. USA. Tel: +1-407-844 1002. Fax: +1-407-842 9493. Manufacture irrigation control timers, valves and sprinklers.

KIFCO/AG-RAIN INC,

600 South Schroder Avenue, Havana, Illinois 62644. USA. Tel: +1-309-543 4425. Fax: +1-309-543 4945. Manufacture a range of hard hose machines from 0.86ins i/d x 220ft to 4.0ins i/d x 1250ft long. Also specialise in both small machines for sportsturf and mid-size to large machines for agricultural use.

LINDSAY INTERNATIONAL

SALES CORP,

363 North Belt, Suite 1230, Houston, TX 77060. USA. Tel: +1-713-591 7300. Telex: 203292 LINTN UR. Fax: +1-713-591 0566. Lindsay® and Zimmatic® centre pivot irrigation systems are widely recognised as leaders in the industry. Zimmatic systems using water, energy and labour to deliver higher yields. A wide array of sprinkler/spray options allows maximum water application efficiency.

LOCKWOOD CORPORATION,

PO Box 160, Highway 92 East, Gering, Nebraska. USA. Tel: +1-308-436 5051. Telex: 484454. Fax: +1 308-436 5732. Manufacture's of mechanised centre pivot irrigator and linear irrigation for medium and large acreage.

MAXIJET,

PO Box 1849, Dundee, Florida 33838. USA. Tel: +1-813-439 3667. Telex: 5106006190. Fax: +1-813-439 6851. Maxijet® pioneered low-volume spray irrigation. 14 years experience and commitment to quality guarantees the finest spray jet available.

MOSS PRODUCTS PTY LTD,

711 Clayton Rd, Clayton South, Victoria, Australia. Tel: +61-3-551 6188. Fax: +61-3-551 7915. Garden watering & small irrigation systems. Supplies of pop-up sprinklers & drip watering systems, micro-spray and misting sprinklers. The complete irrigation system. For the home gardener or small market gardens.

L R NELSON CORP,

7719 North Pioneer Lane, Peoria, Illinois 61615. USA. Tel: +1-309-692 2200. Telex: 882149. Fax: +1-309-692 5847. Manufacturer of high quality commercial and residential watering equipment. Oscillators, impact, nozzle, hose

repair couplings and timers. Underground products include up sprinklers, controllers and valves.

THE OASIS WAY,

4260 Venture Circle, Meridian, Idaho 83642 USA. Tel: +1-208-323 8283. Make automatic fertiliser systems for turf irrigation and the fertiliser to go with the system. Through our system there is no friction loss or pressure loss, no gauges for external power required. It is totally self-contained and automatic.

OMACO INTERNATIONAL INC,

230 Park Avenue, Suite C-303, New York 10169, USA. Tel: +1-212-682 4460. Telex: 961666. Fax: +1-212-490 6383. Suppliers of irrigation and agricultural equipment.

PEPCO WATER CONSERVATION PRODUCTS,

1820 West Jacquelyn Avenue, Fresno, CA 93722-5027, USA. Tel: +1-209-275 3555. Fax: +1-209-275 5021. Manufacturers of products used for water conservation in landscaping irrigation. Extrude polythene tubing, which is laser drilled, allowing water to be emitted over 6ins to 12ins. Also manufacture Quadra Bubbler flow control device, which controls flow from 2gpm to 20gpm.

PERROT IRRIGATION LTD,

38 High St, Rowhedge, Colchester, Essex CO5 7ET, UK. Tel: +44-206 867624. Telex: 987852. Fax: +44-206 869911. Manufacture and supply of irrigation equipment: sprinklers; mobile, stationary, quadrangle, horticultural, agricultural, dust suppression; pipes and fittings, pumps and hose reel irrigators, slurry irrigators.

PIOGGIA CARNEVALI SPA,

Strada South, Cisa 47, Porto Martovano, MN 46047, Italy. Tel: +376-398151 234. Telex: 300541 PIOCAR. Fax: +376-390873. Pioggia Carnevali SpA is one of the largest and oldest manufacturers of irrigation equipment in Italy. The firm manufactures self-propelled hard hose irrigation systems offering 68 different models for all type and size of farms. These high quality irrigation systems are sold and promoted worldwide. Also manufactures: aluminium and galvanised steel pipe, couplings, fittings, large volume and low volume sprinklers, tractor and engine driven pumps of all sizes, tripod and hand-primer-pumps.

PLUMMER SUPPLY INC,

PO Box 177, Bradley, Michigan 49311. USA. Tel: +1-

616-792 2215. Fax: +1-616-792 6637. Sales & service of pumping units, hard & soft hose, travelers, alum & pvc pipe & fitting. Also sprinklers.

PREMIER IRRIGATION EQUIPMENT LTD,

17/1C Alipore Rd, Calcutta, West Bengal 700027, India. Tel: +91-45-530245-762645-7455. We manufacture a range of irrigation equipment and systems available at competitive prices alongwith full technical, sales and installation support: aluminium and lightweight galvanised quick coupling pipes, sprinklers of all types, drip irrigation tubing, fittings and filters, pumps, diesel/electric and tractor driven pumps and hydrams - powerless pumps.

RAVIT IRRIGATION SYSTEMS,

PO Box 9217, Tel Aviv 61091, Israel. Tel: +972-3-338405. Telex: 342630. Fax: +972-8-443445/972-55-79552. Portable aluminium irrigation equipment: 2ins up to 10ins, couplings, valves, accessories, giant sprinkler system accessories, hydraulic control valves, tow line system and accessories, turnkey projects.

REINKE MANUFACTURING CO INC,

PO Box 566, Deshler, Nebraska 68340 USA. Tel: +1-402-365 7251. Telex: 910623-8031. Fax: +1-402-365 4370. Manufacture central pivot and lateral move irrigation systems.

RÜHREN-UND PÜMPENWERK RUDOLF, BAUER GMBH,

Kowaldstraße 2, Voitsberg, Postfach 2, 8570, Austria. Tel: +43-3142-2473. Telex: 03214803-1341. Bauer sprinkler irrigation systems help to make soil fertile. Conventional sprinkler irrigation plants with Bauer quick-coupling pipes, sprinklers and 'Star-gun' wide-range rainers are operating throughout the world. Solid set sprinkler systems which require little maintenance. Rainstar irrigation machines for fully mechanised irrigation operation. Center Pivot systems to make sprinkler irrigation fully automatic. Turnkey sprinkler irrigation plant and agroindustrial projects. Industrial plants for manufacturing sprinkler irrigation equipment. Waste water treatment, transforming of waste water into water usable for irrigation.

SALCO PRODUCTS INC,

4463 West Rosecrans Avenue, Hawthorne, California

IRRIGATION SYSTEMS

90250. USA. Tel: +1-213-973 2400. Salco Products Inc has over twenty years' experience in the manufacture of drip irrigation products. This experience, together with extensive research and development, enable Salco to offer one of the best, most reliable and cost-effective drip irrigation systems available anywhere in the world. Their products are distributed extensively in the USA and in many parts of the world and are used with great success in both the agricultural and the landscape industries.

SAPP,

PO Box 5513, Stockholm S-11485. Sweden. Tel: +46-8-783-85-00. Telex: 19620 EXPORT S. Fax: +46-8-662-90-93. SAPP is the semi-official organisation for collaborating Swedish companies specialising in the provision of services, technology, plants and equipment for agro-industry and agriculture, including water resources assessment and water supply.

SENNINGER IRRIGATION INC,

6416 Old Winter Garden Rd, Orlando, FL 32811. USA. Tel: +1-407-293 5555. Telex: 56-6558. Fax: +1-407-293 5740. Manufacturers of sprinklers, spray nozzles and pressure regulators for all types of irrigation equipment, both pivot and solid step systems.

SNEED-MCBRIDE INTERNATIONAL INC,

8440 Walnut Hill Lane, Suite 501, Dallas, Texas 75231. USA. Tel: +1-214-369 5710. Telex: 732645. Fax: +1-214-739 3551. SMI/Sneed-McBride International Inc, was among the first companies to introduce modern methods of irrigation worldwide. SMI equipment includes: SMI 360 center pivot, SMI drip and micro spray, SMI speedroll sprinkler, kelley pumps and SMI grain-potato-storage systems.

SOCIETE NOUVELLE IRRIFRANCE,

34230 Paulhan. France. Tel: +67-25-25-25. Telex: 490-971 F. Irrifrance is a member of the SETI group (Societe d'etudes des techniques d'irrigation). The company supplies: installations with mobile pipes, sprinklers and pumping stations; mechanised equipment such as 'automatic reel machines' for sprinkling of small and medium areas; pivot system 'pivomatic' for the automatic sprinkling of medium and large areas; drip irrigation or micro-irrigation.

SPRINKLINK,

PO Box 45-0054, Garland, Texas 75045-0054. USA. Tel:

+1-214-530 3631. Residential and commercial landscape irrigation design.

STUBENRUSS IRRIGATION SAS,
V Castellano 4, Bressanone, BZ I-39042. Italy. Tel: +39-472 35775. Telex: 400477. Fax: +39-472 34355.

SUBMATIC INC,

PO Box 246, Lubbock, Texas 79408. USA. Tel: +1-806-747 9000. Drip irrigation equipment, pivots and extension equipment for drip tubing.

T-L IRRIGATION CO,

PO Box 1047, Hastings, Nebraska 68901. USA. Tel: +1-402-462 4128. Telex: 438047 THRRGHAST. Fax: +1-402-462 4617. Manufacturer of centre pivot, linear mode corner systems, quickflow and aluminium tubing.

TEAM SPRAYERS LTD,

Unwins Industrial Estate, Prickwillow Rd, Ely, Cambs CB7 4QT. UK. Tel: +44-353 661211. Telex: 81486 STANDEN G. Design, develop and manufacture agricultural and horticultural spraying machinery and equipment for spraying products going into store.

TORO (EUROPEAN & MIDDLE EAST OFFICE),

Unit 7, Millstream Trading Estate, Ringwood BH24 3SD. UK. Tel: +44-4254 6261. Telex: 41136. Toro offers fingertip control plus quality products designed specifically for irrigating landscape, parkland and sports turf areas worldwide. Backed by their extensive international distributor network, Toro also provides reliable maintenance and spares back-up customer services.

TORO (HEAD OFFICE),

5825 Jasmine St, Riverside, California 92504. USA. Tel: +1-714-688 6261. Telex: 676490. Toro offers fingertip control plus quality products designed specifically for irrigating landscape, parkland and sports turf areas worldwide. Backed by their extensive international distributor network, Toro also provides reliable maintenance and spares back-up customer services.

TORO (PACIFIC OFFICE) F7,

Waitara. New South Wales 2077. Australia. Tel: +61-2-487 1622. Telex: 790-25873. Toro offers fingertip control plus quality products designed specifically for irrigating landscape, parkland and sports turf areas worldwide. Backed by

their extensive international distributor network, Toro also provides reliable maintenance and spares back-up customer services.

TWIN DROPS IBERICA SA,

Basilio Sala 21, San Juan De Alicante, Alicante 03550. Spain. Tel: +34-96-5652058. Fax: +34-96-5657437. Drip-irrigation systems, drippers, polyethylene tubes, valves, accessories and irrigation equipment.

TYKOFLEX AB,

Box 614, Tyresö S-13526. Sweden. Tel: +46-8-712 0055. Telex: 10902. Fax: +46-8-742 3001. Tykoflex sell irrigation systems for golf courses, cemeteries, lumber yards and agriculture purposes. Red obstruction light, RL30, for high obstacles, quick coupling, Model 42, pipes and fittings of stainless steel, aluminium and galvanised steel.

THE URBAN FARMER STORE,

2833 Vicente St, San Francisco, CA 94116. USA. Tel: +1-415-661 2204. Publish their own mail-order catalog of drip and low volume irrigation supplies, and are a source for Hardie, Toro, Buckner, Rainbird, Oasis and Garden America/Irritrol/Richdel timers, valves and sprinklers.

US EXPORT & TRADING CO,

848 Harding St, Escondido, California 92027. USA. Tel: +1-619-743 8211. Telex: RCA294277/ITT4994245. Fax: +1-619-745 1314. Specialists in landscape irrigation design. Manufacturers of irrigation products (sprinklers, pipes, fittings and valves), ultra-violet resistant PVC pipe.

ÜSTERREICHISCHE SALEN-KUNSTSTOFFWERK GESELLSCHAFT MBH,

A-1072 Wien, Kaiserstrasse 45, PO Box 100. Austria. Tel: +43-222-96 1501. Telex: 131406. Österreichische Salen-Kunststoffwerk GesmbH are Austria's biggest producer of plastic piping: systems and networks of plastic pipes characterised by corrosion-resistance, optimum flow (smooth internal wall surfaces), low weight (easy transport) and quick coupling, mainly for water management purposes. The line-up also includes plan: planning and installation, and various irrigation systems, ranging from drip to sprinkler plants.

VALMONT INDUSTRIES INC,

Highway 275, Valley, Nebraska 68064. USA. Tel: +1-402-359 2201. Telex: 484459 VMTVLY. Fax: +1-402-359 4429. Manufacturers of mechanised irrigation

equipment (central pivot, linear moves and hard-nose travellers).

WADE'RAIN SPRINKLER IRRIGATION,

PO Box 23666, Portland, Oregon 97223. USA. Tel: +1-503-641 1865. Telex: 15-1539. Fax: +1-503-626 8298. Manufacturers of a variety of irrigation systems primarily for agriculture and centre pivot systems, side-roll systems, aluminium solid set systems, aluminium portable systems, aluminium mainline, plastic drip systems and polyethylene drip tubing. Over 50 years experience. Also systems design and turnkey projects.

ING WALDHAUSER MASCHINEN-FABRIK GESELLSCHAFT MBH & CO KG,

A-8591 Maria Lankowitz, Puchbachweg 239. Austria. Tel: +43-3144/2228 3153 3157. Telex: 3-104513. Waldhauser is engaged in the production of automatic sprinkling plants for various crops and field or farm sizes. A special feature of the Waldhauser sprinkling plants is the hydrostatic drive, which operates with minimum pressure losses, and guarantees troublefree handling of muddy or sandy water and even homogeneous liquid manure without the need for filtration. The sprinklers are of simple design and maintenance-free.

WATER WAYS IRRIGATION ENGINEERING INC,

PO Box 70188, Bakersfield, California 93387. USA. Tel: +1-805-831 3535. Manufacturers of aluminium irrigation systems.

SOFTWARE & IRRIGATION SERVICE

ARI KFAR CHARUV WATER SUPPLY ACCESSORIES,

Kibbutz Klar Charuv, 12950. Israel. Tel: +972-6-763390. Telex: 6731 ARI IL. Fax: +972-6-763402. ARIMAD-2, Field Testing System gets its information directly from the plant. A single leaf is placed in a sealed test chamber, in which atmospheric pressure is increased until a drop of water appears at the cut end of the leaf's stem. At that instant, the pressure is read, yielding an indication of the plant's 'water potential' - its ability to absorb and utilise additional moisture. The test is then repeated with several additional

SOFTWARE & IRRIGATION SERVICE

specimens, to obtain a representative average value. ARI-MAD-2 is light and portable. It can be operated easily by one person anywhere.

JAMES BARRETT ASSOCIATES INC,

PO Box 853, Montclair, NJ 07042. USA. Tel: +1-201-744 8237. The firm provides a full range of design and consulting services for all facets of golf course irrigation systems, including new construction and remodeling.

CPN CORP,

2830 Howe Rd, Martinez, CA 94553. USA. Tel: +1-415-228 9770. Fax: +1-415-228 3183. Manufacture of neutron probe for measurement of sub-surface moisture.

DUNTECH IRRIGATION SERVICES LTD,

Lashlake Nurseries, Towseley, Oxon OX9 3QZ. UK. Tel: +44-84421 5411. Telex: 83628. Agricultural and horticultural irrigation and water engineering. Feasibility studies, design, procurement, installation and management. Techcrop hydroponics and rockwell systems. Environmental control, effluent treatment, well master rising main and associated pumps.

EASTERN IRRIGATION CONSULTANTS INC,

13229 Ronehill Drive, Beltsville, Maryland 20705. USA. Tel: +1-301-572 7674. Fax: +1-301-572 5306. Irrigation design/specification, irrigation master planning, water use studies, water supply alternatives, pumping plant design/specifications, irrigation control systems. Commercial, golf, wastewater, agricultural, athletic fields, cemeteries, nurseries, construction management/contract administration. Certified irrigation designers. Members: American Society of Irrigation Consultants, American Society of Agricultural Engineers, Construction Specifications Institute.

EASTERN IRRIGATION CONSULTANTS INC,

12 Pine St, Pepperell, MA 01463. USA. Tel: +1-508-433 8972. Fax: +1-508-433 2788. Irrigation design/specification, irrigation master planning, water use studies, water supply alternatives, pumping plant design/specifications, irrigation control systems. Commercial, golf, wastewater, agricultural, athletic fields, cemeteries, nurseries, construction management/contract administration. Certified irrigation designers. Members: American Society of Irrigation

Consultants, American Society of Agricultural Engineers, Construction Specifications Institute.

FEDERAL LAWN SPRINKLER SUPPLY CO,

6029 14 Mile Rd, Sterling Hts, MI 48077. USA. Tel: +1-313-264 7460. Fax: +1-313-264 7171. Wholesale distributor of irrigation fountains and low voltage landscape lighting supplies. Product lines include Hardie Irrigation, Nelson Sprinklers, Weather-Matic Lawn Sprinklers, Rainjet Fountains, Luma landscape lighting and many more. Services include complete specification and design for each of these areas.

FLOSONICS INC,

PO Box 390, Jmailla, OR 97882. USA. Tel: +1-503-567 1966. Flosonics Inc offers complete irrigation system design, analysis and re-design, computer printouts for centre pivot sprinkler spacing and related services.

FRIEL IRRIGATION INC,

PO Box 415 Marsions Mills, Cope Coc, MA 02648. USA. Tel: +1-508-420 7805. We sell, install and service underground lawn sprinkler systems. Friel irrigation is a full service company, serving both the residential and commercial market. We are centrally located in the town of Barnstable covering the Cape.

HYDRAULIC ANALYSIS LTD,

Mill House, Hawskworth Rd, Horsforth, Leeds LS18 4JP. UK. Tel: +44-532 581622. Telex: 556301. Fax: +44-532 520863. Fluid flow consultants offering professional advice on pipeline and network design, particularly problems in pumping systems. Sophisticated computer simulation techniques supported by experienced hydraulic engineers provide optimum practical solutions to water hammer problems. Similar facilities are available for free surface open channel flow in treatment works, drainage and irrigation systems. Simulation software for these applications can be licensed.

NETAFIM MAGAL,

K Magal, D N Hefer 38-845. Israel. Tel: +06-367222. Fax: +972-6367252. Netafim offers the grower an ingeniously designed irrigation system to maintain full control on plant growth and yield. The agronomic department in conjunction with the design and field service departments, make sure you will get the equipment, design and professional back-up to full success.

SPECIAL PURPOSE PUMPS, PIPES & OTHER EQUIPMENT

NUOVO PIGNONE,

Via Tiburtina Km. Rome 12730 Italy. Tel: +06-40993-1.
Fax: +06-4091239. Supervisory and remote control systems for water distribution, water treatment, wastewater treatment and water quality.

SIEMENS SOLAR GMBH,

Bucherallee 3, Bergisch Gladbach 1, D-5060. West Germany. Tel: +49-2204 4060. Telex: 884891 SSOE.
Fax: +49-2204 40666. Our scope of supply encloses solar powered surface water and deep well pumping systems for irrigation: surface water pump - max height 11.5m, max output 43m³/h. DEEP WELL PUMP - MAX HEIGHT 5:60M, MAX OUTPUT 1.3-36M³/h. CONVERTING LIGHT INTO ELECTRICITY, WE USE THE GREATEST ENERGY RESOURCE AT LOWEST COSTS.

WADE'RAIN SPRINKLER IRRIGATION,

PO Box 23666, Portland, Oregon 97223 USA. Tel: +1-503-641 1865 Telex: 15-1539. Fax: +1-503-626 8298. Manufacturers of a variety of irrigation systems primarily for agriculture and centre pivot systems, sizeroll systems, aluminium solid set systems, aluminium portable systems, aluminium mainline, plastic drip systems and polyethylene drip tubing. Over 50 years experience. Also system design and turnkey projects.

WAT-IRR INC,

PO Box 215, Buckeye, Arizona, 85326. USA. Tel: +1-602-247 4170. Irrigation systems, design, system analysis and trouble shooting.

WATERMATION LTD,

Monument Way East, Woking, Surrey GU27 5LY. UK. Tel: +44-4862 70303. Fax: +44-483 755082. Manufacturers of irrigation equipment for sports turf, landscape and dust control. Contractors for installation of irrigation schemes. Maintenance division for repairs and maintenance and consultancy for design of irrigation schemes.

SPECIAL PURPOSE PUMPS, PIPES & OTHER EQUIPMENT

A/S DE SMITHSKE,

Tagholm 1, PO Box 205, DK-9400 Norresundby, Denmark. Tel: +46-9-817811. Telex: 69620 DESMI DK. Fax: +45-98:75494. A/S De Smithske is a modern production and sales enterprise with a considerable technical know-how and

with modern production and administration facilities. During the past years an intensive product development has resulted in new DESMI products within our entire range of centrifugal pumps and transmissions for the industrial and agricultural sectors. Please contact direct for further details.

ABACHEM ENGINEERING LTD,

Jessop Way, Newark, Notts NG24 2ER. UK. Tel: +44-636 76483. Manufacture windpumps for domestic, irrigation and drainage systems, up to 120m head and maximum capacity of 8,700 litres per hour.

ABS PUMPEN AG,

Lohmar D-5204. West Germany. Tel: +49-2246-13-1. Telex: 889619. Fax: +49-2246-13-200. ABS PUMPEN AG is one of the world leaders for submersible pumps for drainage, irrigation and sewage up to 500 kw, including submersible mixers. Subsidiaries and representation in more than 50 countries.

ALPHA POMPE SRL,

PO Box 10, Via Molino Emili, Macodidio BS 25030. Italy. Tel: +39-30-978661. Fax: +39-30-27-22-261. Centrifugal, selfpriming drainage pumps, electric pumps, petrol and diesel motor pumps.

AMIAD FILTRATION SYSTEMS,

Kiboutz Amiad, Mobile Post Korazim 12335. Israel. Tel: +972-6-935838. Telex: 6693 AMIAD IL. Fax: +972-6-935-337. Manufacturers of water filters for irrigation, industry and municipal purposes. Manually-cleaned plastic filters from 0.75in to 3ins. Manually-cleaned steel filters from 2ins to 14ins. Automatic self-cleaning filters from 2ins to 12ins made of steel or stainless steel. Also manufacturing chemical and fertiliser injectors which need no outside source of energy.

AQUASERVICE,

Curard Building, Water St, Liverpool L3 1HR. UK. Tel: +44-51-236 6421. Telex: 628512. Fax: +44-51-227 4759. Aquaprime engine pumpsets for irrigation and dewatering.

BERSELLI SAS DI BERSELLI LEANDRO MIRRO RC,

PO Box 76 Via Emilia Est 86, Castelfranco Emilia, MO 41013. Italy. Tel: +3959-92-41-06. Telex: 520527 IRRBER I. Fax: +3959-92-01-06. Specialised in the production of galvanised steel pipes and aluminium pipes for irrigation and industry, fittings, motorpumps, electric pumps.

SPECIAL PURPOSE PUMPS, PIPES & OTHER EQUIPMENT

BIZZI & TEDESCHI SNC,

Via Brodolini 35A, Campegine, RE 42040. Italy. Tel: +39-522 677209-676257. Fax: +39-522 677633.

Manufacturers of submersible electropumps for wells.

CARVELLE,

PO Box 2, St Denis Hotel 45550. France. Tel: +33-38-59-02-10. Telex: 760786. Fax: +33-38-59-15-93. Pumps and sprayers for crop treatment.

CROWN AGENTS QUALITY ASSURANCE & INSPECTION SERVICE,

St Nicholas House, Sutton, Surrey SM1 1EL. UK. Tel: +4481-643 2211. Telex: 916205 GALOND G. Fax: +4481-770 9101. Contact Name: Roger Dane. For over 80 years our worldwide inspection service has protected the purchasing activities of our clients (public sector authorities and major international development agencies) by ensuring that goods ordered meet specified levels of quality, reliability and safety. The service operates at source and destination and covers all engineering plant and equipment and general stores commodities. See Groundwater Section for advertisement.

CWG GMBH,

Hasenacker Str 19-25, 6800 Mannheim-1. West Germany. Tel: +49-0621 817015. Fax: +49-0621 818990. Wholesalers for the following products for water treatment. Chemicals for wastewater treatment; Industrial wastewater treatment; Special purpose pumps, pipes and other equipment; Pumps - positive displacement and other special pumps; Analysers, electrodes and meters; Control equipment; Dosing systems and equipment; Meters - flow measurement and Cooling towers and equipment.

DAF DIESEL,

Geldropseweg 303, TK Eindhoven 5645. The Netherlands. Tel: +31-40-142709. Telex: 51297. Fax: +31-121-047. Manufacturers of high quality diesel engines and power packs for irrigation installations.

DAVEY PRODUCTS PTY LTD,

118 Atkinson St, Oakleigh, Victoria 3166. Australia. Tel: +61-3-568 1655. Telex: AA139654. Fax: +61-3-568 4551. Manufacturers and marketers of pressure systems, end suction pumps - domestic, commercial and farm, swim-

ming pool filters and pumps, spa bath pumps, engine driven pumps and pressure tanks.

DE LANGE PLASTIC LININGS,

Neptunusweg 4, 8939 AA Leeuwarden. Holland. Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

DUIJVELAAR POMPEN BV (DP INDUSTRIES),

Kalkovenweg 52, Alpher Aan Den Rijn, IJ 2401. The Netherlands. Tel: +31-1720 37034. Telex: 39691. Fax: +31-1720 33137. Duijvalaar pumps are used to supply drinking water, for irrigation in greenhouses, as jockey pump, boilerfeed pump, on car wash installations, for air conditioning and many other purposes. One of the most important features of the Duijvalaar pumps is that they are mainly made of stainless steel, thus combining durability with high efficiency.

EBARA CORPORATION,

11-1 Haneda Asahicho, Ohta-Ku, Tokyo 144. Japan. Tel: +181-3-743-67-16. Telex: EBARA TYO 322988. Fax: +181-3-745 3576. EBARA is probably one of the largest specialist pump companies in the world 4000 employees manufacturing in Japan, Indonesia and Singapore a comprehensive range of pumps for all applications.

EMPIRE IRRIGATION INC,

Box 1237, Adams City, CO 80022. USA. Tel: +1-303-288 3400. Telex: 493-2481 EMPIRE. Manufacturers of gravity flow surface irrigation products such as aluminium syphon tubes and plastic collapsible surface gated pipes.

ESSE BI PLASTIC SRL,

Via La Forma 1, Sirolo (Ancona) 60020. Italy. Tel: +39-71-73600145. Telex: 560606 MARRA I. Fax: +39-71-936787. Clamp saddles, Quick release joint from pm 16 to 63 diameter from 75-80-110 they are pm 10, PVC fittings jointed threading, Sprinklers - small rotating atomiser, Sprayers, Dripper.

EVENPRODUCTS LTD,

Blayney's Lane, Evesham, Worcs WR11 4TS. UK. Tel: +144-386 41212. Telex: 337300. Evenproducts Ltd are suppliers of irrigation equipment, specialising in sprinkler,

trickle, sprayline and most systems for small to medium sized farmers. They supply a full range of ancillary products such as tanks, pumps, PVC main, etc.

FLATWATER FLEET INC,
4835 Caribou Lake Rd, Saginaw, Minnesota 55779.
USA. Tel: +1-218-729 8721. Fax: +1-218-729 7644.
The RTT-Rig Tender Truck is ideally suited as an irrigation system support vehicle. Combined into one truck is a large capacity flat-type water tank, 16 square meters of pipe-carrying deck capacity, power generator and crane. A wide selection of pumps provide for high capacity and/or high discharge head pressure. Lots of space for tools, fittings, valves, etc.

FLUXINOS ITALIA SRL,
 Via Genova 8, 58100. Italy. Tel: +39-564451272. Telex: 322458 IKRANE I. Fax: +39-564454237. Revolutionary Pulsa System water oscillation or spring rebound inertia deep well solar and/or hand pumps for small-scale microirrigation market gardening and animal watering in developing countries. Used in boreholes from 65mm internal diameter and for water levels up to 50m+. 300Wp photovoltaic array connected directly to above ground direct current motor. Daily capacity approximately 9m³, plus supplementary capacity through use by hand in hours when sunlight not available or in support of the solar panels when instantaneous sun power insufficient on its own for pump operation.

FLYGT AB,
 Box 1309, Solna 171 25. Sweden. Tel: +46-8-7336500. Telex: 43887. Fax: +46-8-295816. Flygt is the world's leading manufacturer of submersible heavy-duty pumps for contaminated and abrasive liquids. The annual sales for 1988 was approx SEK 2.8 billion. With over 1,500,000 installations in more than 100 countries throughout the world, Flygt submersible products encompass an awesome range of pumps, mixers and hydro turbine generators for small scale hydro electric power stations. The main office is situated in Solna, just outside Stockholm, with manufacturing facilities are in Lindas. Flygt has subsidiaries in 16 countries and 3,400 employees of which 1,500 are in Sweden.

GEORG FISHER +GF+,
CH-8201 Schaffhausen. Switzerland. Tel: +41-053-81-34-02. Telex: 89-70-70-40 GF CH. Fax: +41-053-25-84-10. George Fisher +GF+ plastic fittings and valves for irrigation systems. The following points: ease, speed and economy of installation using

modern jointing technology; highest operational safety and performance: no corrosion, no leakages, no incrustation; wide range of purpose-designed and proven products; minimal maintenance costs; savings in investment based on a particularly long life of the PVC gate valve, the fittings and - consequently - the pipeline itself are exactly the goals which are being achieved in a large number of important irrigation projects by means of our above-mentioned products throughout the world. Our POLYRAC compression fittings are reliable and simple to use. They have been specially designed to ensure fast and safe connections of PE pipes in irrigation networks even under extreme conditions.

GILMOUR GROUP,
 332 West Broadway, Louisville, KY 40202. USA. Tel: +1-502-587 5975. Fax: +1-502-587 5142. Irrigation and hose end (sprinklers, nozzles), pressurised tank sprayers in polythene and galvanised.

GRUNDFOS INTERNATIONAL A/S,
P D Jensensvej 7, Bjerringbro 8850. Denmark. Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. Grundfos can supply a wide range of general water supply and booster pumps for both surface and groundwater based irrigation schemes.

HASTINGS IRRIGATION PIPE INC,
 East Highway 6, Hastings, Nebraska 68901. USA. Tel: +1-402-463 6633. Telex: 910-621-0808. Fax: +1-402-463 4355. Manufacturers of welded seam aluminium irrigation pipes offering a complete line of irrigation pipe, fittings, pumps and irrigation systems. Also waste water systems.

HAWSELLIOTT LTD,
 Rawlings Rd, Smethwick, Warley, West Midlands B67 5AB. UK. Tel: +44-21-420 2494. Fax: +44-21-429 1668. Manufacture watering cans, spray heads, watering lances and pressure sprayers.

HAYWARD TYLER LTD,
 24 Crawley Green Rd, Luton, Beds LU1 3LW. UK. Tel: +44-582 31144. Telex: 82158. Fax: +44-582 452198. Borehole submersible pumps for water supply and irrigation.

RICHARD HILL PUMPS LTD,
 Brooke Rd, Ridlington, Leics LE15 9AN. UK. Tel: +44-572

SPECIAL PURPOSE PUMPS, PIPES & OTHER EQUIPMENT

823385. Telex: 34694. Manufacturers of self-priming centrifugal pumps close coupled to petrol and diesel engines and electric motors. Widely used for irrigation systems and general industrial applications.

H R HOLFELD (PUMPS) LTD,

65 Carshalton Rd, Sutton, Surrey SM1 4LH. UK. Tel: +44-1-661 0719. Telex: 28650. Fax: +44-1-642 0454. Holfeld Pumps design and supply advanced pumping technology and the Holpak range of pump sets and pressure booster systems to specific customer requirements covering a wide range of applications including building services, irrigation, water and waste treatment and fire prevention.

HOMA PUMPENFABRIK GMBH,

Industriestr 1, Postfach 2020, Neunkirchen-Seelscheid 2, D-5206. West Germany. Tel: +49-2247 7020. Telex: 889448. Fax: +49-2247 70244. HOMA Pumps has been developing and producing submersible pumps for over 20 years. Its actual product range includes pumps for sewage and effluent treatment, drainage, irrigation, pumping chemicals, a full range of accessories and equipment up to complete control panels and associated equipment for large pump stations.

HUGALL & HOILE,

46 Flynn St, Wembley, WA 6014. Australia. Tel: +61-9-3877677. Fax: +61-9-387 8554. Wholesaler of irrigation and industrial pump & valve products. Retailer of domestic and rural irrigation products through network of six owned retail shops. Contractor designing/installing domestic & commercial irrigation systems.

HYDROFLO CORPORATION,

Plumsteadville, PA 18949. USA. Tel: +1-215-766 7867. Fax: +1-215-766 8290. Chemical injection pumps for irrigation systems. Also used in water and waste treatment systems.

JOHNSTON IRRIGATION INC,

Post Office Box 2076, Fort Pierce, FL 34954. USA. Tel: +1-407-466 4500. Fax: +1-407-466 6081. Johnston Irrigation serves the US and the international marketplace with complete irrigation services including overhead and drip irrigation systems, wholesale materials, pump design, and consulting. Johnston Irrigation is one of the largest agricultural irrigation contracting companies in the United States.

KROY INDUSTRIES,

PO Box 309, York, NE 68467. USA. Tel: +1-402-362

6651. Fax: +1-402-362 6566. PVC tubing for irrigation from 0.75in to 16ins. Make 6ins, 8ins, 10ins and 12ins transmission PVC line for above ground. Also aluminum tubing from 2ins to 12ins.

KUBOTA LTD,

11-12 Honover St, London W1R 9HF. UK. Tel: +44-71-629 6471. Telex: 263235. Fax: +44-71-629 6915

Manufacture a very wide range of pumps, valves, ductile iron piping, pvc piping and ancillary equipment. Design, construction and equipment for water supply, irrigation and pollution control systems in many countries.

LABOUR PUMP CO LTD (ALCORN DIVISION),

Derington Estate, Wellesborough, Northants NN8 2QL. UK. Tel: +44-933 225080. Telex: 31428. Fax: +44-933 440032. The 'Alcorn' pump range comprises self-priming centrifugal, end suction and diaphragm pumps. Supplied mainly to the agricultural, horticultural, building contracting and civil engineering industries. Outputs range up to 4000 lit/min and heads to 55m.

LASCO FITTINGS PHILIPS INDUSTRIES INC,

3255 East Miraloma Avenue, Anaheim, California 92806 USA. Tel: +1-714-993 1220. Fax: +1-714-524 0232. Lasco Fittings, a division of a Fortune Manufacturing 500 firm, is a leading producer of schedule 40 and 80 PVC pressure pipe fittings, insert fittings and PVC-DWV fittings, as well as specialised swing joints, swivel joints and repair couplings for both large-scale and small-scale turf irrigation projects, proven in worldwide installations under every climatic condition.

LAYNE-WESTERN CO INC,

721 West Illinois Avenue, Aurora, IL 60506. USA. Tel: +1-312-897 6941. With 28 offices located throughout the US, Layne-Western Co is recognised as the leader in the field of water technology. Fully capable of providing practically every vital service needed by water users, municipal, industrial and agricultural. Services: complete hydrological engineering investigation, industrial and irrigation supply systems, drill and maintain water wells, install and service deep well pumping equipment, sell and install water and waste water treatment equipment for municipal and industrial use.

LUMMUS DEVELOPMENT CORP, 712 10th Avenue, PO Box 2526, Columbus, GA

31902-2526. USA. Tel: +1-404-323-1081. Telex: 4611158. Fax: 1-404-324 4899. Manufactures portable earth drilling equipment. Equipment ranges from a small free-standing tripod drilling machine to larger hydraulically-controlled rotary drilling rigs. Several units can be skid or truck mounted.

MACHINEFABRIEK LANDUSTRIE BV,

PO Box 199, A D Sneek NL-8600. The Netherlands. Tel: +31-5150 11411. Telex: 46145. Fax: +31-5150 12398. Manufacturer and supplier of pumping stations for drainage, irrigation and sewage and sewage treatment stations.

MASCHINENFABRIK ANDRITZ AG,

PO Box 24, Statteggerstrasse 18, Graz-Andritz A-8045. Austria. Tel: +43-316-6020. Telex: 03-1313. Pumps and complete pumping stations for irrigation and drainage, industrial water supply plants, cooling water pumps for thermal power stations, sewage pumps and process pumps. All the pumps designs have been based on models subjected to detailed scrutiny of characteristics, efficiency and cavitation.

MCDOWELL MANUFACTURING CO,

PO Box 665, Dubois, PA 15801. USA. Tel: +1-814-371 6550. Fax: +1-814-371 7110. Manufacture a complete line of couplings and fittings for use with PVC pipes in IPS PIT and metric size fittings. They are epoxy coated steel for use in irrigation.

MERRILL PUMPS & ENGINEERING CO LTD,

Crope Works, Sheffield Rd, Sheepbridge, Chesterfield, Derbys S41 9EH. UK. Tel: +44-246 450518. Fax: +44-246-455-552. Manufacturers of hand pumps for bore holes in the developing world. Also irrigation pumps.

MID-SOUTH PUMP CO,

PO Box 16785, Memphis, TN 38186. USA. Tel: +1-901-345 7204. Fax: +1-901-345 3129. Shipping: 1555 Three Place Memphis TN 38116 United States of America. Manufactured with skill and pride for irrigation needs. Settings up to 600' with standard construction Jacuzzi and Deita lineshaft and submersible turbines. Vitreous enameled close grain cast iron bowls, enclosed or

semi-open bronze impellers to 3800gpm, water or oil lubricated. Complete one stop shopping-delivery without delay.

NEW HADEN PUMPS LTD,

New Haden Works, Cheadle, Stoke-on-Trent, Staffs ST10 2NW. UK. Tel: +44-538 752351. Telex: 36142. Fax: +44-538 756569. New Haden Pumps are leaders in the manufacture of systems for water supply, irrigation, sewage handling effluent treatment and sludge pumping. A complete service is available for any of the above.

NIJHUIS PUMPS,

PO Box 102, Parallelweg, De Winterswyck 47102. The Netherlands. Tel: +31-5430 16561. Telex: 44185.

Involved in international business. Irrigation, water and sewage treatment; bio-protection and booster stations. Also produce surgical turbine pumps, mixed flow pumps, induction pumps and horizontal split case pumps.

NIKEX HUNGARIAN FOREIGN TRADING CO,

H-1016 Budapest 1, Mészáros v 48-54. Tel: +36-1-753128/560122. Telex: +22-6406 NIKEX-H. Fax: +36-1-755131. Nikex is a foreign trading co established in 1948 and having approximately 600 employees, mostly engineers and economists. The Company represents approximately 1000 Hungarian firms in the foreign market and has connections to companies all over the world. Main fields of activity are: foundry, metallurgy, industrial fittings, rolling stocks, machines for the building and road construction industries; water engineering and environmental protection; mining equipment; building industry, agriculture/irrigation, transfer of agricultural technologies etc drilling of oil, water and geothermal wells.

OCHSNER GESELLSCHAFT MBH & CO,

PO BOX 60, Oberfeldstrasse 8, Linz A-4024. Austria. Tel: +43-732-41-3-58 Telex: 02-1439 OCHSNR A. For over 100 years Ochsner have produced pumps and compressors for the chemical, petrochemical and refining industries and for use in irrigation plants. The line-up includes water and waste water pumps (also pumps for the heavy industry) displaying the following characteristics: delivery up to 8,000m³/h, LFT UP TO 700M, DRIVE CAPACITY UP TO 1,500KW. MATERIALS USED ARE ALLOYED AND UNALLOYED METALS DEPENDING ON OPERATING CONDITIONS. ROTARY COMPRESSORS FOR CHARGING BIOGAS MOTORS AND WATER COMPRESSORS AS BIO-

SPECIAL PURPOSE PUMPS, PIPES & OTHER EQUIPMENT

GAS COMPRESSORS FOR GAS LANCES FOR SLUDGE ACTIVATION ARE ALSO TURNED OUT.

PAIGE ELECTRIC CORP,
PO Box 368, 1071 Hudson St, Union, New Jersey 07083.
USA. Tel: +1-201-687 7810. Telex: 138121. Fax: +1-201-687 2722. Design and supply cable for submersible pumps, agricultural irrigation and turf irrigation.

PEERLESS PUMP LTD,
Ferry Lane, Brentwood, Middlesbrough, Cleveland, UK. Tel: +44-1-560 3922. Borehole submersible pumps for water supply and irrigation.

PERFECTION SPRINKLER CO,
Box 1363, Ann Arbor, MI 48106. USA. Tel: +1-313-761 5110. Fax: +1-313-761 8659. The continuous cleaning action of Perfection Sprinkler's self-cleaning strainers increase the time of pumping cycles and eliminates strainer maintenance. The self-cleaning strainers are available in sizes 3ins to 10ins, with gallon ratings from 100gpm to 3000gpm. All models are adapted easily to existing suction lines.

PERROT IRRIGATION LTD,
38 High St, Rowheage, Colchester, Essex CO5 7ET. UK. Tel: +44-206 867624. Telex: 987852. Fax: +44-206 869911. Manufacture and supply of irrigation equipment: sprinklers; mobile, stationary, quadrangle, horticultural, agricultural; dust suppression; pipes and fittings; pumps and hose reel irrigators; slurry irrigators.

G C PILLINGER & CO (ENGINEERS) LTD,
30 Factory Lane, Croydon, Surrey CR0 3RT. UK. Tel: +44-1-688 7445. Telex: 887463. Fax: +44-1-681 2887. Manufacture specialised pumping systems, ie booster sets, irrigation systems. Provide the complete package for all pumping needs.

PIOGGIA CARNEVALI SPA,
Strada South, Cisa 47, Poro Mantovano, MN 46047. Italy. Tel: +376-398151 234. Telex: 300541 PIOCAR. Fax: +376-390873. Pioggia Carnevali SpA is one of the largest and oldest manufacturers of irrigation equipment in Italy. The firm manufactures self-propelled hard hose irrigation systems offering 68 different models for all type and size of farms. These high quality irrigation systems are sold and promoted worldwide. Also manufactures: aluminium and galvanised steel pipe, couplings, fittings, large volume and low

volume sprinklers, tractor and engine driven pumps of all sizes, tripods and hand-prime-pumps.

PIVOT PRODUCTS DISTRIBUTORS INC,
PO Box 591, 15/16 West American Boulevard, Muleshoe, Texas 79347. USA. Tel: +1-806-272 5536. Manufacture DROPS and LEPA equipment: for irrigation. Also drive line couplers and associated parts.

POLYTHENE PIPES CD-HD,
PO Box 488, 152 St Andrew St, Limassol, Cyprus. Tel: +357-51-62860. Telex: 2668. Suppliers of drip irrigation systems, polythene tubes, PVC pipes and associated products.

POLYTUBES (1977) LTD,
PO Box 3814 Sin D, 12160 160 St, Edmonton, Alta T5L 4J8. Canada. Tel: +1-403-452 8375. Fax: +1-403-452 8397. Poly tubes (1977) Ltd has been in the polyethylene tubing and pipe business for 36 years. We manufacture tubing and pipe from 0.25in to 6ins diameters in low, medium and high densities. We also manufacture tubing for drip applications.

RAINBOW IRRIGATION SYSTEMS,
PO Box 70, Fitzgerald, Georgia 31750. USA. Tel: +1-912-423 4341. Telex: 80501. Fax: +1-912-423 4345. Manufacture pumps, pipes, centre pivot, travellers, volume guns and all kinds of fittings. Also supply equipment for irrigation of waste water and land application.

OYE SÄRLIN AB,
Division Pumps, PO Box 750, Helsinki, 10, 00101. Finland. Tel: +358-0-535022. Fax: +358-0-5633989. Contact Name: Martti Varis, Director of Pump Division. Säriln is a manufacturer of submersible pumps for sewerage systems, raw water intake, dewatering, irrigation and flood control. Pumps are easy to install and maintain.

PHILIPP SCHENK GESELLSCHAFT MBH & CO KG,
PO Box 3, Jedleseer Strasse 59, Wien A-1212. Austria. Tel: +43-1-385131/385132. Philipp Schenk was founded in 1930 and specialises in the production of industrial and scientific measuring devices. For water management purposes flow meters of various kinds are turned out guaranteeing pre-

SPECIAL PURPOSE PUMPS, PIPES & OTHER EQUIPMENT

cise water measurement both in pipelines of up to 2m diameter and in open rectangular channels.

SIGMA CONCERN,

Vaclavske Nam 60, 111 87 Praha 1, Czechoslovakia
Manufacture the SPS range of mobile seasonal pumping stations for delivering water to spray irrigation systems. Output ranges from 70 litres to 100 litres per second at a delivery head of 60 to 100m.

SIHI - HALBERG,

Halbergsstr 1, Luwigshafen/Rh 1, 6700. West Germany.
Tel: +49-621 56120. Telex: 464833 HALU D. Fax: +49-621 5612209. Pumping stations, pumps irrigation, water supply pumps and water work pumps.

SNAP-TITE HOSE INC,

217 Titusville Rd, Union City, PA 16438. USA. Tel: +1-814-438 7616. Telex: 4735-TLX-0914553-01. Fax: +1-814-438 7616. Snap-tite Hose Inc - A manufacturer of lightweight, layflat, synthetic hose products ranging in diameters from 1in through 8ins. Primary products include irrigation hose for soft hose traveler machines.

SNEED-MCBRIDE INTERNATIONAL INC,

Suite 501 8440 Walnut Hill Lane, Dallas, Texas 75231. USA. Tel: +1-214-369 5710. Telex: 732645. Fax: +1-214-739 3551. SMI/Sneed-McBride International Inc, was among the first companies to introduce modern methods of irrigation world-wide. SMI equipment includes: SMI-360 center pivot, SMI drip and micro spray, SMI speedroll sprinkler, kelley pumps and SMI grain-potato-storage systems.

STA-RITE INDUSTRIES,

175 Wright St, Dequan, Wisconsin 53115. USA. Tel: +1-414-728 5551. Telex: 4970245. Fax: +1-414-728 4461. Major suppliers of residential water systems and commercial irrigation type pumps to anywhere in the world. Branches in Australia, Canada, England, Germany and Japan.

SULZER BROS (UK) PUMPS LTD,

Manor Mill Lane, Leeds LS11 8BR. UK. Tel: +44-532 701244. Telex: 55471. Fax: +44-532 772397. Sulzer have supplied complete pumping packages for water supply, sewage and irrigation applications in developing countries throughout the world. Wide experience in engi-

neering and financial packaging makes Sulzer a strong partner for your project.

SULZER BROTHERS LTD,

Pump Division, 8401 Winterthur. Switzerland. Tel: +41-52-8111-22. Telex: 896-060-40. Fax: +41-52-23-42-83.

Over many years, Sulzer has established an extensive manufacturing pump programme for liquid transport application. Currently, this programme includes pumps for large flows of water over long distances with high heads, drinking water supply pumps, irrigation and drainage pumps and effluent transport pumps.

TAVLIT PLASTIC LTD,

3 Hazorfim St, Industrial Zone, Bat-Yam. Israel. Tel: +972-3-5517075. Telex: 341667. Fax: +972-3-5518180.

Developing and manufacturing of irrigation accessories to fit modern irrigation systems.

TEFEN PLASTIC PRODUCTS MFG,

Nahsholim 30815. Israel. Tel: +972-6-390782/396711. Fax: +972-6-390813. Manufacturers of plastic fittings and tubes for irrigation and pneumatics.

THOMPSONS KELLY & LEWIS LTD,

PO Box 160, Springvale, Victoria 3171. Australia. Tel: +61-3-562 0744. Fax: +61-3-562 0885. Thompsons, Kelly & Lewis is Australia's leading manufacturer and supplier of end suction centrifugal pumps. The K-I-S-O and HYDRO-TITAN are back pull-out pumps with the K-I-S-O COMPACT a close-coupled version using a standard electric motor. These pumps are ideal for all rural applications including irrigation. Flow Rates to 250 l/s and heads to 150m.

US EXPORT & TRADING CO,

848 Harding St, Escondido, California 92027. USA. Tel: +1-619-743 8211. Telex: RCA 294277/ITT4994245. Fax: +1-619-745 1314. Specialists in landscape irrigation design. Manufacturers of irrigation products (sprinklers, pipes, fittings and valves), ultra-violet resistant PVC pipe.

J M VOITH AG,

PO Box 168, St Poulten A-3100. Austria. Tel: +43-27-42-2501. Telex: 015510. For decades J M Voith have turned out pumps for irrigation, drainage and drinking water supply purposes and cooling water pumps for nuclear and thermal power plants.

VOPO POMPEN- & MACHINEFAB-RIEK BV,

De Volger 2, De Rijp, NL 1483 GA. The Netherlands.

Tel: +31-2997 1312. Fax: +31-2997 3358.

Surface water pumps, built for continuous operation, maintenance free. Large capacity for low heads. Widely used for drainage and irrigation jobs. Capacity 40-1000m³/hour.

VU-FLOW FILTERS CO,

7805 Ellis Rd, Melbourne, FL 32901. USA. Tel: +1-407-

723 5171. Fax: +1-407-723 1627. Manufacture filters, strainers and sand separators commonly used in turf and agricultural irrigation. These filters are manufactured entirely of non-corrosive materials and are capable of flow rates from 5 to 2000 gallons per minute.

J T WADE & SON LTD,

West Wycombe Rd, High Wycombe, Bucks HP11 2UJ. UK.

Tel: +44-494 450133. Telex: 837935. Fax: +44-494

465640. Manufacturers of a large range of pumping sets for agriculture, brewing, chilled water, hospitals, domestic water supply and water booster installations, fire booster sets, shower pumps plus many general applications.

WATER CONSERVATION SYSTEMS INC,

141 South Spring St, Claremont, California 91711. USA.

Tel: +714-621 5805. Telex: 9102402436 WCS INC

CLA. Fax: +714-621 5806. Water Conservation Systems

Inc (WCS) manufactures patented fully automatic irrigation control sensors and related products. These self-contained devices measure available soil moisture and rain fall and can start, stop or interrupt irrigation by zone. Tradenamed Hydrovisor and Rain Guard these and other WCS products are available worldwide. Contact WCS for information.

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Telephone
(518) 783-1281.

Mechanical &

Electrical Equipment

PUMPS AND MAINTENANCE

by Len Hutton, Water, Engineering and Development Centre (WEDC).

Water supplies and wastewater treatment inevitably use some type of mechanical or electrical equipment in their systems.

If we consider a simple rural groundwater scheme, a pump (mechanically or electrically powered) lifts water through a foot valve (mechanical) up a delivery pipe through a pump (mechanical) to a tank for distribution through pipes controlled by valves.

POWER GENERATION

The power to drive the pump may be electrical or mechanical. When rural electrification schemes are successful often the first major use is to pump water. Where electricity is not available from a power station pumping energy is often provided directly by using diesel powered engines or indirectly from diesel powered electrical generators. Even in countries where power supply and distribution are very reliable you will often find diesel powered generating sets at treatment works ready to fire up to carry on pumping. In rural areas the familiar 'tonk-tonk' of the very reliable single and twin cylinder diesel engines will often lead you to the borehole or wellhead.

The energy needed for pumping water may also be provided by using kinetic and potential energy of flowing water from dams and streams turning Pelton wheel or other turbine blades to produce mechanical energy. The mechanical energy is converted to electrical energy in genera-

tors. Some flowing water systems can also be used to pump water directly by utilising either water hammer in a ram pump or rotational energy from low head turbines to drive positive displacement



RIGHT: Typical pumped shallow well with overhead tank, rural Malaysia

pumps with the ability to lift a proportion of the water long distances.

On a larger scale hydroelectric power generating dams often coupled to irrigation schemes provide attractive renewable energy schemes. Of course there will be environmental and health hazards implicated whenever dams are built and these need to be balanced against the need for electrical power to develop industry. Increasingly low head turbines will be used to generate small amounts of power for local use and all potential sites can be surveyed. Even water supply dams can use the flows into treatment works to generate sufficient power for local pumping and power supply by using simple Pelton wheel turbines without pollution.

Research into the most appropriate type of turbine generators such as Francis, Kaplan or Pelton and their mountings whether vertical or horizontal needs to be carried out to determine the optimum performance at each site. Many of the lessons learnt for operating turbines are being fed back into design of new plant and renovation of older systems for hydroelectric generation.

ENERGY REUSE

The reuse of pumping energy from water pressure is exploited in the reverse osmosis water treatment process when the flow-rates are 0.55ml/d with energy savings of up to 60 per cent. In pumped storage schemes when water has been lifted over the highest point turbine generators can be installed to feed and recover some of the pumping energy. How much energy could be recovered from bulk transfer schemes of which you are aware?

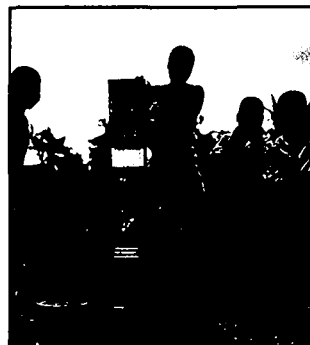
PUMPING AND MAINTENANCE

Much of the energy costs of water supply schemes is spent in pumping. The appropriate selection of pumps is very critical not just in capital costs but also in running and maintenance expenses. Pump performance will deteriorate with time and efficiency will fall. With modern techniques such as vibration analysis, optical fibre probe inspection and pump efficiency testing the old technique of listening to machinery using a screwdriver held to the ear to monitor performance is fast disappearing.

Regular planned preventative maintenance is more cost effective in operating pumping equipment than just keeping it going until it stops



ABOVE: High lift pumps at a waterworks



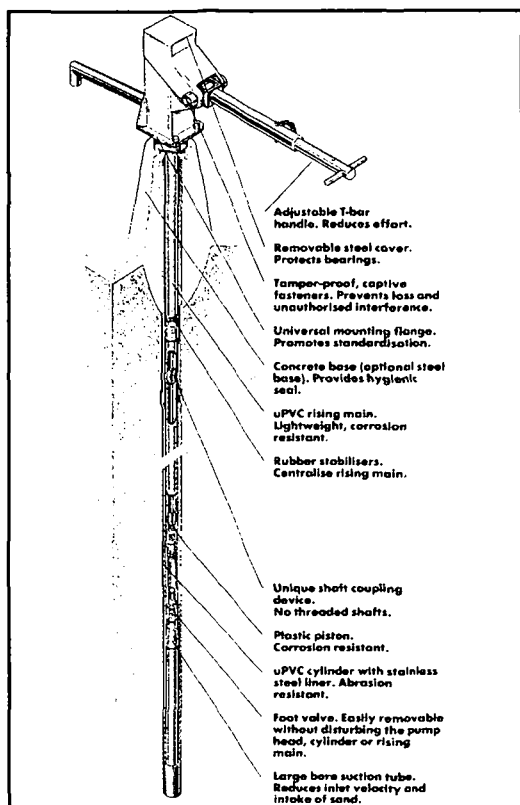
RIGHT: Aquadev pump in use

(repair). Maintenance of electrical and mechanical plant is expensive but failure to maintain will be even more expensive.

Adequate provision of spares for pumps is essential for any maintenance scheme to work properly. Up to 90 per cent of problems with pumps will be on the inlet side of the pump more often than not due to loss of priming. Running centrifugal pumps with insufficient water will lead to cavitation and damage to the impellers. The key to solving this is the correct selection of pumps, proper and careful installation and regular maintenance.

MATERIALS AND PLANT SELECTION

The choice of materials used in pumps is very critical if corrosion and consequent vibration is to be avoided. Where desalination is being employed to provide water supply the materials used to pump hot brines, cold seawater, dosing chemicals or low TDS (Total Dissolved Solids) fresh water will be very diverse and undoubtedly expensive. The challenges faced by engineers designing and operating desalination plants, especially multi stage flash methods, are considerable when working out the mechanical, metallurgical and electrical requirements and specifications. Even with the modern chemicals available to prevent scale forma-



ABOVE: Components of the Aquadev pump
BELOW: Essential maintenance kit

tion and corrosion regular blowdown and plant downtime maintenance scheduling is very important.

HANDPUMPS

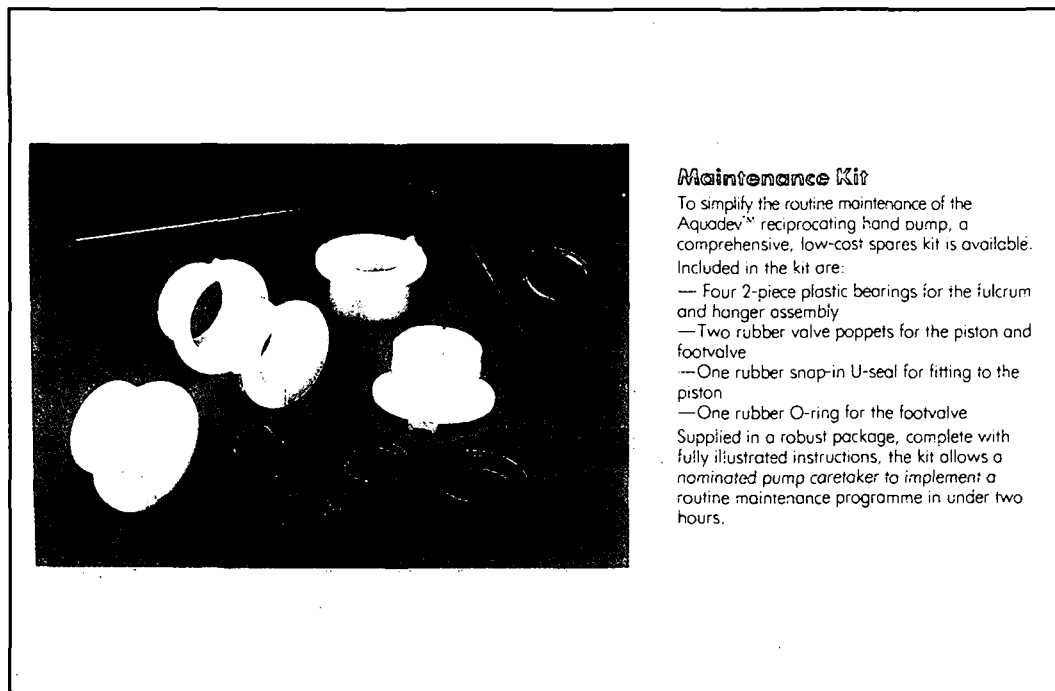
At the other end of our range of water supply systems the basic problem of lifting groundwater by using handpumps has been alleviated appreciably during the Water Decade. Research by the World Bank, UNDP and the Consumers Association testing laboratory and product development with manufacturers worldwide has resulted in pumps such as the Afridev. Improvements still need to be made to produce even better pumps and components but are development funds drying up for the rural sector?

SOLAR POWER

Solar power for pumping and improved communications is enjoying more emphasis because of the shortages of fossil fuels and the Greenhouse effect.

FUTURE PROSPECTS

The market for mechanical and electrical plant for water supplies throughout the world is still expanding and prospects for improved and more efficient products are exciting.

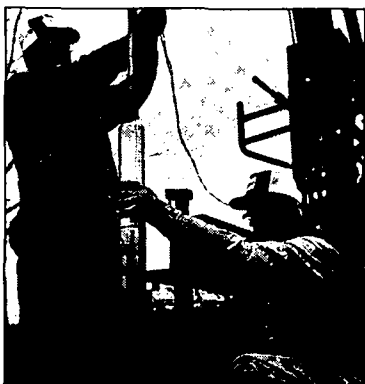


Maintenance Kit

To simplify the routine maintenance of the Aquadev™ reciprocating hand pump, a comprehensive, low-cost spares kit is available. Included in the kit are:

- Four 2-piece plastic bearings for the fulcrum and hanger assembly
- Two rubber valve poppets for the piston and footvalve
- One rubber snap-in U-seal for fitting to the piston
- One rubber O-ring for the footvalve

Supplied in a robust package, complete with fully illustrated instructions, the kit allows a nominated pump caretaker to implement a routine maintenance programme in under two hours.



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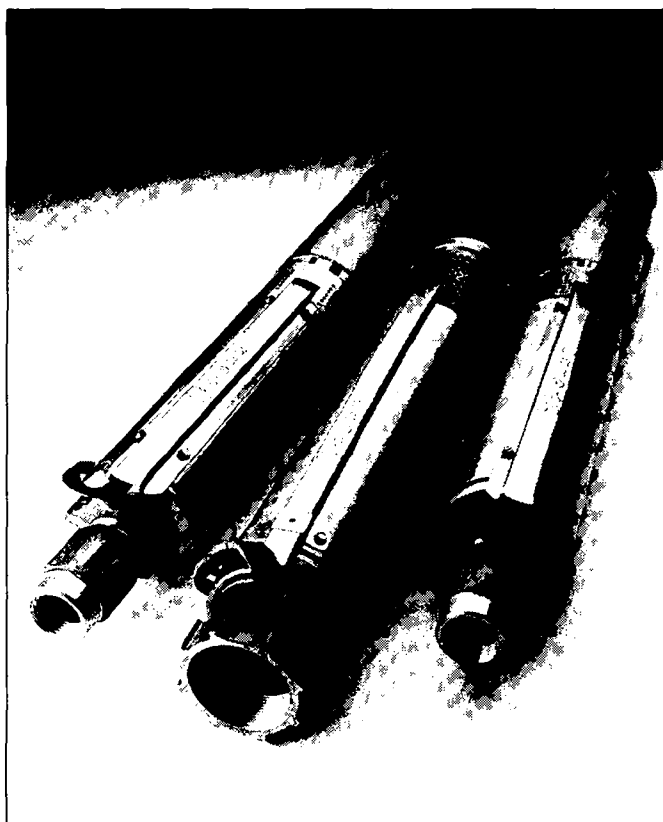
Responding to the needs of drillers and installers with innovative technology keeps Myers at the front of the submersible pump marketplace. Exclusive design features make our Predator and Rustler series submersibles the most dependable and innovative pumps available. And Myers' heavy-duty NEMA motor delivers greater reliability for longer life.

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PO Box 6, Oberrburg D-8753, West Germany. Tel: +49-6022 31047. Telex: 4-188-132 GRES D. Fax: 49-6022 31050. Gressbach Winder - und Maschinenbau GmbH was founded in 1816. Manufacturing and marketing of WiMAG equipment: lifting gear and construction equipment, especially for underground engineering; pipe handling equipment; cranes and special constructions.

JLG INDUSTRIES INC,

JLG Drive, McConnellsburg PA 17233, USA. Tel: +1-717-485 5161. Fax: +1-717-485 6417. Complete range of self-propelled aerial work platforms in telescoping, articulating and scissors models - from 7.62m to 33.5m platform heights. Capacities from 230kg to 908kg. Complete range of truck mounted boom cranes (loaders) from 6 to 17 tons (US). Manufacturing and production facilities in USA, UK and Australia.

KRAYAN,

Foreign Trade Co, 2 Yanvaraskogo Vosstaniya, Odessa 270017, USSR. Tel: +7-048 610525. Telex: 232714 KRAN. Krayan handle the export of the cranes produced by the Production Association for the Manufacture of Heavy Cranes in Odessa, - one of the largest manufacturers of diesel-electric cranes in the world. Their range also includes hydraulic cranes on special vehicle chassis. These cranes have proved their versatility in many countries, on construction sites, pipe-laying projects etc.

KROELLGiant CRANES A/S,

Nordkranvej 2, Lyngø 3540 DK, Denmark. Tel: +45-2-187 400. Telex: 42175 KROEL DK. Fax: +45-2-188 807. Kroell Giant Cranes A/S is a world leader in the manufacture of tower cranes with long reach and high capacity specially suited for dam construction, pumping and power station construction. Capacities from 200 tons metre and upwards.

MANITEX INC,

4300 Acapulco Avenue, McAllen, Texas 78503, USA. Tel: +1-512-630 2690. Fax: +1-512-630 2695. Manitek is a

wholly owned subsidiary of the Manitowoc Co. Manitek designs and builds a wide range of crane products including overhead travelling and Gantry or Goliath cranes, pedestal mounted box, telescopic and lattice boom hydraulic cranes and a line of telescopic hydraulic cranes for installation on a commercial truck chassis.

RANSOMES & RAPIER PLC,

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ACROMET (AUST) PTY LTD,

14 Winterton Rd, Clayton, Victoria 3168, Australia. Tel: +61-3-544 7333. Fax: +61-3-543 6706. Acromet is an Australian manufacturer of chemical metering pumps and dry chemical feeders and a distributor of gas chlorination equipment and chemical pumps, both diaphragm and centrifugal, in plastic and special alloy construction. Acromet pumps and feeders are widely used throughout Australasia and South East Asia in water and wastewater treatment plants, and have an even wider range of applications in industry. Distributorships are available in many parts of the world.

AIR POWER & HYDRAULICS,

2 Erskine Square, Hillington Estate, Glasgow G52 4PQ, UK. Tel: +44-41-810 4511. Telex: 777819. Fax: +44-41-883 3825. An independent company specialising in the design and manufacture of a complete range of hydraulic cylinders, sub cylinders, activators and power units.

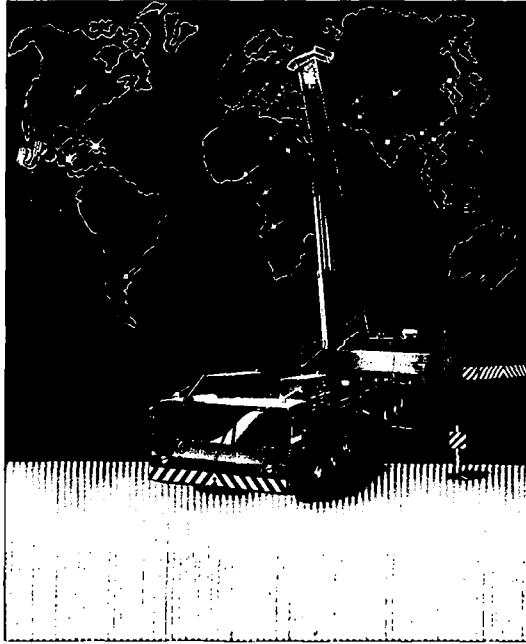
ALL SPEEDS LTD,

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ANGUS & CO LTD (GEO),

Fluid Seal Div, Coast Rd, Wallsend, Tyne and Wear NE28 9NR, UK. Tel: +44-91-262 4551. Telex: 53628. Fax: +44-91-263 4301. Manufacturer of oil seals and hydraulic/pneumatic packings, diaphragms, gaskets, o-rings, mechanical seals etc.

Cranes that give profits a lift



They are manufactured at the Production Association for the Manufacture of Heavy Cranes "January Insurrection" in Odessa. The cranes have proved their wide-scale application possibilities in dozens of countries. They can be successfully used at construction sites for mounting, loading and unloading and for laying down oil or gas pipe-lines, etc.

The export programme of the Association embraces:

- rubber-tyred self-propelled Diesel-electric cranes with full-revolving jib, and
- self-propelled hydraulic cranes mounted on special vehicle chassis, with jib.

The lifting capacities of the self-propelled cranes range from 25 to 63 tonnes.

Diesel-electric cranes

The Association is one of the biggest diesel-electric crane manufacturers of the world.

Exported by:
Odessa Heavy Crane Building Production Amalgamation

Zavod Imeni Yanvarskogo Vosstaniya 270017
Odessa, USSR.

The main advantages of the cranes are:

- high manoeuvrability
- working capability in narrow spaces
- high-load lifting and lowering speed
- increased revolving speed of the rotating part
- extendable working space (applicability of a 15 or 25 m long non-adjustable or adjustable pivotarm on the jib or tower).
- with 25 t cranes, with the application of a special construction, the lifting capacity can be increased to 40 t.

Hydraulic cranes

Mounted on special vehicle chassis they are high mobility units with high crossing power, easy-to-transfer from one working site to another. The transport state can quickly be changing into working position. Cranes like this, due to the possibility of a telescopic transformation of the length of the loaded jib, are indispensable at narrow working places.



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ANSALDO SISTEMI INDUSTRIALI SPA,

Via Pieragostini 50, Genoa 16151, Italy. Tel: +39-10-41-031. Telex: 281311 ANGAS I. Fax: +39-10-42-0451. Ansaldo Sistemi Industriali SpA is the contracting and engineering Co of Ansaldo operating in the field of industrial and electromechanical plants, of material handling and hydraulic systems, of port, ship and offshore systems, of territory architect engineering.

AQUATICS UNLIMITED,

2150 Franklin Canyon Rd, Martinez, CA 94553, USA. Tel: +1-415-370 9175. Fax: +1-415-370 9179. Manufacture of Aquamog - a multi purpose marine maintenance vessel with many easily interchangeable attachments. Aquamog cuts aquatic weeds deep and fast, rotates hydrosol, removes rooted vegetation. Aquamog is a powerful suction dredge and bucket dredge. Self propelled, eliminates cables, reduces downtime, reaches under piers, inside boat slips, close to shore and cleans waterways.

ATLAS COPCO ENERGY AB,

S-105 23 Stockholm, Sweden. Tel: +46-8-743-80-00. Telex: 14090 COPCO S. Fax: +46-8-716-59-75. Atlas Copco Energy offers a complete range of high pressure compressors for deep air drilling, portable compressors and compressors mounted on special carriers (eg customised for off-road trailers), as well as booster compressors.

BESTOBELL SEALS,

202-208 Bath Rd, Slough, Berks SL1 4DP, UK. Tel: +44-753 20222. Telex: 847285. Fax: +44-753 691145. Manufacturers and suppliers of mechanical seals from 6mm shaft upwards, including split-face types. Wide range of material combinations available.

BRITISH AUTOGUARD LTD,

A Thousand Oaks, Maysey Hampton, Cirencester, Glos GL7 5JH, UK. Tel: +44-285 713555. Telex: 437114. Fax: +44-285 713556. British Autogard are Market leaders in overload torque protection and control systems, covering a torque range from 28/57,000nm. Typical drives protected in the water industry include: screens collectors, clarifiers thickeners, screw pumps, scrapers etc.

CONTINENTAL INDUSTRIE,

10 Rue Du Capitaine-Ferber, Villeurbanne F-69100, France. Tel: +33-78-93-25-96. Telex: 900855. Fax: +33-78-89-65-58. Manufacture multicellular centrifugal blowers and exhausters.

JOHN CRANE UK LTD,

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St Nicholas House, Sutton, Surrey SM1 1EL, UK. Tel: +4481-643 2211. Telex: 916205 GALOND G. Fax: +4481-770 9101. Contact Name: Roger Dane. For over 80 years our worldwide inspection service has protected the purchasing activities of our clients (public sector authorities and major international development agencies) by ensuring that goods ordered meet specified levels of quality, reliability and safety. The service operates at source and destination and covers all engineering plant and equipment and general stores commodities. See Groundwater Section for advertisement.

DRG KWIKSEAL PRODUCTS,

The Woodside Estate, Dunstable, Beds LU5 4TP, UK. Tel: +44-582 696666. Telex: 826040. Fax: +44-582 471085. DRG Kwikseal Products manufacture single and double-sided self-adhesive foam tapes, strip adhesive, pre-formed butyls and gun-grade sealants under the trade names of Inseal, Kwikstik and iDL. Please contact us for further information.

EUTECTIC CO LTD,

Central Way, Feltham, Middlesex TW14 0UE, UK. Tel: +44-890 3680. Telex: 27966. Fax: +44-751 2038. Suppliers of welding consumables and equipment for maintenance and repair welding.

FABBRICA TURBINE E CALDAIE,

F T C Legnano Srl Piazza Monumento, 12 - Legnano, Milan 20025, Italy. Tel: +39-331-522-111. Telex: 330661-314385 F TOSI. Fax: +39-331-593-321. Fabbrica Turbine E Caldaie - FTC Legnano SRI (Franco Tosi Group) represents a wealth of know-how and experience in the fields of generation, conversion, utilisation and recovery of energy in its various forms, as well as in other areas such as sea water desalination, ship propulsion and in general industrial plants, where equipment produced by the company finds a field of application.

DIESEL, PETROL & NATURAL GAS ENGINES

FIBERGRATE CORP,

PO Box 814610, Dallas, Texas 75381-4610 USA. Tel: +1-214-250 1633. Fax: +1-214-250 1530. Manufacturer of fibreglass grating, walkways, platforms, bridges, ladders, handrail and other corrosion-resistant pedestrian facilities; complete concept to completion capabilities including design and installation.

FLATWATER FLEET INC,

4835 Caribou Lake Rd, Saginaw, Minnesota 55779.

USA. Tel: +1-218-729 8721. Fax: +1-218-729 7644.

The RTT-Rig Tender, a multi-purpose four-trucks-in-one vehicle is available with a wide selection of both material handling and pump service cranes, as well as welders, generators and compressors. Fuel tank up to 2400 litres and flat-type water tank up to 12,000 litres, both with pumps, are additional features.

THE GLACIER METAL CO,

Argyle House, Joel St, Northwood Hills, Middlesex HA6 1LN. UK. Tel: +44-9274 26100. Telex: 936881 GLAMET G. Fax: +44-9274 26507. Manufacturers of a wide variety of plain bearings (including Du Hi-ex and Deval).

GREAT LAKES HYDRAULIC INC,

4170 36th St, South East Grand Rapids, Michigan 49508.

USA. Tel: +1-616-949 8844. Fax: +1-616-949 6598.

Manufacturer of the 'Infidrive' a variable speed drive which works on oil-shear principle for torque transmission. Used primarily in pumping applications to control flow, level and pressure.

HOERBIGER FLUIDTECHNIK KG,

Prince-Eugen-Strasse 70, Wien A-1040. Austria. Tel: +43-222-65-67-01-0. Telex: 133687. In the hydraulic sector Hoerbiger Fluidtechnik offer the following products and services: hydraulic cylinders, adapted in size, capacity and operation to various requirements and with piston diameters up to 550mm and stroke length of 8m; hydraulic power units, geared to control and space requirements and built up from standardised sub-assemblies; hydraulic valve blocks, as complete and compact solutions to relevant problems; and the design and construction of complete hydraulic systems.

HYDROVANE COMPRESSOR CO LTD,

Claybrook Drive, Washford Industrial Estate, Redditch, Worcs B98 0DS. UK. Tel: +44-527 25522. Telex: 339843 HYUANE G. Fax: +44-527 21140.

Manufacturers of industrial and portable rotary vane compressors.

IMI FLUIDAIR LTD,

Miller St, Radcliff, Manchester M26 0JB. UK. Tel: +44-4955 57722. Telex: 667071 IMIF:U. Fax: +44-61-724 8727. Rotary air compressors, air dryers and rotary vacuum pumps.

INTERNATIONAL MACHINERY CONSULTANTS INC,

PO Box 700, Cabano, Quebec G0L 1E0. Canada. Tel: +1-418-492 1261. Fax: +1-418-929/308. International machinery consultants trade in heavy machinery for multiple applications.

IPG PLANUNG UND INDUSTRIELLE PRODUKTION VON ELEKTRO- UND KÜTETECHNISCHEN,

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KINGSBURY INC,

10385 Drummond Rd, Philadelphia, PA 19154. USA. Tel: +1-215-824 4000. Telex: 710670-1897. Fax: +1-215-824 4999. Designers and manufacturers of fluid film bearings and magnetic bearings systems.

KLINGER LTD,

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LÄNNEN WATERMASTER,

Säkylän Works, SF 27820 ISO Vimma, Säkylä, Finland. Tel: 358-0-3512400. Fax: +358-0-3512468. The

Watermaster is a unique multipurpose marine excavator, designed specifically for conservation and civil engineering projects in water construction. The machine's production of solids varies between 50 and 120m³ per hour. The maximum pumping distance with the unique pumping bucket is 500m and with the cutter pump 1000m. The Watermaster can move itself into and out of the water, transport itself on dry land and load itself on to a truck or trailer.

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LUMMUS DEVELOPMENT CORP,

712 10th Avenue, PO Box 2526, Columbus, GA 31902-2526. USA. Tel: +1-404-323-1081. Telex: 4611158. Fax: 1-404-324 4899. Manufactures portable earth drilling equipment. Equipment ranges from a small free-standing tripod drilling machine to larger hydraulically-controlled rotary drilling rigs. Several units can be skid or truck mounted.

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Specific design and manufacture of combined heat and power up to 3000 kW and prime, standby and emergency packages for power generation up to 5000 kW. This quality background has led to the development of the leading range of small scale combined heat and power systems called Mini-Chips which are being adopted more widely for new and existing leisure centres, hospitals, hotels, sheltered housing, residential property such as blocks of flats and estates, water treatment works and industrial processes.

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ENERGOMASHEXPOT,

19 pr Kalinina, Moscow 121019. Tel: +709-5-288-69-47. Telex: 411965. Contact Name: Mr Bogdanov. (See advertisement).

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KHD GREAT BRITAIN LTD,

Riverside Rd, London SW17 0UT. UK. Tel: +44-81-946 9161. Telex: 8954;36. Fax: +44-81-947 6380.
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Largest independent supplier of medium & high speed diesel engine spare parts in UK. Over 7.1m. of diesel engine spare parts carried ex stock for UK and worldwide despatched.
Spare parts for Ruston, English Electric, Whallen, Mirlees Blackstone (Stamford), Paxman, Lister-Peters and Cummins etc & Napier Turbocharger etc. Qualified diesel engineers also available.

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Manufacturers and suppliers of air and water cooled diesel engines from compact single cylinder models up to turbo-charged 6-cylinder versions producing continuous power outputs from 1.1 to 224kw (1.5 to 300 brake horsepower).

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Medium speed diesel, spark ignited gas and dual fuel engines within the power range of 715 to 7000 BHP (500 to 4400kw). Designed for continuous operation in arduous conditions the engines are ideally suited to base load power generation. Emergency stand-by with automatic mains failure facilities.

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VOLVO PENTA,

S-40508 Goteborg. Sweden. Tel: +46-3123 5460. Telex: 20755 S. Fax: +46-3151 0595. Volvo Penta is an industrial company which has advanced technology, high quality and a high level of product specialisation as its principal competitive assets. Volvo Penta designs, manufactures and markets engines for marine and industrial use. Volvo Penta engines are used in a wide range of industrial applications. Over 30,000 engines 50-350KW are installed for irrigation pump drive the world over.

SWITCHGEAR, ALTERNATORS & GENERATORS

BANCHORY INVESTMENTS LTD,

North Deeside Rd, Banchory, Kincardineshire AB3 3YR. UK. Tel: +44-3302 2667. Fax: +44-3302 3573. Condition monitoring equipment for power generation equipment.

BEVI WRIGHT LTD,

Pellon Lane, Halifax, West Yorks HX1 5QL. UK. Tel: +44-422 60201. Telex: 51101. Fax: +44-422 51092.
Comprehensive range of standard and special AC motors, both single and three-phase in sizes from 0.1 to 160kw.

BRIMOTOR LTD,

Clarence Works, 30a Church Rd, Tunbridge Wells, Kent TN11 1JP. UK. Tel: +44-892 37588. Telex: 95446 BRIMOTR G. Manufacturers of portable, mobile and mains failure generating sets, and portable mobile floodlighting units.
Manufacturers of self-priming and diaphragm pumps.

BRUSH ELECTRICAL MACHINES LTD,

PO Box 18, Loughborough, Leics LE11 1HJ. UK. Tel: +44-509 611511. Telex: 341091. Fax: +44-509 610440.

SWITCHGEAR, ALTERNATORS & GENERATORS

Generators for diesel and turbine drive motors and variable speed drives. Dedicated microprocessor systems. Generator control equipment.

BRUSH TRANSFORMERS LTD,
PO Box 20, Loughborough, Leics LE11 1HN. UK. Tel: +44-509 611511. Telex: 341094. Fax: +44-509 610550.
Manufacturers of distribution and power transformers, flame-proof transformers and switchgear, transformers for highly specialised applications.

CATERPILLAR DO BRAZIL SA,
Av Nacoes, Unidas 22-540, Sao Davlo sp 04795. Brazil. Tel: +55-11-246 4880. Manufacture, assembly, importation and exportation of tractors and construction machinery, marine engines, generators, winches and related parts and equipment for the following markets: agriculture, earthmoving, road construction, industrial machinery and mining.

CORTINA ELECTRIC CO LTD,
Oids Approach, Tolpits Lane, Watford, Herts WD3 8XL. UK. Tel: +44-923 775235. Fax: +44-923 771029. Design, manufacture and supply variable frequency inverter drives, DC converter drives, kramer slip energy recovery drives and composite pump control centres built to customers' specification.

DAWSON-KEITH LTD,
DeeKay House, Brockhampton Lane, Havant, Hants PO9 1QH. UK. Tel: +44-705 474122. Telex: 86491. Fax: +44-705 470921. Manufacturers of diesel and gas engine generator sets, containerised power packages, mains failure and synchronising panels, mobile standby sets, power range from 4 to 14 megawatts. A worldwide after sales service available as are maintenance contracts.

DEPENDABLE TURBINES LTD,
7-3005 Murray St, Port Moody, BC V3H 1X3. Canada. Tel: +1-604-461 3121. Fax: +1-604-461 2314.
Manufacturers of a complete range of governors, generators and turbines.

WILLIAM DON LTD,
Low Lane, Horsforth, Leeds LS18 5NY. UK. Tel: +44-532 584286. Telex: 55417. Fax: +44-532 390056.
Manufacturers of fixed and variable speed AC/DC motor control system. General motor control system and automation aids. Turnkey programmable control system. Turnkey computer control and monitoring system.

ELECTRICAL SYSTEMS LTD,
226-228 Holbrook Lane, Holbrooks, Coventry CB6 4DD. UK. Tel: +44-203 637086. Manufacturers of medium voltage motor control gear panels, starters, distributors, switchboards and general control panels for use in the sewage and water industry.

EMERSON ELECTRIC CO,
PO Box 4100, 8000 West Florissant Avenue, St Louis, Missouri 63136. USA. Tel: +1-314-553 2000. Telex: 19-3117-44-876. Fax: +1-314-553 3527. Manufacturers of a broad range of electrical/electronic products. Specialists in pump motors.

ERSKINE SYSTEMS LTD,
Lee De Forrest House, Eastfield, Scarborough, North Yorks YO11 3DU. UK. Tel: +44-723 583511. Telex: 52562 ERSKIN G. Fax: +44-723 581231. Manufacturers of secure AC and DC power supplies, emergency lighting, battery chargers and uninterruptible power supplies.

FRANKLIN ELECTRIC,
Blufton, IN 46714. USA. Tel: +1-219-824 2900. Telex: 232-493. Fax: +1-219-824 2909. Franklin is the world's leading manufacturer of submersible motors for deep well pumps and a leading manufacturer of electric motors for centrifugal pumps, with a maximum rating of 3hp.

N J FROMENT & CO,
Easton Stamford, Lincs PE9 3NP. UK. Tel: +44-780 51051. Telex: 32275. Fax: +44-780 66061. Manufacturers of reactor-driven generators, load banks, dynamometers and test equipment.

G E CANADA,
795 First Avenue, Lachine, Quebec H8S 2S8. Canada. Tel: +1-514-485 4110. Fax: +1-514-485 4230. G E Canada has served the worldwide hydro market for over 100 years. The company designs and manufactures hydraulic turbines, hydrogenerators, synchronous generators, static excitation equipment and isolated phase bus duct.

GEC ELECTRICAL PROJECTS LTD,
Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-788 542144. Telex: 311335. Fax: +44-788 60767.
Contact Name: Mr F W Ballard or Mr S W G Cheshire.
Mechanical, electrical and control engineering company with experience in water and sewage pumping

stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor convertor equipment particularly suited to the control of pumps, compressors and fans.

GEC LARGE MACHINES LTD,
Mill Rd, Rugby, Warks CV21 1BD. UK. Tel: +44-788 542121. Telex: 31671 GECMCR G. Fax: +44-788 79740. Manufacturers of motors and generators for pumping applications including variable speed drive equipment, also provide a spares, commissioning and maintenance service.

GRUNDFOS INTERNATIONAL A/S,
PD Jensensvej 7, Bjerringbro 8850. Denmark. Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. The Grundfos range of products includes not only pumps and attached driving arrangements but also the entire palette of related accessories such as starters, controls and wellheads etc.

HANSEN TRANSMISSIONS INTERNATIONAL SA,
Leonardo Da Vinciilaan 1, Edegem B-2520. Belgium. Tel: +32-3-450 1211. Fax: +32-3-450 1220. Hansen manufactures several lines of high-quality power transmission products. The central product line is the Hansen Powerplus standardised gear unit. The complementary Hansen Junior range of geared motors, is available from 20 Nm to 9,000 Nm. Synergic components, such as mechanical and electronic speed variators, couplings, brakes, belt and chain drives, to name but a few, complete the programme and combine ideally with the gear unit to give solutions to a wide variety of power transmission problems. Hansen has a worldwide service with local manufacturing and assembly facilities.

HEENAN DRIVES LTD,
PO Box 52, Blackpole Rd, Worcester WR3 8TL. UK. Tel: +44-905 57555. Telex: 335409. Fax: +44-905 56539. Manufacturers of AC and DC variable speed drives, eddy current couplings and complete drive systems for the water industry.

HUBERTS BV,
PO Box 251, Veghel, AG 5460. The Netherlands. Tel: +31-41-30-66811/41-30-42275. Telex: 74645. Fax:

+31-41-30-42029. Import/export wholesale company in mainly woodworking and metalworking machines for semi-industrial purposes: metal lathes, wood lathes, bench grinders, (pedestal) drilling machines, air tools, compressors, water pumps, electric motors, band sawing machines, metal sawing machines, welding equipment and dust exhausters.

HUSBANDS SHIPYARDS LTD,
Electrical Division Crickmore Hard Marchwood, Southampton. SO4 4ZD. UK. Tel: +44-703 663555. Telex: 47450 HUSBND G. Fax: +44-703 663094. Designers and manufacturers of MV switchboards, distribution, motor control, process control and instrumentation control panels for electrical, electropneumatic and pneumatic systems. Site installation, commissioning and maintenance. After sales service.

HYDRO BOND ENGINEERING LTD,
Unit 2B, Woodside Rd Bridge of Don, Aberdeen AB2 8EF. UK. Tel: +44-224 822996. Telex: 739454. Fax: +44-224 825142. Hydro-Bond Engineering design, manufacture and service a range of underwater electrical connectors and electrical pressure penetrators. The extensive service facility covers cable connector moulding, cable splicing, connector/cable repair, tether and umbilical cable termination.

IDEAL ELECTRIC CO,
330 East First St, Mansfield, Ohio 44903. USA. Tel: +1-419-522 3611. Telex: 987410. Ideal Electric has been designing and building custom designed electrical equipment for 85 years. Horizontal and vertical, synchronous and induction motors, also build eddy current couplings which can be used as variable speed drives.

KLOECKNER INDUSTRY ANLAGEN GMBH,
PO Box 100852, Kloeckner Haus, Duisburg D-4100. West Germany. Tel: +49-203-181. Telex: 085581870 RC D. Fax: +49-203 340095. Provide a complete turnkey service to the waste water industry. Also complete mechanical and electrical packages including engineering, start up and operation maintenance if required.

MARATHON ELECTRIC MFG CORP,
PO Box 8003, Wausau, WI 54402-8003. USA. Tel: +1-715-675 3311. Telex: 260175. Fax: +1-715-675 6361. Manufacturer of generators and motors.

SWITCHGEAR, ALTERNATORS & GENERATORS

MAWDSLEY'S LTD,

Dursley, Glos GL11 5AE. UK. Tel: +44-453 4131. Telex: 43128. Fax: +44-453 46571. Mawdsley's specialise in the manufacture of low voltage AC generators from 3-2,000 KVA for hydro electric installations.

NEI ELECTRONICS LTD (INDUSTRIAL CONTROLS),

Kingsway, Team Valley, Gateshead, Tyne & Wear NE11 0QJ. UK. Tel: +44-91-487-0811. Telex: 537040. Fax: +44-91-482 0006. AC & DC variable drive systems from 3kW to highest ratings available, motor control centres and control and instrument packages.

PED LTD,

Exning Rd, Newmarket, Suffolk CB8 0AX. UK. Tel: +44-638 665161. Telex: 81245. Fax: +44-638 660718. Manufacturers of relays, solenoids and solenoid valves.

PETBOW LTD,

Ramsgate Rd, Sandwich, Kent CT13 9NE. UK. Tel: +44-304 613311. Telex: 96329. Fax: +44-304 613358. Manufacture a range of generating sets from 1 KVA up to 6,000 KVA either as open, enclosed, portable, mobile, silenced, or fully automatic with a wide choice of diesel engines and control systems.

SAFTRONICS LTD,

Pearson St, Leeds, West Yorks LS10 1BQ. UK. Tel: +44-532 457170. Telex: 55210. Fax: +44-532 421739. Manufacturers of AC and DC motor control systems including multi-motor control centres.

A O SMITH,

531 North 4th St, Tipp City, Ohio 45371. USA. Tel: +1-513-667 2431. Telex: 288097. Fax: +1-513-667 2339. Manufacturers and suppliers of electric motors for domestic water systems and swimming pools, and of centrifugal pumps.

SQUARE D (UK) LTD,

Cheney Manor, Swindon, Wilts SN2 2QG. UK. Tel: +44-793 513533. Telex: 8958791. Fax: +44-793 485141. Manufacturers of electrical motor control including control centres, variable speed AC and DC drives, distribution switchboards, and programmable controllers including data logging systems with graphic displays.

THAMESMEAD ENGINEERING LTD,

Headley Cottage, Weston Green, Thames Ditton, Surrey KT7 0JY. UK. Tel: +44-1-398 3178. Telex: 8955340. Fax: +44-1-398 7021. Electronic load governors, water level and pressure pulse output controllers, speed monitor relays, control panels, full range of alternators, motors and switchgear, purpose built and designed for water power and water industry requirements.

THORNEMI ELECTRONICS LTD (AUTOMATION DIVISION),

PO Box 4, Rugeley, Staffs WS15 1DR. UK. Tel: +44-8894 5151. Telex: 36135. Fax: +44-8894 5151 ext 213. Motor drives for pumps, fans and for other process plant, providing close control of variable speed. The range of standard units covers most ratings up to 600kw.

TORRENT PUMP INDUSTRIES,

PO Box 51066, Kifissia GR-145 10. Greece. Tel: +30-1-81617128161702. Telex: 215870. Fax: +30-1-8161018. Power panels.

TOTTON PUMPS LTD,

Southampton Rd, Cadman, Southampton, SO4 2MS. UK. Tel: +44-703 813136. Fax: +44-703 813-650. Manufacturers of magnetically coupled centrifugal pumps, diaphragm pumps, submersible column pumps and small electric motors to 80 watt output.

VERBUND-PLAN GMBH,

Am Hof 6A - A-1010 Vienna, Austria. Tel: +43-1-0222-53113 4800. Telex: 115978 VPLWN A. Fax: +43-1-0222-53113 4848. Out of more than 30 years experience with generation of electricity, Verbund-Plan can give a lot of expertise in the field of electrical motors, controls, transformers, switchgear, alternators and generators. Verbund-Plan has designed most of Austria's power-plants and has also the operation and maintenance experience of these installations available.

WEBER SENSORTECHNIK GMBH,

2201 Kollmar. West Germany. Tel: +49-04128 591. Telex: 218326. Fax: +49-04128 593. The vent-captor, for the monitoring of air and gaseous media, is frequently applied in the ventilation and cooling of electrical motors. The flow-captor for liquids and semi-solids finds a number of applications in the mon-

itoring of oil coolant circuits or lubrication circuits in motors, engines and generators. Both units are small, compact, maintenance free and long-life.

WHIPP & BOURNE LTD,

Switchgear Works, Castleton, Rochdale, Lancs OL11 2SS. UK. Tel: +44-706 32051. Telex: 63442. Fax: +44-706 345896. Manufacturers of: DC switchgear up to 3000 volt, 12,000 amp, vacuum switchgear up to 13.8kv, 3000 amp, 40ka, air-brake switchgear to 7.2kv, 43ka.

HYDROELECTRIC TURBINES & EQUIPMENT

ABB STAL,

Dept M, Finspong South 61220. Sweden. Tel: +46-122 81000. Telex: 64045. Fax: +46-122-186-84. Manufacturers of turbines and pressurised fluidised bed combustion systems.

AMERICAN HYDRO CORPORATION,

130 Derry Court, York, PA 17402. USA. Tel: +1-717-764 3587. Fax: +1-717-764 0848. Manufacturers of custom-designed, upgraded turbine runners. Specialists in turbine research and development, repair and refurbishment.

BIWATER HYDRO POWER LTD,

Crow Arch Lane, Ringwood, Hants BH24 1PE. UK. Tel: +44-425 472405. Telex: 418295 ARLICO G. Fax: +44-425 471652. Specialise in small scale water engineering designed to produce hydro-electric power for local, domestic and industrial consumption or for investment purposes.

BOVING & CO LTD,

Villiers House, 41-47 Strand, London, WC2N 5LB. UK. Tel: +44-71-839 2401. Telex: 28444 BOVING G. Fax: +44-71-930 3991. Boving & Co Ltd, a part of the Kvaerner Hydro Group of companies, was founded in 1912 and is the only supplier of large water turbines in the United Kingdom.

CIMH,

42 Avenue J Desplats, Castres 81100. France. Tel: +33-63-35-63-15. Telex: 520200. Manufacturers of small frontsturbines and propeller turbines up to 400kw. CIMH also undertake feasibility studies and design for the water industry.

DANUBE HYDRO AUSTRIA,

PO Box 88, Parkring 12, Vienna A-1011. Austria. Tel: +43-222-515-38-0. Telex: 111-366-DO1A. Fax: +43-1-515-38-3900. International consulting service for dam and hydro power development covering the multitude of technical and economic disciplines with particular emphasis on low head dams, river engineering and inland navigation.

DEPENDABLE TURBINES LTD,

7-3005 Murray St, Port Moody, BC V3H 1X3. Canada. Tel: +1-604-461 3121. Fax: +1-604-461 2314. Manufacturers of a complete range of governors, generators and turbines.

DUMONT SA,

Port de St Uze, St Vallier 26240. France. Tel: +33-75-23-09-22. Telex: 345-501. Fax: +33-75-03-94-82. Hydraulic turbines.

ESSEX TURBINE CO,

Kettle Cove Industrial Park, Magnolia, MA 01930. USA. Tel: +1-617-525 3523. Fax: +1-617-525 3214. The company builds hydro-electric turbines (axial flow bulb style - 50 to 1000 kw). Specialists in stand-alone power plant. Manufacturers of turnkey packages.

FABBRICA TURBINE E CALDAIE,

FTC Legnano SRL Piazza Monumento, Legnano 12, Milan 20025. Italy. Tel: +39-331-522-111. Telex: 330661-314385 F TOSI. Fax: +39-331-593-321. Fabbrica Turbine E Caldaie - FTC Legnano SRL (Franco Tosi Group) represents a wealth of know-how and experience in the fields of generation, conversion, utilisation and recovery of energy in its various forms, as well as in other areas such as sea water desalination, ship propulsion and in general industrial plants, where equipment produced by the company finds a field of application.

FLYGT AB,

Box 1309, Solna 171 25. Sweden. Tel: +46-8-7336500. Telex: 43887. Fax: +46-8-295816. Flygt is the world's leading manufacturer of submersible heavy-duty pumps for contaminated and abrasive liquids. The annual sales for 1988 was approx SEK 2.8 billion. With over 1,500,000 installations in more than 100 countries throughout the world, Flygt submersible products encompass an awesome range of pumps, mixers and hydro turbine generators for small scale hydro electric power stations. The main office in

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situated in Solna, just outside Stockholm, with manufacturing facilities in Lindas. Flygt has subsidiaries in 16 countries and 3,400 employees of which 1,500 are in Sweden.

FRANCO TOSI INDUSTRIALE SPA,

Piazza Monumento 12, Legnano, Milan 20025. Italy. Tel: +39-331-522-111/36-331-547-690. Telex: 330661-314385 F TOSI. Fax: +39-331-593-321. Established in 1882, operates in the field of power generation equipment design and manufacturing (steam and hydraulic turbines, boilers, feedwater heaters and condensers, compressors, pumps and desalination plants).

GANZ-MAVAG LOCOMOTIVE & RAILWAY CARRIAGE MANUFACTURERS, MECHANICAL ENGINEERS,

PO Box 136, Budapest VIII, Konyves Kalman kr 76, Budapest H-1967. Hungary. Tel: +36-137-020, 335-950. Telex: 22-5575, 22-5576. Water turbines (Francis, Kaplan and Pelton types), water turbine stations, pumps and pumping stations.

GE CANADA,

795 First Avenue, Lachine, Quebec H8S 2S8. Canada. Tel: +1-514-485 4110. Fax: +1-514-485 4230. GE Canada has served the worldwide hydro market for over 100 years. The company designs and manufactures hydraulic turbines, hydrogenerators, synchronous generators, static excitation equipment and isolated phase bus duct.

GEC ENERGY SYSTEMS LTD,

Cambridge Rd, Whetstone, Leicester LE8 3LH. UK. Tel: +44-533 863434. Telex: 34611. Fax: +44-533 866084. Manufacturers of Francis, Kaplan and propeller type water turbines and associated ancillary equipment including electronic governors.

GILKES LTD,

Kendal, Cumbria LA9 7BZ. UK. Tel: +44-539 20028. Telex: 65125. Fax: +44-539 32110. Manufacturers of water turbines for hydro-electric use; cooling water pumps; simulation equipment for educational establishments; power systems.

GSA INTERNATIONAL CORPORATION,

Croton Falls Executive Park, Croton Falls, NY 10519. USA.

Tel: +1-914-277 8000. Fax: +1-914-277 8001.

Manufacturers of complete packaged hydro-electric plants from 1 kw to 1 megawatt; impulse turbines, double regulated Kaplan turbines and Francis turbines. Suppliers of speed increasers, generators and control panels. Provide a training service in the developing countries.

HYDROELECTRA AG,

Karl Vülkerstrasse 2, Heerbrugg CH-9435. Switzerland. Tel: +41-71-72-60-79. Telex: 881111. Suppliers of used turbines in all sizes, and of complete computer control systems for hydro-power stations.

IREM SPA,

Via Vaie 42, South Antonio Di Susa, Turin 10050. Italy. Tel: +3911-9649133. Telex: 212134. Fax: +3911-9649933. Ecowatt Microhydroelectric plants exploit small falls and flows generating clean energy (power from 50w to 50kw). Irem Research quality, reliability are driving forces behind success.

JANSEN VENNEBOER BV,

PO Box 12, AA Wijhe 8130. The Netherlands. Tel: +31-5702 2525. Telex: 49418. Fax: +31-5702 3618. Design, production and installation of mechanical construction for hydraulic works. Products include: archimedean screws; penstocks, sluice gates and radial gates; regulating and measuring weirs; weedcreens; automatic raking installations Volanta handpumps and low-head water turbines (up to 1000 kW).

NATIONAL ENGINEERING LABORATORY,

East Kilbride, Glasgow G75 0QU. UK. Tel: +44-3552 20222. Telex: 777888. Fax: +44-3552 36930. NEL is an international centre for the testing and approval of water turbines.

NOHAB-KMW TURBIN AB,

PO Box 925, Trollhättan 46129. Sweden. Tel: +46-520 18410. Telex: 42247. Fax: +46-520 89299. Manufacturers of water turbines (Francis and Kaplan), also of auxiliary equipment for the nuclear power industry.

OBERMEYER HYDRAULIC TURBINES LTD,

10 Front St, Collinsville, Connecticut 06022. USA. Tel: +1-203-693 0295. Telex: 9102503706. Fax: +1-203-693 1447. Manufacturers of hydro-electric turbines and support

systems (induction and synchronous) gate systems, control and switchgear and engineering support.

OSSBERGER TURBINES INC,
5709 South Laburnum Avenue, Richmond, Virginia 23231.
USA. Tel: +1-804-226 9180. Telex: 5101001298. Fax:
+1-804-222 1097. Ossberger Turbines Inc are suppliers of
complete hydropower stations for independent and/or grid-
connected operation in the range between heads of 1 and
200m and outputs of between 1 and 1,500 kw. Most of
the Ossberger Plants are run-off-the-river applications.

**OSSBERGER - TURBINENFABRIK
GMBH & CO,**
PO Box 425, Otto-Rieder-Strasse 7, Weissenburg, Bavaria
D-8832. West Germany. Tel: +49-9141 4091. Telex:
624627 OSSBG D. Fax: +49-9141 70522. Based on the
OSSBERGER Turbine which is a radial impulse type turbine
with partial admission, Ossberger-Turbinenfabrik GmbH &
Co offer complete small hydropower stations for indepen-
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heads of 1 and 200m and outputs of between 1 and
1,500 kW.

PSL INTERNATIONAL LTD,
PO Box 4, Humber Rd, Barton-on-Humber, Southe
Humberside DN18 5BN. UK. Tel: +44-652 32702. Telex:
527305. Fax: +44-652 33401. Rotating equipment engi-
neers - pumps, turbines and compressors, particularly for the
water industry. Repairs to submersible pumps.

SCHICK WASSERKRAFTTECHNIK,
Prager Gasse 3-5, Vohenstrauß D-8483. West Germany.
Tel: +49-9651 2301. Fax: 49-9651 1693. Specialised in
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ice sluice weirs and electronic control module complete for
parallel power line operation of synchronized and asynchro-
nized small hydro plants with quick-disconnect in case of
malfunctions and power failure.

TAMPELLA LTD,
PO Box 616, Tampere 33101. Finland. Tel: +358-31-
32400. Telex: 22577. Fax: +358-31-134511.
Manufacturers of turbines, gate and butterfly valves.

VERBUND-PLAN GMBH,
**Am Hof 6A - A-1010 Vienna, Austria. Tel: +43-1-
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+43-1-0222-53113 4848. In the field of hydro-electric**

**Turbines and equipment Verbund-Plan has a lot of
engineering expertise available and can give substan-
tial support in primary design, layout, tendering,
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supervision and putting into operation, as well as
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West Germany. Tel: +49-7321 370. Telex: 714-79920.
Fax: +49-7321 373000. Francis, Pelton and Kaplan tur-
bines, Kaplan bulb turbines, pump/turbines and
power-recovery turbines.

WASSERKRAFT VOLK GMBH,
Gefall 45. Simonswald D-7809. West Germany. Tel: +49-
7683 844. Telex: 0772668. Control systems, governors,
generators and a wide range of turbines.

WATER POWER ENGINEERING,
Coaley Mill, Coaley, Dursley, Glos GL1 1 5DS. UK. Tel:
+44-453 89376. Telex: 437105. Fax: +44-45-383
4004. Manufacturers of a small range of hydro-electric
power systems of modern design and high performance, of
modular construction. Available in four sizes, manufactured
in polymers and composites.

LIGHTING EQUIPMENT

AEROFLASH SIGNAL,
1715 West Carroll Avenue, Chicago, IL 60612. USA. Tel:
+1-312-733 3513. Fax: +1-312-733 0192. Manufacturer
of solid state strobe lights, warning systems and back-up
alarms.

BRIMOTOR LTD,
Clarence Works, 30a Church Rd, Tunbridge Wells, Kent
TN11 1JP. UK. Tel: +44-892 37588. Telex: 95446 BIMOTR
G. Manufacturers of portable, mobile and mains failure gen-
erating sets, and portable mobile floodlighting units.
Manufacturers of self-priming and diaphragm pumps.

JULIAN A MCDERMOTT CORP,
1635N Stephen St, Queens, NY C 11385. USA. Tel: +1-
718-456 3606. Fax: +1-718-381 0229. This company
has been in business for 45 years engineering and supply-
ing safety and lighting equipment to utilities and
municipalities. The devices include battery operated hand

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lights, flashers and work lights, barricades and vehicle warning lights for protection of men from vehicular traffic.

PARAGON ELECTRIC CO INC,

606 Parkway Boulevard, Two Rivers, WI 54241, USA. Tel: +1-414-793 1161. *Manufacturer of programmable time controls, both electronic and electromechanical for lighting and HVAC.*

F W THORPE PLC,

Facet Rd, Kings Norton, Birmingham, B38 9PJ, UK. Tel: +4421-459 1122. Telex: 39327. Fax: +4421-451 2131. F W Thorpe Plc (Thorlux Lighting) *manufacturers of industrial and commercial lighting equipment. Product range covers fluorescent luminaries, bulkheads, floodlights High Bay reflectors, Type-N luminaries for zone 2 use and emergency lighting.*

PUMPS - CENTRIFUGAL, AXIAL FLOW & GENERAL

A/S DE SMITHSKE,

Tagholm 1, PO Box 205, DK-9400 Norresundby, Denmark. Tel: +46-9-8178111. Telex: 69620 DESMI DK. Fax: +45-9-8175494. A/S De Smithske is a modern production and sales enterprise with a considerable technical know-how and with modern production and administration facilities. During the past years an intensive product development has resulted in new DESMI products within our entire range of centrifugal pumps and transmissions for the industrial and agricultural sectors. Please contact direct for further details.

ABS PUMPEN AG,

PO Box 12, 20 Scheidehorn, Lohmar 1, 5204, West Germany. Tel: +49-2246-13-0. Telex: 889-619. Fax: +49-2246-13-200. ABS produces axial flow pumps with submersible electrical motor for a maximum capacity of 11000 l/sec. The use of axial flow pumps with submersible motor reduces building costs by 40 per cent.

AGROMACHINA IMPEX,

1st Stoyan Lepoev Str. Bulgaria. Tel: +21 1882. Telex: 22563. Fax: +209129. Agromachinaimpex FTO for Import, Export and Inland Trade with tractors, farming machines and equipment, dealing with engineering, technical attendance and service. The Export List of Agromachinaimpex Foreign Trade Organisation covers 16 pump families, each produced in many modifications, a range of irrigation equipment and drip irrigation.

ALBANY ENGINEERING CO LTD

(INCORPORATING CROWN PUMPS), Church Rd, Lidney, Glos GL5 5EQ, UK. Tel: +44-594 42275. Telex: 43363. Fax: +44-594 42574. Albany Engineering manufacture a range of diaphragm type metering pumps, centrifugal and rotary pumps, for a variety of applications in the water industry.

ALLWEILER AG,

D-7760 Rodoifzell, West Germany. Tel: +49-07732 860. Telex: 793437. Fax: +49-07732 86436. ALLWEILER present throughout the world with pumps and pumping systems of all kinds. Centrifugal pumps, Propeller pumps, Screw pumps, Eccentric screw pumps, Hand pumps and macerators all in most different designs and materials for all applications in water resources, treatment, distribution and supply, irrigation, waste water purification and treatment, sewage engineering and environmental systems. Please contact us on the above address.

ALPHA POMPE SRL,

PO Box 10, Via Molino Emili, Macclodio BS 25030, Italy. Tel: +39-30-978661. Fax: +39-30-27-22-261. Centrifugal, self-priming drainage pumps, electric pumps, petrol and diesel motor pumps.

AQUATEC MARKETING LTD,

Unit 1D, Kennelside, Newbury, Berks RG14 5PX, UK. Tel: +44-635 49141. Fax: +44-635 38681. Aquatec Marketing Ltd is an international distributor of swimming pool, spa, whirlpool, water treatment and water engineering equipment. The company's comprehensive product range includes pressure vessels, pumps and irrigation equipment.

ARKOS,

Via Repubblica, 34 Brescello RE, Italy. Tel: +39-522 687521. Telex: 531-227. Manufacturers of centrifugal and self-priming low pressure water pumps 1-2.5in, 30-100 cc two-stroke engines.

ARMSTRONG PUMPS LTD,

Peartree Rd, Stanway, Colchester, Essex CO3 5JX, UK. Tel: +44-206 579491. Telex: 987858. Fax: +44-206 760532. Manufacturers of pumps, expansion equipment, booster sets and associated accessories.

AUTOMETRIC PUMPS LTD,

Turkey Court, Ashford Rd, Maidstone, Kent, UK. Tel: +44-622 677650. Telex: 965-633. Producers of small pumps

and sizes up to 2ins BSP. The range includes centrifugal, gear, turbine, hand and vacuum pumps. We also handle a large range of pumps of other manufacture.

C BANCROFT PIPELINE LTD,
Pellon Lane, Halifax, West Yorks HX1 5BG. UK. Tel: +44-422 64121. Telex: 517743. Fax: +44-422 53513.

Bancroft Pipeline are distributors of pipeline equipment to water authorities and industrial users both in the UK and overseas. Their range includes: pumps, valves, control equipment and pipework in various materials.

BARNANT CO,
28W092 Commercial Avenue, Barrington, IL 60010. USA. Tel: +1-312-381 7050. Manufacture peristaltic tubing pumps, lab equipment (pH, thermometers, vacuum/pressure pumps).

BARNES BOWSER (PUMPS) LTD,
75 Tupwood Lane, Caterham, Surrey CR3 6DD. UK. Tel: +44-883 43619. Barnes Bowser manufacture self-priming single stage pumps from 1.5in-6in bore and mixed flow pumps (non self priming) upto 12in bore. These products have their application in drawing water from wells and bore holes.

BARTHOD POMPES SA,
21 Rue Bearraban, Lyon, Paris 69006. France. Tel: +33-78848651. Barthod Pompes produce a large range of pumps and associated accessories such as rotating head systems and nozzles. Standard pressure range from 50-100 bars but high pressure versions are available from 20-7000 bars.

BC PUMPS LTD,
29-30 Kernan Drive, Loughborough, Leics LE11 0JF. UK. Tel: +44-509 231872. Telex: 342185. Fax: +44-509 215228. Manufacturers of centrifugal pumps for water and sewage applications. Ranges include DIN2455 water pumps, borehole, multistage, horizontal and vertical sewage, submersible sewage and drainers.

BELZONA MOLECULAR LTD,
Claro Rd, Harrogate, North Yorks HG1 4AY. UK. Tel: +44-423 67641. Telex: 629497. Fax: +44-423 505967. Maintenance product and services for the repair and refurbishment of pumps, valves and associated equipment. Accepted supplier of coatings and systems for protection against corrosion and chemical attack on concrete.

BERESFORD PUMPS,
Burnsall Rd, Canley, Coventry CV5 6BN. UK. Tel: +44-203 78412. Telex: 317298. Manufacturers of centrifugal self-priming pumps in cast iron, bronze or stainless steel, sump and cellar drainage pumps. Also water and chemical pumps of polypropylene construction.

BIWATER PUMPS LTD,
Millers Rd, Warwick CV34 5AN. UK. Tel: +44-926 411740. Telex: 317473. Fax: +44-926 410740. Manufacturers of electro-submersible and conventional dry-well solids handling pumps, manufacturer of electrical control panels, and multi motor control centres. Contractor supplying above from design through to installation, commissioning of complete sewage pump station installations.

BOMBAS GRUNDFOS ESPANA SA,
Francisco Gervás, 2, Pol Ind Alcobendas, Apartado 222, 28100 Alcobendas. Madrid. Tel: +91-653-24-22. Fax: +91-653-20-32. Manufacture and sale of stainless steel pumps, especially for use in water supplies, irrigation, heating systems, air conditioning, water desalination etc.

BRIMOTOR LTD,
Clarence Works, 30a Church Rd, Tunbridge Wells, Kent TN1 1JP. UK. Tel: +44-892 37588. Telex: 95446 BIMOTR G. Manufacturers of portable, mobile and mains failure generating sets, and portable mobile floodlighting units. Manufacturers of self-priming and diaphragm pumps.

CAPITAL ENGINEERING SERVICES,
Unit D4, Mailmech Industrial Estate, 83 Copeth Cope Rd, Beckenham, Kent. UK. Tel: +44-1-658 2243. Capital Engineering produce a full range of pumps, both manually operated and mechanical ranging from 0.5 horse power to 1000s of horse power for drawing water from wells and bore holes etc.

CAPRARI SPA,
Emilia Ovest 900, MO 41100. Italy. Tel: +39-59-330-533. Fax: +39-59-338153. Leading European manufacturers of: electric submersible pumps for 4ins to 14ins wells, deep well turbine pumps, vertical and horizontal electric monobloc pumps, single and multistage centrifugal pumps and PTO pumps.

CAT PUMPS AG,
Loretöhöhe 5, CH-6300 Zug. Switzerland. Tel: +41-042

PUMPS - CENTRIFUGAL, AXIAL FLOW & GENERAL

213140. Fax: +41-042 218133. Manufacture and supply positive displacement high pressure pumps. Many models are available with corrosion resistant parts for use in the reverse osmosis process for treatment of brackish water and sea water. Pump sizes from 2 to 75 shaft horsepower, and a complete line of stainless steel pump accessory items such as pressure regulation valves, pulsation dampeners etc.

CHAMPENOIS SA,

Chamouille, Eurville F-52410, France. Tel: +33-25-55-59-55. Telex: 840914. Manufacture small centrifugal pumps.

CLASSEN & CO LTD,

Horton Close, West Drayton, Middlesex UB7 8JA. UK. Tel: +44-895 443206. Fax: +44-895 441274. Classen and Co are distributors for a full range of multiple application pumps from Hanring & Kahl and Grundex submersible electric pumps from 1-50hp, and Telstar float regulators.

CLAYTON SON & CO LTD,

Moor End Works, Hunslet, Leeds, West Yorks LS10 2BH. UK. Tel: +44-532 705226. Fax: +44-532 760372. Welded steel pumps, 450mm diameter and over. All UK standards API-511 (monogram authorized, all coatings). Well casing tubes, surge and contact vessels. Floating roof digestors and gas holders.

CLEGHORN WARING & CO (PUMPS) LTD,

9-15 Hitchin St, Baldock, Herts SG7 6AH. UK. Tel: +44-462 893838. Telex: 826832. Fax: +44-462 894719. Specialist distribution of centrifugal and positive displacement pumps, including self priming types, for low pressure water transfer.

CORROCOAT SERVICES LTD,

Forster Rd, Leeds, West Yorks LS10 1PW. UK. Tel: +44-532 760760. Telex: 557243. Fax: +44-532 760700. Manufacturers and applications of high technology coatings including the Fluidglide system for the improvement of pumping efficiency. Corrosion engineers specialising in the overhaul and protection of pumps, valves, and pipework. Also treatment of steel and concrete tankage.

CRANE BVMI,

Shaw Rd, Bushbury, Wolverhampton, West Midlands WV10 9NN. UK. Tel: +44-902 20496. Telex: 338171. Fax: +44-902 27167. Manufacturers of strainers (forged or cast), pumps-vertical in line, vertical spindle, end suction and

valves - bellows sealed design, globe or gate. All available in standard or exotic materials and of assured quality conforming to most specified requirements. BS5882, BS570 parts 1,2,3 and MOD Agap series.

CROWN - PACIFIC INTERNATIONAL,

18001 South Mitchell, Irvine, CA 92714, USA. Tel: +1-714-660 1798. Telex: 18100. Fax: +1-714-660 9229. Suppliers of pumps and related equipment.

CT (LONDON) LTD,

Westfield House, Westfield Rd, Guildford, Surrey GU1 1EL. UK. Tel: +44-483 502020. Telex: 859284. Fax: +44-483 502953. CT (London), long established in fluids handling, can offer a variety of valves, pumps, pipe supports, gauges, chemical dosing and spray equipment to solve your water handling problems. Call us!

DAVEY PRODUCTS PTY LTD,

118 Atkinson St, Oakleigh, Victoria 3166, Australia. Tel: +61-3-568 1655. Telex: AA139654. Fax: +61-3-568 4551. Manufacturers and marketers of pressure systems, end suction pumps - domestic, commercial and farm, swimming pool filters and pumps, spa bath pumps, engine driven pumps and pressure tanks.

DEAN PUMP DIV MET-PRO CORP,

6040 Guion Rd, Indianapolis, IN 46254, USA. Tel: +1-317-293 2930. Manufacture and sell single-stage, single suction pumps.

DRESSER PLEUGER UNTERWASSERPUMPEN,

PO Box 701320, Friedrich-Ebert-Damm 105, Hamburg 70, D-2000, West Germany. Tel: +49-40-69-460. Telex: 21-32-75. Fax: +49-40-69-46-242. Modern industry requires more water than all residential users put together. And often the water is corrosive, hot or polluted. But this is no problem for Pleuger units as they are specially constructed to perform well under these conditions.

DUIJVELAAR POMPEN BV (DP INDUSTRIES),

Kalkoverweg 52, Alphen Aan Den Rijn, UK 2401, The Netherlands. Tel: +31-1720 37034. Telex: 39691. Fax: +31-1720 33137. Duijvelaar pumps are used to supply drinking water, for irrigation in greenhouses, as jockey pump, boilerfeed pump, on car wash installations, for air

conditioning and many other purposes. One of the most important features of the Duijvelaar pumps is that they are mainly made of stainless steel, thus combining durability with high efficiency.

EBARA CORPORATION,

11-1 Haneda Asahicho, Ohta-Ku, Tokyo 144, Japan. Tel: +81-3-743 6716. Telex: EBARA TYO 322988. Fax: +81-3-745 3576. EBARA is probably one of the largest specialist pump companies in the world 4000 employees manufacturing in Japan, Indonesia and Singapore a comprehensive range of pumps for all applications.

ENSIVAL (ATELIERS DE CONSTRUCTION D') SA,

44 Rue Hodister, Pepinster-Wegnez 4853, Belgium. Tel: +32-87-46-01-11. Telex: 49058 POMPSI B. Fax: +32-87-46-04-41. A Belgian manufacturing company with over 60 years' experience in light/heavy pumps, Ensival is a leading expert in the development of water management. Our products and services are renown worldwide.

FARROW (A DIVISION OF WRIGHT RAIN LTD),

Crow Arch Lane, Ringwood, Hants BH24 1PA. UK. Tel: +44-425 472251. Telex: 41206. Fax: +44-425 472258. A range of small to medium size pumps available as tractor PTO, diesel or electrically driven. The diesel units are available on two-wheeled trolleys or mounted on skid base. Also available is a full range of pump control and engine protection equipment.

FORDWATER PUMPING SUPPLIES LTD,

49-53 Stratford Rd, Birmingham, West Midlands B11 1RQ. UK. Tel: +44-21-772 8336. Telex: 335807. Supply and maintain all types of pumps.

FYBROC DIV MET-PRO CORP,

235 Township Line Rd, Hatfield, PA 19440. USA. Tel: +1-215-723 8155. Corrosion resistant fiberglass pumps - horizontal, vertical and cantilever configurations - capacities to 4,000gpm - heads to 300ft. Also recessed impeller pumps that handle many solids up to 6ins diameter.

GARBARINO SPA,

Via St Iazzero 3, Acqui Terme, AL 15011. Italy. Tel: +39-144 58671. Telex: 212158. Fax: +39-144 55260. Garbarino are manufacturers of centrifugal, self-priming,

gear and rotary pumps (constructed to NATO and Italian Military standards) which are supplied worldwide to the naval, industrial and chemical sectors.

GELBER PUMPS INC,

3721 West Morse Avenue, Lincolnwood, IL 60645. USA. Tel: +1-312-673 5800. Manufacturer/distributor of wide variety of pumps and related equipment including filters, fluid agitators, instrumentation and controls.

THE GORMAN - RUPP INTERNATIONAL CO,

PO Box 1217, Mansfield, Ohio 44901-1217. USA. Tel: +1-419-755 1011. Fax: +1-419-755 1251. Manufacturers of self-priming centrifugal pumps, trash-handling, clear-water and sewage pumps. Gorman - Rupp also manufacture a line of submersibles, diaphragm pumps and straight centrifugals.

GOULDS PUMPS INC,

240 Fall St, Seneca Falls, NY 13148. USA. Tel: +1-315-568 2811. Manufacture over 60 different pump models.

GRAHAM PRECISION PUMPS LTD,

The Forge, Congleton, Cheshire CW12 4HQ. UK. Tel: +44-260 274721. Telex: 667383. Fax: +44-260 276965. Specialist manufacturers of liquid ring and rotary vane vacuum pumpsets and ejectors, centrifugal pumps, twin pumps, inline, horizontal and vertical multi-stage pumps, self priming, gear and rotary vane pumps.

RICHARD GROSVENOR & CO LTD,

21 Woodthorpe Rd, Ashford, Middlesex TW15 2RP. UK. Tel: +44-7842 41021. Telex: 892322. Manufacturer of industrial and marine electrically driven reciprocating pumps in a range of materials to suit many liquids. Packaged pump and tank sets also made with a range of accessories. All pumps available with variable output.

GRUNDFOS INTERNATIONAL A/S,

PD Jensensvej 7, Bjerringbro 8850. Denmark.

Tel: +45-86-681-400. Telex: 60731 GFO SDK. Fax: +45-86-684-472. Manufacturers of water pumps, domestic circulators, industrial circulators, booster, boiler feed and general service pumps, sump pumps, deep well submersible pumps, in line and end suction pumps.

PUMPS - CENTRIFUGAL, AXIAL FLOW & GENERAL

GRUNDFOS PUMPS LTD,

Grovebury Rd, Leighton Buzzard, Beds LU7 8TL. UK. Tel: +44-525 850000. Telex: 825544. Fax: +44-525 850011. Grundfos manufacture a wide range of hot and cold water pumps for applications including domestic and commercial heating, water boosting and supply, liquid transfer, dewatering and cooling. Details of the complete range are available in a handy pocket-size publication entitled 'Pump Selection Guide'.

HARRISBURG INC,

12000 West Little York Rd, 77041. USA. Tel: +1-713-462 4110. Telex: 4620561 HBI UI. Fax: +1-713-937 7151. Manufactures and distributes (worldwide) complete line of high volume, low pressure centrifugal pumps in 1-1/8ins, 1-7/8ins and 2-1/2ins shaft series covering the 1in through 8ins discharge range. Multi-component fluid ends, including unique 'Xtra-life' hardened components for abrasive service, offer maintenance cost savings over competitive designs.

HAZLETON ENVIRONMENTAL PRODUCTS INC,

225 North Ceder St, Hazleton, Pennsylvania 18201-0488. USA. Tel: +1-717-455 7711. Telex: 831881. Fax: +1-717-459 2586. Contact Name: Mr Randy Galgon. Manufacturer of rugged pumps for slurries, wastewater and most demanding services. Abrasion/corrosion resistant alloys and ceramics are available.

RICHARD HILL PUMPS LTD,

Brooke Rd, Ridlington, Leics LE15 9AN. UK. Tel: +44-572 823385. Telex: 34694. Manufacturers of self-priming centrifugal pumps close coupled to petrol and diesel engines and electric motors. Widely used for irrigation systems and general industrial applications.

H R HOLFELD (PUMPS) LTD,

65 Carshalton Rd, Sutton, Surrey SM1 4LH. UK. Tel: +44-1-661 0719. Telex: 28650. Fax: +44-1-642 0454. Holfeld Pumps design and supply advanced pumping technology and the Holpak range of pump sets and pressure booster systems to specific customer requirements covering a wide range of applications including building services, irrigation, water and waste treatment and fire prevention.

HOVAL FARRAR LTD,

Northgate, Newark, Notts NG24 1JN. UK. Tel: +44-636

72711. Telex: 37164. Fax: +44-636 73532. Birral Pumps manufactured in Switzerland from the highest quality materials to exacting standards. Birral can design and build to specific requirements or supply standard pumps from its large stocks. The range is from small water circulating pumps to deep well submersibles to pressure boosting and water feed pumps, sewage pumps, control systems and special designs.

HUBERTS BV,

PO Box 251, Veghel, AG 5460. The Netherlands. Tel: +31-41-30-66811/41-30-42275. Telex: 74645. Fax: +31-41-30-42029. Import/export wholesale company in mainly woodworking and metalworking machines for semi-industrial purposes: metal lathes, wood lathes, bench grinders, (pedestal) drilling machines, air tools, compressors, water pumps, electric motors, band sawing machines, metal sawing machines, welding equipment and dust exhausters.

HYDRAINER PUMPS LTD,

Norwood Industrial Estate Rotherham Rd, Killarmar Sheffield, South Yorks S31 8HB. UK. Tel: +44-742 484868. Fax: +44-742 510136. The Hydrainer range covers a complete spectrum of pumping applications with various power pack and a family of pumps which cater for flows up to 1630 gpm, head capability to 250ft and solids handling to 2.72ins solids. All pumps up to and including the 4ins unit can be handled by one man. The unique concept of the Hydrainer power pack offering variable speed to the impeller significantly improves the overall pumping efficiency. Furthermore the Hydrainer will consume only 1/3 of the fuel used by a conventional end suction pump.

F E HYERS A PENTAIR CO,

1101 Myers Parkway, Ashland, Ohio 44805-1923 USA. Tel: +1-419-289 1144. Telex: 98-7443. Fax: +1-419-289 6658. Today, with more than 118 years of industry experience, F E Myers, a Pentair Co, manufactures submersible and centrifugal jet pumps for residential water systems, environmental waste handling pumps and systems, sump and sewage pumps, reciprocating and centrifugal industrial pumps, plus a wide range of repair part and accessories.

HYPRO CORPORATION,

375TH Fifth Avenue NW, New Brighton, MN 55112. USA. Tel: +1612-633 9300. Telex: 4310109. Fax: +1612-633 6864. Manufacturer of pumps and fluid handling accessories for high pressure cleaning, spraying and general liquid transfer. Roller pumps, centrifugal pumps and diaphragm pumps in a range of sizes.

**INDUSTRIAL FILTER & PUMP
MFG CO,**

5900 Ogden Avenue, Cicero, IL 60650. USA. Tel: +1-312-656 7800. Fax: +1-312-656 7806. Manufacturer of filters, demineralizers and pumps used in the water treatment industry.

**INTERSIGMA EXPORT & IMPORT
CORPORATION OF SIGMA CON-
CERN,**

PO Box 1111, Praha 1, Václavské nám 60 111 87. Czechoslovakia. Exports: pumps, pumping equipment, irrigation equipment, industrial valves, complete water management plants, pumping stations, sewage water purifying plants, water treatment plants and industrial pipings.

INTERTUB GERMANIA GMBH,

Industriestrasse 7, Dogern D-7891. West Germany. Tel: +49-7751 2106. Telex: 792219. Fax: +49-33-42701. Manufacturers and distributors of submersible pumps, water pumps and vacuum pumps for a variety of applications.

**JLC PUMPS & ENGINEERING CO
LTD,**

Oxgate Farm Works, Coles Green Rd, London NW2 7EX. UK. Tel: +44-81-452 4081. Telex: 82317. All types of pumps for all purposes.

JOBSON BECKWITH LTD,

Treadway House, 26-30 Cubitt St, London WC1X 0LR. UK. Tel: +44-71-833 0395. Telex: 940-96319. Fax: +44-71-837 5673. Jobson Beckwith manufacture/distribute a range of positive displacement pumps for handling viscous liquids. Centrifugal, hand and flexible impeller pumps are also available, as is installation, servicing and pumping systems.

**THE KSB MANUFACTURING CO
LTD,**

Duke House, 6-12 Tabard St, London SE1 4JT. UK. Tel: +44-71-403 1789. Telex: 8952557. Fax: +44-71-403 2101. Centrifugal pumps for all applications across the spectrum. Also manufacture valves.

**LABOUR PUMP CO LTD (ALCORN
DIVISION),**

Denington Estate, Wellingborough, Northants NN8 2QL. UK. Tel: +44-933 225080. Telex: 31428. Fax: +44-933 440032. The 'Alcon' pump range comprises self-priming centrifugal, end suction and diaphragm pumps. Supplied

mainly to the agricultural, horticultural, building contracting and civil engineering industries. Outputs range up to 4000 lit/min and heads to 55m.

GEORGE LANCASTER LTD,

501 Ipswich Rd, Slough Trading Estate, Slough, Berks SL1 4EP. UK. Tel: +44-753 692527. Telex: 846395 REMEX G. Fax: +44-753 73235. Manufacturers of float switches. Suppliers of pumps and pump equipment.

LITTLE GIANT PUMP CO,

3810 No Tulsa St, Oklahoma City, OK 73112. USA. Tel: +1405-947 2511. Fax: +1405-942 2285. Manufacturer of fractional HP centrifugal pumps, submersible and non-submersible. Used in water and corrosive chemicals. Specialty pumps also for effluent and sewage.

GEORGE MELLER LTD,

Orion Park, Northfield Avenue London W13 9SJ. UK. Tel: +44-81-579 2111. Telex: 27800/919153. Fax: +44-81-579 7326. George Meller Ltd is a supplier of equipment to the process industries. Specifically for the water industry we can supply flowmeters, valves and pumps.

METRIX ENGINEERING,

Blagdon St, Sheffield S2 5QS. UK. Tel: +44-742 767921. Telex: 547621. Manufacturers of a range of centrifugal and heavy-duty diaphragm pumps and associated equipment for the water and sewage industry.

FRANK W MURPHY LTD,

22 Blackmoor Rd, Verwood, Dorset BH21 6AY. UK. Tel: +44-202 827223. Telex: 418388. Fax: +44-202 827890. Designers and manufacturers of reliable and simple diagnostic instrumentation and control systems for pumps; over 50 years' experience in providing reliable and simple control systems.

F E MYERS CO,

400 Orange St, Ashland, Ohio 44805-2285. USA. Tel: +1419-289 1144. Telex: 987443. Fax: +1419-289 6658. Manufacturers of a complete range of pumps for all aspects of the water industry.

MYSON PUMPS & MOTORS LTD,

Pellen Lane, Halifax, West Yorks HX1 5QL. UK. Tel: +44-422 60201. Telex: 51101 WRIGHT G. Fax: +44-422 51892. In-line and centrifugal pumps for pumping of water and similar fluids, sizes up to 200mm-75kW. Also a range

PUMPS - CENTRIFUGAL, AXIAL FLOW & GENERAL

of twin pumps for the heating and ventilating industries.

NATIONAL ENGINEERING LABORATORY,

East Kilbride, Glasgow G75 0QU. UK. Tel: +44-3552 20222. Telex: 777888. Fax: +44-3552 36930. The National Engineering Laboratory (NEL) carries our research, testing and consultancy in the field of mechanical engineering including centrifugal, mixed-flow or axial pumps. NEL has facilities to test such pumps utilising dynamometers with power up to 260kw. Once particular facility is available which can test high-power pumps (up to 3mw) at flowrates up to 1.0m³/s and head of 4250m.

NEI - APELTD LEE-HOWL (A DIVISION OF BELLISS & MORCROM),

Icknield Square, Birmingham B16 0QL. UK. Tel: +44-21-454 3531. Telex: 337507. Fax: +44-21-455 8607. Pump range includes submersible turbine borehole pumps, mixed flow bowl pumps, split casing water pumps, drywell and submersible sewage and solids handling pumps. Capacities 10l/s to 350l/s.

NEW HADEN PUMPS LTD,

New Haden Works, Cheace, Stoke-on-Trent, Staffs ST10 2NW. UK. Tel: +44-538 752351. Telex: 36142. Fax: +44-538 756569. New Haden Pumps are leaders in the manufacture of systems for water supply, irrigation, sewage handling effluent treatment and sludge pumping. A complete service is available for any of the above.

NIJHUIS PUMPS,

PO Box 102, Parallelweg, De Winterwyh 47102. The Netherlands. Tel: +31-5430 16561. Telex: 44185. Involved in international business. Irrigation, water and sewage treatment, bio-protection and booster stations. Also produce surgical turbine pumps, mixed flow pumps, induction pumps, horizontal split case pumps.

NUOVO PIGNONE,

Via Tiburtina Km, Rome 12730. Italy. Tel: +06-40993-1. Fax: +06-4091239. Supervisory and remote control systems for water distribution, water treatment, wastewater treatment and water quality.

NUOVO PIGNONE,

Via E Matteucci, 2, 50100 Firenze. Italy. Tel: +47-055 43921. Telex: 571320. Fax: +47-055 4392880.

Nuovo Pignone SpA, - 2 Via F. Matteucci, 2 Florence, Italy. Tel: 39-55-43921. Fax: 39-55-417651. Telex: 571320. Centrifugal pumps, Ball valves and valve actuators.

OCHSNER GESELLSCHAFT M B H & CO,

PO BOX 60, Oberfeldstrasse 8, Linz A-4024. Austria. Tel: +43-732-41-3-58. Telex: 02-1439 OCHSNR A. For over 100 years Ochsner have produced pumps and compressors for the chemical, petrochemical and refining industries and for use in irrigation plants. The line-up includes water and waste water pumps (also pumps for the heavy industry) displaying the following characteristics: delivery up to 8,000m³/H, lift up to 700M, DRIVE CAPACITY UP TO 1,500KW. MATERIALS USED ARE ALLOYED AND UNALLOYED METALS DEPENDING ON OPERATING CONDITIONS. ROTARY COMPRESSORS FOR CHARGING BIOGAS MOTORS AND WATER COMPRESSORS AS BIOGAS COMPRESSORS FOR GAS LANCES FOR SLUDGE ACTIVATION ARE ALSO TURNED OUT.

OSMONICS INC,

5951 Clearwater Drive, Minnetonka, MN 55343. USA. Tel: +1-612-933 2277. Telex: 029-0847. Fax: +1-612-933 0141. Osmonics manufactures TONKAFLO® multi-stage centrifugal and American air operated diaphragm pumps. TONKAFLO pumps deliver 2-300 gpm at 50-600 psig with one pump and up to 100 psig with two pumps in series. materials of construction are stainless steel and Noryl. American pumps offer capacities from 0 to 120 gpm. Made of pure Teflon; PTFE or Virgin Polypropylene with no metal to liquid contact.

PEACOCK INC,

PO Box 1040, Station 'A', Montreal, Quebec H3C 2X5. Canada. Tel: +1-514-366 5900. Fax: +1-514-366 9804. Market a range of speciality pumps including "Seepex" progressive cavity positive displacement pumps, "Desmi" centrifugal pumps, "Leistritz" positive displacement rotary screw pumps, "Emerick" piston diaphragm pumps and the full range of Weir centrifugal pumps.

PEGSON LTD,

Mammoth St, Coalville, Leics LE6 3ES. UK. Tel: +44-530 510051. Telex: 34423. Fax: +44-530 510041. Self-priming and centrifugal pumps incorporating defusion pipe priming principle, suitable for suction lifts up to 7.5m. Branch sizes range from 50mm to 100mm. Applications include marine, agricultural, contractors, industrial uses and aircraft refuelling.

POMPE PORCELLI ELVIO & FIGLI SNC,
 S S 148 KM 82,500, B GO S Donato, Sabaudia (LT)
 04010. Italy. Tel: +39-773 50392-3. Fax: +39-773
 50393. Range of pumps from deep well vertical and hori-
 zontal pumps, electric submersible, centrifugal and trolleyed
 pumps.

PROTEK SPECIALTY CO,
 PO Box 446, Bellaire, TX 77401. USA. Tel: +1-713-667
 6691. Fax: +1-713-667 7867. Diaphragm pumps and
 primers for centrifugal pumps.

PSL INTERNATIONAL LTD,
 PO Box 4, Humber Rd, Barton-on-Humber, South
 Humberside DN18 5BN. UK. Tel: +44-652 32702. Telex:
 527305. Fax: +44-652 3340. Rotating equipment engi-
 neers - pumps, turbines and compressors, particularly for the
 water industry. Repairs to submersible pumps.

**PUMP TECHNICAL SERVICES
 LTD,**
 Beco Works Kent House Lane, Beckenham, Kent BR3 1LA.
 UK. Tel: +441-778 4271. Fax: +441-659 3576. Pump
 Technical Services are currently enjoying their sixtieth year in
 the pumping industry. The association with Jung Pumpen of
 West Germany has proved very successful. Broadwall Jung
 having become synonymous with sewage and surface water
 pumping, for civil and water authorities. Special packaged
 sets, drainers, macerators and corrosion resistant pumps.

**PUMPENFABRIK ERNST VOGEL
 GESELLSCHAFT MBH,**
 PO Box 42, Stockerau A-2000. Austria. Tel: +43-2266-25-
 61. Telex: 135679 ERVO A. Vogel pressure boosting plants
 are automatically controlled pumping stations and are used
 for supplying single houses, high-rise buildings, villages and
 whole settlements. They incorporate all the components nec-
 essary for fully automatic operation such as pumps, air
 receiver with compressor or membrane type tank, fittings,
 pressure gauge and electric switchboxes.

PUMPING SERVICE (GB) LTD,
 Whitehouse St, Jack Lane, Hunslet, Leeds LS10 1AD. UK.
 Tel: +44-532 446111. Telex: 557445. Fax: +44-532
 465649. Distributors for most of the leading British
 pump manufacturers. Around 2,000 pumps of
 various sizes and types in stock at any time, covering
 all applications.

RED JACKET MFG CO,
 Box 3888, Davenport, IA 52808. USA. Tel: +1-319-391
 8600. Manufacture water systems pumps.

RITZ PUMPENFABRIK,
 PO Box 1780, Schwaebisch, Gmuend D707. West
 Germany. Tel: +49-7171 6091. Telex: 7248806. Fax:
 +49-7171 609287. Manufacture pumps for water of any
 consistency sizes up to one cubic meter p/s at depths up to
 1000m.

SCANPUMP AB,
 PO Box 2053, Holmdal South 43102. Sweden. Tel: +46-
 3183 6300. Telex: 20626. Fax: +46-3118 4906.
 Supplier of all kinds of centrifugal pumps, including sub-
 mersible. Capacities up to 18,000 m³/hr.

SELWOOD PUMPS,
 Bournemouth Rd, Chandler's Ford, Eastleigh, Hants SO5 3ZL.
 UK. Tel: +44-703 266311. Telex: 477481. Fax: +44-703
 260906. Selwood Pumps design and manufacture a range
 of 2ins-6ins pumps suitable for handling a variety of fluids
 from clean water to solids in suspension. Models include the
 Selwood Simplex Spate, Selflow and Seltorque.

SIHI PUMPS (UK) LTD,
 Bridgewater Rd, Broadheath, Altrincham, Cheshire UK. Tel:
 +44-61-928 6371. Telex: 667013. Fax: +44-61-928
 3022. Extensive range of centrifugal pumps, single and
 multi-stage, which can be used for potable water or in the
 treatment of waste water.

SIHI - HALBERG,
 Halbergstr 1, Ludwigshafen/Rh 1, 6700. West Germany.
 Tel: +49-621 56120. Telex: 4-64-833 HALU D. Fax: +49-
 621 5612209. Pumping stations, pumps irrigation, water
 supply pumps and water work pumps.

A O SMITH,
 531 North 4th St, Tipp City, Ohio 45371. USA. Tel: +1-
 513-667 2431. Telex: 288097. Fax: +1-513-667 2339.
 Manufacturers and suppliers of electric motors for domestic
 water systems and swimming pools, and of centrifugal
 pumps.

SPP PUMPS LTD,
 Theale Cross, Reading RG3 7SP. UK. Tel: +44-734
 323123. Telex: 848189. Fax: +44-734 323302.
 Manufacturers of centrifugal pumps and pump packages for

PUMPS - CENTRIFUGAL, AXIAL FLOW & GENERAL

water, sewerage and fire protection industries.

THE STERLING PUMP CO LTD,

Water Lane, Spalding, Lincs PE11 2TH. UK. Tel: +44-775 2404. Fax: +44-775 710501. Suppliers of pumps - engine driven, electrically driven, PTO driven for all types of liquids, slurries, effluents etc. All pumping accessories including hosepits, fittings and piping.

SULZER BROTHERS LTD,

CH-8401 Winterthur, Switzerland. Tel: +41-52-81-11-22. Telex: 896060. Fax: +41-52-23-42-83. Sulzer water treatment and wastewater purification plants meet the special requirements associated with all kinds of municipal and industrial applications. In addition, pumps are supplied for communal and industrial water supply and irrigation installations. Furthermore, pumps, clarifiers and fluid-bed driers required for the treatment of waste waters and sewage sludges.

SYKES PUMPS LTD,

Gallions Rd, Charlton, London SE7 7AP. UK. Tel: +44-81-858 8121. Telex: 896324. Fax: +44-81-853 4786. Sykes Pumps are specialists in the provision of self-priming diesel and electro submersible pumps for ground water, slurry, sludge and storm water control. From 33 depots nationwide, Sykes provide a first class hire, sales and maintenance service.

THOMPSONS KELLY & LEWIS LTD,

PO Box 160, Springvale, Victoria 3171. Australia. Tel: +61-3-562 0744. Fax: +61-3-562 0885. Thompsons, Kelly & Lewis is Australia's leading manufacturer and supplier of a complete range of centrifugal and positive displacement pumps for use throughout the water industry from rural, ground water to industrial and sewerage.

TONKAFLOW PUMP - DIV OSMOSIS,

595 i Clearwater Drive, Minnetonka, MN 55343. USA. Tel: +1-612-933 2277. Manufactures medium and high pressure multi-stage centrifugal pumps constructed of 316 stainless and durable noryl.

TORRENT PUMP INDUSTRIES,

PO Box 51066, Kifissia GR-145 10. Greece. Tel: +30-1-81617128161702. Telex: 215870. Fax: +30-1-8161018. 'Torrent' mixed and axial flow vertical pumps, centrifugal surface pumps and accessories.

TOTTON PUMPS LTD,

Southampton Rd, Cadman, Southampton, SO4 2MS. UK. Tel: +44-703 813136. Fax: +44-703 813650. Manufacturers of magnetically coupled centrifugal pumps, diaphragm pumps, submersible column pumps and small electric motors to 80 watt output.

STUART TURNER LTD,

Market Place, Henley on Thames, Oxon RG9 2AD. UK. Tel: +44-491 572655. Telex: 847093. Fax: +44-491 573704. Stuart Turner Ltd manufacture a range of centrifugal and regenerative pumps up to 4 hp with flow rates up to 6000 gph. Also supplied are submersible pumps suitable for up to 2000 gph.

ULTRA POMPES SA,

47 BD Georges Clemenceau, Courbevoie 92400. France. Tel: +33-16-1-43-33-53-90. Telex: POMPSYK 611432 F. Centrifugal self priming pumps from 18 to 200 M³/H; submersible drainage pumps from 11.5 to 50M³/H; diaphragm pumps.

UNION PUMP CO,

4600 West Dickman Rd, Battle Creek, MI 49015. USA. Tel: +1-616-966 4600. Supplier of pumps for both brackish and saltwater RO applications.

VANDEZANDE,

Esenweg 142, Diksmuide 8160. Belgium. Tel: +32-51-50-01-17. Telex: 81649. Fax: +32-51-504-117. Manufacturers of screw pumps for sewage and effluent. Also for land drainage.

VARISCO POMPE PA,

Zona Industriale Nord, Terza Strada 9, Padova 35129. Italy. Tel: +39-49-773944. Fax: +39-49-772168. Manufacturer of self-priming centrifugal pumps for water containing solids in suspension. Capacities up to 1500m³/h, heads up to 100m. Applications in sewage by-pass, water and effluent treatment, surface irrigation, fertirrigation and groundwater dewatering.

J M VOITH AG,

PO BOX 168, St Pöulten A-3100. Austria. Tel: +43-27-42-25-01. Telex: 015510. For decades J M Voith have turned out pumps for irrigation, drainage and drinking water supply purposes and cooling water pumps for nuclear and thermal power plants.

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J M VOITH GMBH,

PO Box 1940, St Poltner Strasse 43, Heidenheim D-7920. West Germany. Tel: +49-7321 370. Telex: 714-79920. Fax: +49-7321 373000. Storage pumps, radial pumps, mixed flow pumps and axial flow pumps.

VOPO POMPEN- & MACHINEFABRIEK BV,

De Volger 2, De Rijp, NL 1483 GA. The Netherlands. Tel: +31-2997 1312. Fax: +31-2997 3358. Surface water pumps, built for continuous operation, maintenance free. Large capacity for low heads. Widely used for drainage and irrigation jobs. Capacity 40-1000 M12 /hour.

WAN-DEL CO INC,

1204 Chestnut Avenue, Minneapolis, MN 55403. USA. Tel: +1-612-332 5681. Manufacturer of pumps.

WARREN KENYA LTD,

PO Box 3015, Nairobi. Tel: +254-2-802353/335671. Manufacturers of sectional pressed steel bolted tanks conforming to BS1564 Pt II available galraised or painted with various options of linings, also tanks for chemical & sewage storage. Stockists of mono industrial pumps handling sewage and corrosive materials, also Rorath centrifugal water pumps for all applications. Warren Kenya undertake turnkey projects in water, sewage and irrigation.

WARSOP POWER TOOLS,

Hever Rd, Edenbridge, Kent TN8 5DL. UK. Tel: +44732 863081. Telex: 95155. Fax: +44732 865680. Warsop manufacture and market a range of pumps, which comprise self priming centrifugals, submersibles, diaphragm and flexible shaft driven types. Suitable for clean water or water containing up to 40 per cent solids in suspension.

WEIR PUMPS LTD,

Newlands Rd, Cathcart, Glasgow G44 4EX. UK. Tel: +44-41-637 7141. Telex: 77161. For water supply and sewage treatment: abstraction pumps; borehole pumps (shaft driven and submersible); pipeline and other distribution pumps; water treatment system pumps; sewage pumps; submersible sewage and land drainage pumps; complete pumping systems and controls; contract management; surge assessment of pumping systems, including the supply and setting to work of the necessary equipment; comprehensive facilities for model testing of pump sumps and complete intake systems.

WORTHINGTON SIMPSON,

PO Box 17, Lowfield Works, Newark, Notts NG24 3EN. UK. Tel: +44-636 705151. Telex: 37451. Fax: +44-636 705991. UK's largest suppliers of standard industrial pumps. A division of Dresser (UK)Ltd.

PUMPS - POSITIVE DISPLACEMENT & OTHER SPECIAL PUMPS

ACROMET (AUST) PTY LTD,

14 Winterton Rd, Clayton, Victoria 3168. Australia. Tel: +61-3-544 7333. Fax: +61-3-543 6706. Acromet is an Australian manufacturer of chemical metering pumps and dry chemical feeders and a distributor of gas chlorination equipment and chemical pumps, both diaphragm and centrifugal, in plastic and special alloy construction. Acromet pumps and feeders are widely used throughout Australasia and South East Asia in water and wastewater treatment plants, and have an even wider range of applications in industry. Distributorships are available in many parts of the world.

ALBANY ENGINEERING CO LTD (INCORPORATING CROWN PUMPS),

Church Rd, Lidney, Glos GL5 5EQ. UK. Tel: +44-594 42275. Telex: 43363. Fax: +44-594 42574. Albany Engineering manufacture a range of diaphragm type metering pumps, centrifugal and rotary pumps, for a variety of applications in the water industry.

AQUA HYDRAULIUCS LTD,

Star Trading Estate, Partridge Green, West Sussex RH13 8RA. UK. Tel: +44-403 710855. Telex: 87508. Fax: +44-403 710067. Manufacturers of high pressure water pumps-pressures of up to 1000 bars, volumes up to 450 litres per minute. Suppliers of pumps in bare shaft form or made up into a variety of skids and trailer units.

AQUATECH LTD,

St Johns Rd, Wivenhoe, Colchester, Essex CO7 9DR. UK. Tel: +44-206 223232/224242. Fax: +44-206 226262. Manufacturers of specialist pumping equipment including micro-processor and electronic liquid level controls. 'ET' series packaged water pressure booster set with capacities up to 120m³ are compatible with BMS systems.

ARMSTRONG MACHINE CO,

302 North West 13th, Pocahontas, Pocahontas IL 50574.

PUMPS - POSITIVE DISPLACEMENT & OTHER SPECIAL PUMPS

USA. Tel: +1-712-335 4131. Suppliers of mud pumps, both new and used. Also a manufacturer of spare parts and repairs undertaken will even make new spares for pumps, no longer available.

AUTOMETRIC PUMPS LTD,

Turkey Court, Ashford Rd, Maidstone, Kent. UK. Tel: +44-622 677650. Telex: 965-633. Producers of small pumps and sizes 2ins BSP. The range includes centrifugal, gear, turbine, hand and vacuum pumps. We also handle a large range of pumps of other manufacture.

B-RAM SOLIDS,

620 South Broadway, Albert Lea, MN 56007. USA. Tel: +1-507-373 3996. Fax: +1-507-373 5937. Manufacturers of pumps for the transfer of difficult materials - from sludge or slurry to whole bones.

BERESFORD PUMPS,

Burnsall Rd, Canley, Coventry, West Midlands CV5 6BN. UK. Tel: +44-203 78412. Telex: 317298. Manufacturers of centrifugal self-priming pumps in cast iron, bronze or stainless steel, sump and cellar drainage pumps. Also water and chemical pumps of polypropylene construction.

BEVI WRIGHT LTD,

Pellon Lane, Halifax, West Yorks HX1 5QL. UK. Tel: +44-422 60201. Telex: 51101. Fax: +44-422 51092. Pumps for circulation of hot or chilled water, pressure boosting etc. Sizes from 1in. to 8ins. Power output from 0.1 to 40kw. Both single and twin pumps available. Also available in bronze construction.

BIWATER PUMPS LTD,

Millers Rd, Warwick CV34 5AN. UK. Tel: +44-926 411740. Telex: 317473. Fax: +44-926 410740. Manufacturers of electro-submersible and conventional dry-well solids handling pumps, manufacturer of electrical control panels, and multi motor control centres. Contractor supplying above from design through to installation, commissioning of complete sewage pump station installations.

JOHN BLAKE LTD,

PO Box 43, Royal Works, Accrington, Lancs BB5 5LP. UK. Tel: +44-254 354419. Fax: +44-254 382899. Manufacturers of the well known Lake Hydrain self acting water pump requiring no power other than running water.

BLUE WHITE INDUSTRIES,

14931 Chestnut St, Westminster, CA 92683. USA. Tel: +1-

714-893 8529. Manufactures Chem-feed® Diaphragm type metering pumps, Flexilo peristaltic metering pumps, and Scamp® Submersible metering pumps, as well as a full line of hand machined and injection molded flowmeters.

E BRAUDE (LONDON) LTD,

Liberta House, Sandhurst, Surrey GU17 8JR. UK. Tel: +44-252 876123. Telex: 858842. Braude corrosion resistant high performance low cost self priming chemical pumps handle water treatment solutions. Levelmaster provides reliable and accurate level control of chemical solutions and water including de-ionised water.

BURTS PUMPS INC,

PO Box 431F9Decatur, IL 62525. USA. Tel: +1-217-429 2591. Manufacture jet pumps, submersible pumps for water industry.

CAT PUMPS CORPORATION,

1681 94th Lane North East, Minneapolis, MN 55434. USA. Tel: +1-612-780 5440. Telex: 290276. Fax: +1-612-780 2958. Manufacture high pressure, triplex piston and plunger pumps, motorized pump units, corrosion resistant and 316 stainless steel pumps and complete line of complementary systems accessories are available through international network of sales and service reps.

CAT PUMPS CORPORATION,

1681 94th Lane North East, Minneapolis, MN 55434. USA. Tel: +1-612-780 5440. Telex: 290276. Fax: +1-612-780 2958. Manufacture high pressure, triplex piston and plunger pumps, motorized pump units, corrosion resistant and 316 stainless steel pumps and complete line of complementary system accessories are available through international network of sales and service reps.

CHEM-TECH INTERNATIONAL INC,

PO Box 1476, 92 Boat St, Lowell, MA 01853. USA. Tel: +1-617-453 4020. A leading US manufacturer of positive displacement diaphragm and piston pumps. CTI's line consists of over 120 models to address light-duty residential applications, along with demanding industrial requirements.

CHIMMASHEXPORT,

25 Bezbozhny Per, Moscow 129869. USSR. Tel: +7-288-36-90. Telex: 411032. Soviet Foreign Trade Association Chimmashexport was established in 1987 as the sole supplier of machinery and equipment for the chemical and

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petrochemical industry. Exports plant and equipment, oil, petrochemical, pulp and paper industries, cryogenic plant, air and gas compressors, pumps, industrial valves and fittings.

CLEGHORN WARING & CO (PUMPS) LTD,

9-15 Hitchin St, Baldock, Herts SG7 6AH. UK. Tel: +44-462 893838. Telex: 826832. Fax: +44-462 894719. Specialist distribution of centrifugal and positive displacement pumps, including self priming types, for low pressure water transfer.

COLTFIELD ENGINEERING LTD,

Bookers Way, Todwick Rd Industrial Estate, Dinnington, Sheffield. UK. Tel: +44-909 568861. Telex: 54533. Fax: +44-909 569423. Manufacturers of pumps (compressed air & electric high pressure slurry).

COMMERCIAL HYDRAULICS LIVERPOOL LTD,

Long Lane, Fazakerley, Liverpool L9 7BW. UK. Tel: +44-51-525 5933. Telex: 629561. Fax: +44-51-523 4198. Design and manufacture hydraulic axial piston pump and motors, applicable to a wide range of industries.

COMPRESSION SYSTEMS HOLLAND BV,

PO Box 65, Nieuwkoop, AB 2420. The Netherlands. Tel: +31-1725 9218. Telex: 39528. Fax: +31-1725 3695. Manufacturers of sludge pumps (duplex and triplex) to customer specifications, steel and cast-iron piping with coatings suited to customers' requirements. Manufacturers of pipe coating machinery.

CREST PUMPS LTD,

Uddens Trading Estate, Wimborne, Dorset BH12 7NH. UK. Tel: +44-202 874411. Telex: 41195. Fax: +44-202 861080. Manufacture chemical pumps for corrosion resistant duties within the water industry.

CWG GMBH,

Hasenacker Str 19-25, 6800 Mannheim-1. West Germany. Tel: +49-0621 817015. Fax: +49-0621 818990. Wholesalers for the following products for water treatment. Chemicals for wastewater treatment; Industrial wastewater treatment; Special purpose pumps, pipes and other equipment; Pumps - positive displacement and other special pumps; Analysers, electrodes and meters; Control equipment;

Dosing systems and equipment; Meters - flow measurement and Cooling towers and equipment.

W S DARLEY & CO,

2000 Anson Drive, Melrose Park, IL 60160. USA. Tel: +1-312-345 8050. Fax: +1-312-345 8993. Manufacture a complete line of portable pumps, flow testing equipment, leak locators, dipping needles, pilots and offer a complete municipal supplies catalogue.

DAWSON DOWNIE LAMONT LTD,

Elgin Works, North Elgin St, Clydebank, Strathclyde G81 1YF. UK. Tel: +44-41-952 2271. Telex: 777857. Fax: +44-41-952 9088. Dawson Downie Lamont Ltd have been manufacturing reciprocating pumps since 1905. These pumps are in use in countries throughout the world for water, sewage, oil, petrochemical, soap pastes and other uses.

DEPLECHIN POMPES SA,

Ave de Maire 28, Tournai B-7500. Belgium. Tel: +32-69-228152. Telex: 57399. Fax: +32-69-212764. Hand-operated pumps for deep wells also export industrial pumps. Specialise in special pumps and accessories in small quantities to clients requirements. Also pumps for all kinds of industry-chemicals, food etc.

DIA-METER PUMPS LTD,

Unit 22, Bridge Industries, Broadcut, Fareham, Hants PO16 8SX. UK. Tel: +44-329 233542. Telex: 86736 SOTEX G DIA-METER. Manufactures of diaphragm additive pumps for water treatment.

DIAS INC,

PO Box 3188, Kalamazoo, MI 49003. USA. Tel: +1-616-344 1008. Manufactures pumps and pump timer combinations that are used with water treatment chemicals to treat many residential, industrial and commercial applications.

ENVIROCLEAN SYSTEMS LTD,

South Tyne Works, Halwistite, Northumberland NE49 9DE. UK. Tel: +44-498 20556. Telex: 859215. Fax: +44-498 21480. Enviroclean Systems manufacture and distribute an extensive range of high pressure pumping rigs for many duties including: central cleaning systems, high pressure shower dust suppression, reverse osmosis etc.

FLATWATER FLEET INC,

4835 Caribou Lake Rd, Saginaw, Minnesota 55779.

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USA. Tel: +1-218-729 8721. Fax: +1-218-729 7644.
The RTT-Rig Tender Truck has a large selection of self-priming, positive displacement pumps in many capacities and discharge head pressures. This four-trucks-in-one vehicle can pump water, fuel, cement, grout, bentonite grout, drilling fluids, grey water, and slurries. It also carries up to 12,000 litres of water, 2400 litres of fuel, and 10 tons of cargo.

FLUXINOS ITALIA SRL,
Via Genova 8, 58100. Italy. Tel: +39-564451272. Telex: 322458 IKRANE I. Fax: +39-564454237. Pulsa System water oscillation or spring rebound inertia deep well solar and/or hand pumps for rural water supply, microirrigation and animal watering in developing countries. They work exploiting the characteristics of oscillating water columns and represents of the world's most advanced pumping technologies. All completely eliminated to render the Pulsa pumps post-VLOM and post-plastic. Entirely in stainless steel and rust and abrasion resistant, with one single length of flexible polyethylene feed pipe. Vertical and/or horizontal operation. Single level systematic preventive maintenance with itinerant artisan able to handle on his own up to 500 installations. Global long term (10 year cycle) cost 0.405 US\$ per person per year, with cost per cubic meter of water pumped US\$ 0.0385. All parts including those subject to wear and tear guaranteed against breakdown for 12 months irrespective of the intensity of use. Highly competitive from an economic point of view even for small villages. Hydraulic limit of installation: 25 litres/minute.

FMC CORP,
5601 East Highland, Jonesboro, AR 72401. USA. Tel: +1-501-935 1970. Plunger, piston pump manufacturer since 1884 with many innovations, patents in use. Manufactures complete line from 5 to 225 gpm with pressures to 5000 psi.

FORDWATER PUMPING SUPPLIES LTD,
49-53 Stratford Rd, Birmingham, West Midlands B11 1RQ. UK. Tel: +44-21-772 8336. Telex: 335807. Supply and maintain all types of pumps.

GARBARINO SPA,
Via St Lazzaro 3, Acqui Terme, AL 15011. Italy. Tel: +39-144 58671. Telex: 212158. Fax: +39-144 55260. Garbarino are manufacturers of centrifugal, self-priming, gear and rotary pumps (constructed to NATO and Italian

Military standards) which are supplied worldwide to the naval, industrial and chemical sectors.

GENERAL PUMP - US,
3380 Highway 149, Eagan, MN 55121. USA. Tel: +1-612-454 6500. One of the world's largest manufacturers of triplex plunger pumps with 73 models - all ceramic plungers, stainless steel valves forged bronze, stainless steel, aluminum, bronze heads. Flow rates from one to 43 gpm and pressures 100 to 6000 psi. Close-coupled motor/pump assemblies and a complete line of high quality accessories to match all pumps.

GIANT PRODUCTS CO,
900 North Westwood Avenue, Toledo, OH 43607. USA. Tel: +1-419-531 4600. Has one of the widest selection of accessories and high pressure triplex piston/plunger pumps, including direct drive models. Equipment is built to give years of maintenance-free performance.

GIRDLESTONE PUMPS LTD,
Melton, Woodbridge, Suffolk IP12 1ER. UK. Tel: +44-3943 3777. Telex: 98461. Fax: +44-3943 6733. Girdlestone specialise in the design and manufacture of pumps and pumping equipment for the chemical, oil and gas, marine and brewing industries.

GRAHAM PRECISION PUMPS LTD,
The Forge, Congleton, Cheshire CW12 4HQ. UK. Tel: +44-260 274721. Telex: 667383. Fax: +44-260 276965. Specialist manufacturers of liquid ring and rotary vane vacuum pumpsets and ejectors, centrifugal pumps, twin pumps, inline, horizontal and vertical multi-stage pumps, self priming, gear and rotary vane pumps.

HARBEN SYSTEMS LTD,
Churchfields, Salisbury SP2 7UD. UK. Tel: +44-722 25424. Fax: +44-722 411329. Manufacturers of a range of unique radial piston high pressure water pumps producing pressures up to 700 bar. Applications include: water main descaling, drain/sewer cleaning, tube/pipe descaling, general descaling and floor cleaning.

HARRINGTON INDUSTRIAL PLASTICS,
14480 Yorba, Chino, CA 91710. USA. Tel: +1-714-597 8641. Specialises in ultrapure and corrosion resistant plastic liquid handling. Pipe fittings, valves, pumps, tanks, filters and instrumentation.

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HIGH DUTY PLASTICS LTD,

94 Tallyho St, Rotorua, New Zealand. Tel: 64-73-482215. Fax: +64-73-462880. Manufacture and export chemical pumps to Indonesia and the Pacific islands. The pumps have a robust construction, they are efficient, readily overhauled and competitively priced. Full range of spare parts available.

HOMA PUMPENFABRIK GMBH,

PO Box 2020, Industriestrasse 1, N-Seelscheid 2, D-5206. West Germany. Tel: +49-22-47/7020. Telex: 889-448. A wide range of small surface water and cellar drainage pumps from 0.2 to 1.1 kW power input, fountain and self-priming garden pumps, bigger surface water and contractors' pumps up to 10kW.

THE HOTSY CORP,

21 Inverness Way East, Englewood, CO 80112. USA. Manufactures 15 models of corrosion resistant pumps for use in reverse osmosis systems. One: 5gpm, up to 3000psi. Pumps available in pulley belt or direct drive configurations.

HYDROFLO CORPORATION,

Plumsteadville, PA, 18949. USA. Tel: +1-215-766 7867. Fax: +1-215-766 8290. Chemical injection pumps for irrigation systems. Also used in water and waste treatment systems.

HYDRO CORPORATION,

375TH Fifth Avenue NW, New Brighton, MN 55112. USA. Tel: +1-612-633 9300. Telex: 4310109. Fax: +1-612-633 6864. Manufacturer of pumps and fluid handling accessories for high pressure cleaning, spraying and general liquid transfer. Roller pumps, centrifugal pumps and diaphragm pumps in a range of sizes.

JLC PUMPS & ENGINEERING CO LTD,

Oxgate Farm Works, Coles Green Rd, London NW2 7EX. UK. Tel: +44-81-452 4081. Telex: 82317. All types of pumps for all purposes.

JOBSON BECKWITH LTD,

Treadway House, 26-30 Cubitt St, London WC1X 0LR. UK. Tel: +44-71-833 0395. Telex: 940-96319. Fax: +44-71-837 5673. Jobson Beckwith manufacture/distribute a range of positive displacement pumps for handling viscous liquids. Centrifugal, hand and flexible impeller pumps are also available, as is installation, servicing and pumping systems.

L-K INDUSTRIES INC,

PO Box 230305 Houston, TX 77223. USA. Tel: +1-713-926 2623. Telex: 66786. Fax: +1-713-926 7736. Manufacturer of valves, rods and liners for all types of power pumps for the water industry.

LABOUR PUMP CO LTD (ALCORN DIVISION),

Denington Estate, Wellingborough, Northants NN8 2QL. UK. Tel: +44-933 225080. Telex: 31428. Fax: +44-933 440032. The 'Alcorn' pump range comprises self-priming centrifugal, end suction and diaphragm pumps. Supplied mainly to the agricultural, horticultural, building contracting and civil engineering industries. Outputs range up to 4000 lit/min and heads to 55m.

LAWRENCE EDWARDS & CO (CO ENGINEERS) LTD,

Stourport Rd, Kidderminster, Worcs DY11 7QS. UK. Tel: +44-562 66233. Telex: 338373. Fax: +44-562 60231. Manufacture roller vane pumps - 10gpm to 40gpm, slurry pumps - 3500gph and diaphragm pumps from 50 litres per minute. All power take-off driven.

LIQUID DYNAMICS (MEMBRAN-FLEX LTD),

Hurstfield Industrial Estate, Hurst St, Reddish, Stockport: SK5 7BB. UK. Tel: +44-61-442 6222. Telex: 669236. Fax: +44-61-443 1486. "PIPEHUGGER" pulsation dampeners and suction stabilisers for positive displacement pumps, shock (water hammer) alleviators, hydropneumatic accumulators; sizes 0.04 to 4000 litres, pressures from 0-30,000 psi.

LIQUID METRONICS INC,

19 Craig Rd, Acton, MA 01720. USA. Tel: +1-617-263 9800. Manufactures metering pumps.

LITTLE GIANT PUMP CO,

3810 No Tulsa St, Oklahoma City, OK 73112. USA. Tel: +1-405-947 2511. Fax: +1-405-942 2285. Manufacturer of fractional HP centrifugal pumps, submersible and non-submersible. Used in water and corrosive chemicals. Specialty pumps also for effluent and sewage.

LUKO PUMPEN-MASCHINENFABRIK GESELLSCHAFT M B H,

Grillgasse 15, Wien A-1110. Austria. Tel: +44-222 741563-63. Telex: 13-16000 LUKO A. Luko Pumpen-Maschinenfabrik GesmbH turn out series-produced

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displacement, rotary and submersible pumps. Luko self-priming rotary pumps, model jonio, can be supplied ready fitted with electric motor or petrol or diesel engine. They are particularly suitable for conveying heavily contaminated, muddy and sandy waste water, even water of large-solid content. Luko normal-action pumps, Model N, are used for conveying highly contaminated water occurring in industry, agriculture and households.

THE MEC-O-MATIC CO,

5445 Williamsburg Drive, Punta Gorda, FL 33983. USA. Tel: +1-813-539 5235. Manufactures positive displacement chemical feed pumps. Undesirable water quality problems such as iron, pH and offensive hydrogen sulphide odours are addressed and can be corrected.

MEGATOR PUMPS & COMPRESSORS LTD,

Hendon, Sunderland, Tyne and Wear SR1 2NQ. UK. Tel: +44-91-567 5488. Fax: +44-91-567 8512. Manufacturers of pumps and pumping systems for cold water pressurising services, fire sets, water treatment, sump clearance, oil recovery, oil/water separators and filtration, pollution control equipment.

METRIX ENGINEERING,

Blagdon St, Sheffield S2 5QS. UK. Tel: +44-742 767921. Telex: 547621. Manufacturers of a range of centrifugal and heavy-duty diaphragm pumps and associated equipment for the water and sewage industry.

MILS,

17-25 Avenue Paul-Santy, Lyon, Cedex 8, F-69371. France. Tel: +33-78-74-85-71. Telex: 380913. Fax: +33-78-00-82-34. Manufacturers of vacuum pumps and compressors.

MILTON ROY CO,

201 Ivyland Rd, Ivyland, PA 18974. USA. Tel: +1-215-441 0800. Telex: 4761138. Fax: +1-215-441 8620. The coagulant control centre represents the best available technology for coagulant/flocculant dose monitoring and automatic control in treatment of raw surface waters, waste sludge dewatering and process water.

MILTON ROY CO HARTELL DIVISION,

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MOLEX PUMPS DIVISION,

Whale Tankers Ltd, Ravenshaw Lane, Solihull, West Midlands B91 2SU. UK. Tel: +44-21-704 3191. Telex: 336182. Fax: +44-21-705 3053. Provide screw type positive displacement sludge pumps for use independently on trailed chassis and on gravity filled or vacuum tankers for the handling of sewage, water and sludges.

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P & S WATER INDUSTRIES INC,

680 Waterloo St, London, Ontario N6A 4N8. Canada. Tel: +1-519-672 0330. Manufacture of domestic water pumps and wastewater treatment equipment for use in the home and business.

PATTERSON PUMP CO,

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Whitehouse St, Jack Lane, Hunslet, Leeds LS10 1AD. UK. Tel: +44-532 446111. Telex: 557445. Fax: +44-532 465649. Distributors for most of the leading British pump manufacturers. Around 2,000 pumps of various sizes and types in stock at any time, covering all applications.

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Manufacturer of solenoid metering pumps, peristaltic pumps and dosing systems for applications in: water conditioning, chlorination, swimming pools, water treatment plants, industrial purifications, evaporating towers, surface treatment, detergents, photographic developing, hydro cleaning, agriculture, droplet irrigation, catering, drinking water, heating systems, boilers, paper industries, oenology, aquaculture.

SERFILCO UK LTD,

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Siebec provides a complete range of filters for corrosive liquids up to 60 cubic metres per hour, supplied either with magnetic coupled pumps or with mechanical seal pumps. Also pumps with polypropylene or injected PVDF body.

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Engineers and distributors for specialised pumping equipment. Pumping systems and packaged dosing systems designed to customer requirements. Chlorination equipment and pumps.

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TOMLINSON, HALL & CO LTD,
Boathouse Lane, Stockton-on-Tees, Cleve and TS18 3AT. UK. Tel: +44-642 675696. Telex: 587382. Fax: +44-642 676569. Pump engineers whose main area of operation is re-exporting a fast priming pump/dewatering pump, "Helvac" which pumps any combination of air and liquids and some fine solids.

TORRENT PUMP INDUSTRIES,
PO Box 51066, Kifissia GR-145 10. Greece. Tel: +30-1-81617128; 61702. Telex: 215870. Fax: +30-1-8161018. Special purpose pumps and accessories.

ULTRA POMPES SA,
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VANTON PUMPS LTD,
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wells. Installation and maintenance of borehole pumps control gears.

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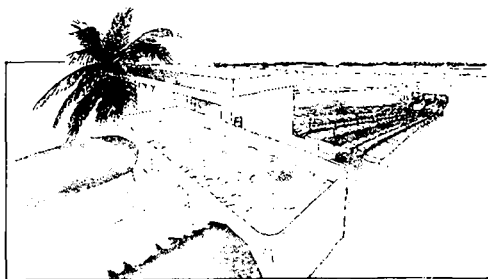


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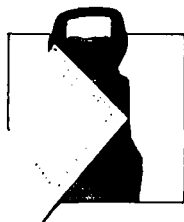
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SCANPUMP AB,

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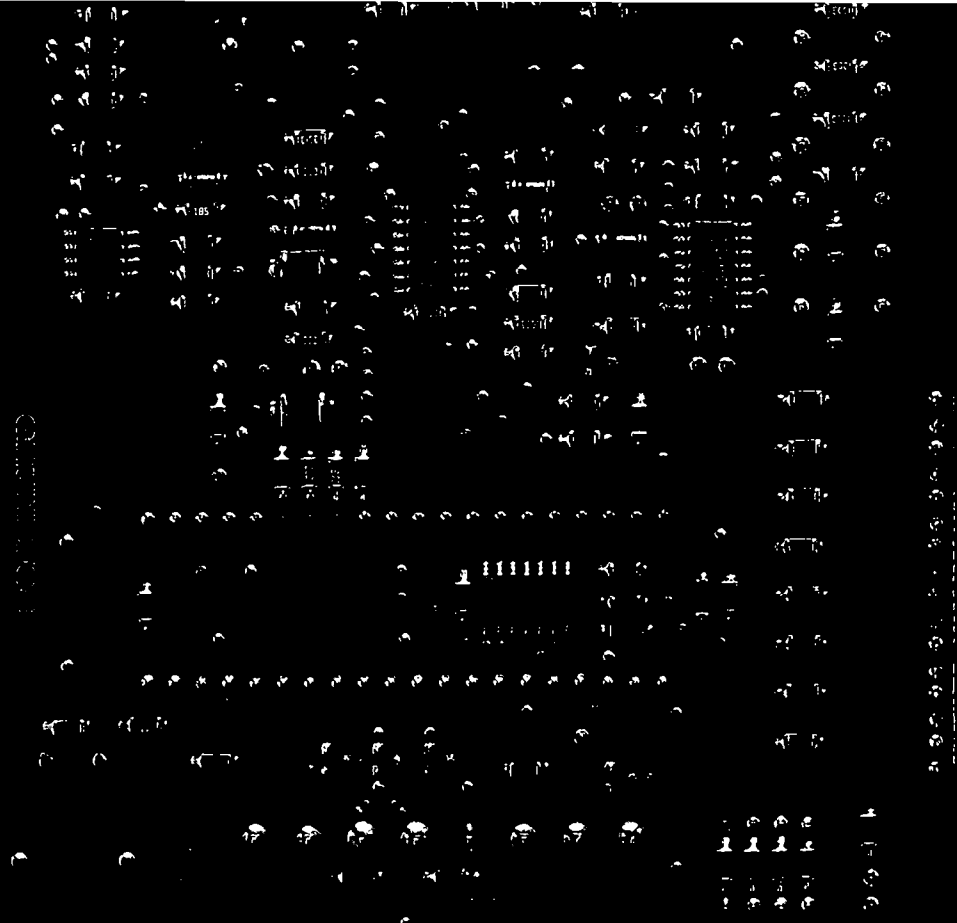
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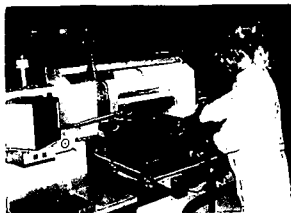
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OPERATION AND PROTECTION OF SUBMERSIBLE PUMPS

Peter Busch, Grundfos International A/S

The increasing availability of municipal electric power has made it possible for more communities to install deep-well electric submersible pumps for the water supply.

Modern electric submersibles are almost maintenance-free compared to earlier types of mechanically driven pumps. Most of the problems that occur with electric submersibles are related to the power supply. This article deals with these problems and describes how to get round them, or to protect the pump against them.

Inside the above ground electrical connection box or starter box all the equipment to start and protect a submersible pump is installed. Like most electrical equipment the individual components inside the box should be protected from heat. For example, never install a starter box in direct sunlight, as the temperature in certain areas gets very high during the day. If you can't avoid an outdoor installation, place a screen between the sun and the starter box.

There are several methods of starting a submersible pump. The simplest one is direct-on-line (DOL) where the current flows directly to the submersible motor which starts immediately. This method is recommended for small pumps, or for pumps where the power supply is very strong.

Since the starting current of a submersible motor is often five to six times the full load current, a considerable peak occurs. For big motors it is therefore recommended to use a starting method that reduces the starting current.

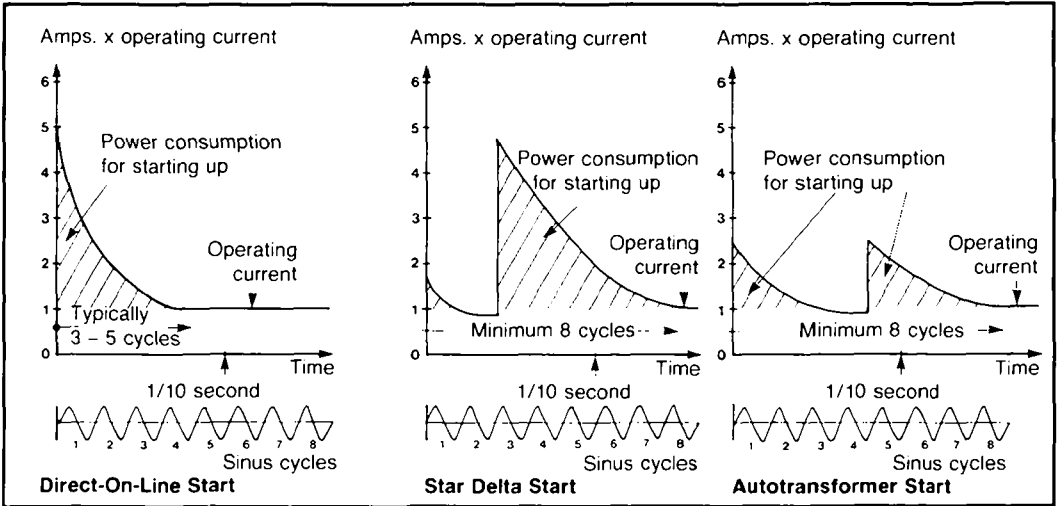
The most efficient method is a soft-starting device, where a resistance before the motor windings is slowly changed towards zero and therefore does not cause a peak. However, these devices are expensive and are therefore not used very much.

The most specified starting method is Star/Delta starting. During start-up your delta connected motor is switched to star configuration. When the motor has started, the switch is turned back to delta. This is done automatically after a specified period.

During start-up in star configuration the starting current is reduced to one-third of the DOL starting current.

This system is relatively cheap, simple and reliable, which is probably the reason why it is so popular. However, for some submersible pumps they are not very efficient, and can be a waste of money.

Submersible pumps are small diameter pumps. The impellers in modern models are very lightweight. This means that a submersible has no – or very low – moments of inertia. Therefore, it only takes a submersible one-tenth of a second to run from 0 to 3,000 RPM, when the power is connected. This also means that it comes to a complete stop immediately after the power is disconnected.



ABOVE LEFT: Figure 3. ABOVE RIGHT: Figure 4.

If you compare the starting current of the DOL start and the star/delta start in figure 3, you will see that star/delta is reducing the current in the beginning. However, when switched from star to delta configuration the pump comes to an almost complete stop, and it has to start DOL the second time. The graphs indicate that there is no real reduction in the starting current.

A much better approach is to use autotransformers for start-up. The flow of current during the starting period is shown in figure 4. Autotransformers are relatively inexpensive, but

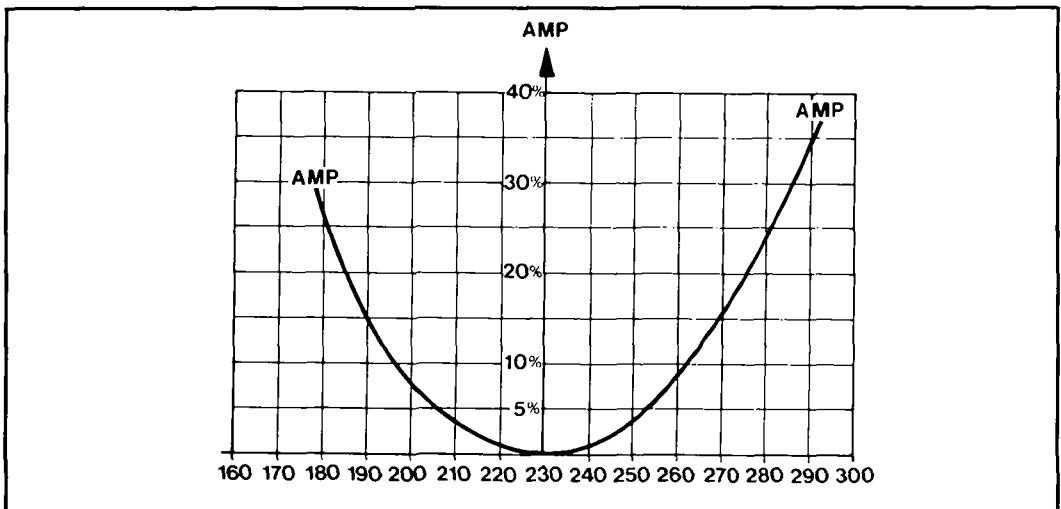
normally very reliable. Starting current is of course dependant on pump and motor characteristics and varies a lot from one type to another.

POWER SUPPLY

When the pump is running, it is important that the voltage stays within certain limits since too much variation in voltage will considerably reduce the lifetime of the motor.

The manufacturer will normally specify the limits for voltage variation but this is typically +/-10 per cent of the rated voltage. Figure 5 shows an

BELOW LEFT: Figure 5.



ADVERTISEMENT FEATURE

example of what happens to the motor current when the voltage varies.

In this example the motor is single-phase, 230V. You will notice that the current increases by approximately the same rate on both sides of rated voltage. This leads to heat build-up in the motor which reduces the lifetime. If the voltage exceeds the manufacturer's limits, a protection device must stop the motor. Another way to protect it is by derating, ie, not running the motor at full load. In other words you should use an oversize motor.

Just as important as the voltage level is the voltage unbalance, ie the voltage difference between each phase in a three-phase system.

Voltage unbalance typically occurs in areas where a lot of single-phase appliances are connected to the power supply, and the power supply is generally weak. In some places where many single-phase appliances are connected, the electric authorities try to control the balance by loading each phase equally. However, stealing or unauthorised consumption of electricity along the power lines makes this impossible to control.

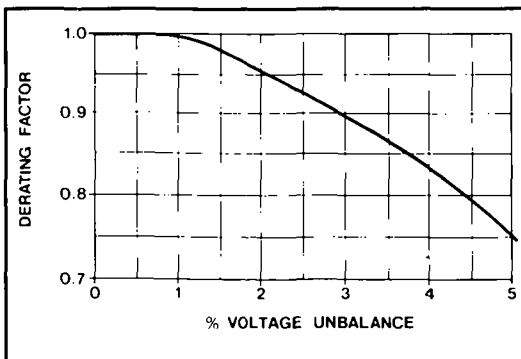
The American NEMA standards specify voltage unbalance as:

$$\% \text{ voltage unbalance} = \frac{\text{max voltage} - \text{average voltage}}{\text{average voltage}}$$

The standard also recommends that if unbalance occurs, motors are derated in accordance with the graph shown in figure 6.

Various equipment for protection from voltage unbalance is available on the market, and it is recommended to install this in the starter box with every submersible pump installation.

BELOW: Figure 6.



TEMPERATURE

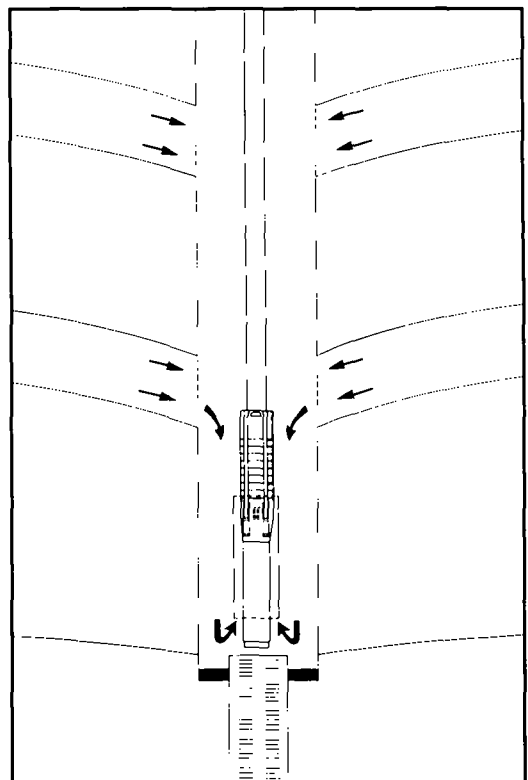
Most problems with submersible pumps are related to burnt motors, either shorted, grounded or both. Breakdown of the electric insulation system may be caused by surges, for example, lightning, or it may be simply a result of constantly running the equipment at very high temperatures.

Efficient cooling of the motor is the key, because the cooler the water, the longer the equipment will last. Additional cooling can be obtained if the following simple rules are obeyed:

- Always install the pump above the filter. This makes sure that the pumped water passes the motor with a certain velocity and cools it off;
- Prevent any kind of dirt building up around the motor. This considerably reduces cooling;
- A simple cooling sleeve attached to the pump improves water velocity and prevents dirt from building up (see figure 7).

Specially designed equipment is available on the market to constantly monitor the temperature

BELOW: Figure 7.



in the motor and protect against too high temperatures.

INSULATION RESISTANCE

The insulation resistance of a submersible pump installation gives an indication of the condition of the motor, cable and cable joint. If the insulation resistance is monitored regularly, you are more likely to prevent breakdowns by timely inspection/exchange of the pump/motor/cable, thus avoiding the panic that a sudden breakdown can cause.

LOW WATER

The submersible pump should be protected against dry-running which occurs if the well is overpumped – most pump types have rubber bearings which are lubricated by the pumped water.

If the flow stops, it only takes a few seconds to destroy the bearings, and then the complete pump.

One way to avoid this is to monitor the water table with sensors hanging in the well. These sensors stop the pump if the water level drops beyond a certain point.

Another method is to control the load on the motor. If the water table drops below the inlet of the pump, the performance of the pump and the current in the motor go down. Special equipment monitoring the current stops the motor, if it goes below a preset limit.

PROTECTION

Modern electric submersibles are designed to resist a harsh environment. New materials have improved insulation, and computer designed pumps have optimised reliability and extended the lifetime.

In spite of this, the equipment must be protected from external factors as described above.

This protection equipment has also improved and new technology now makes it possible to control and protect the pump much more efficiently than before.

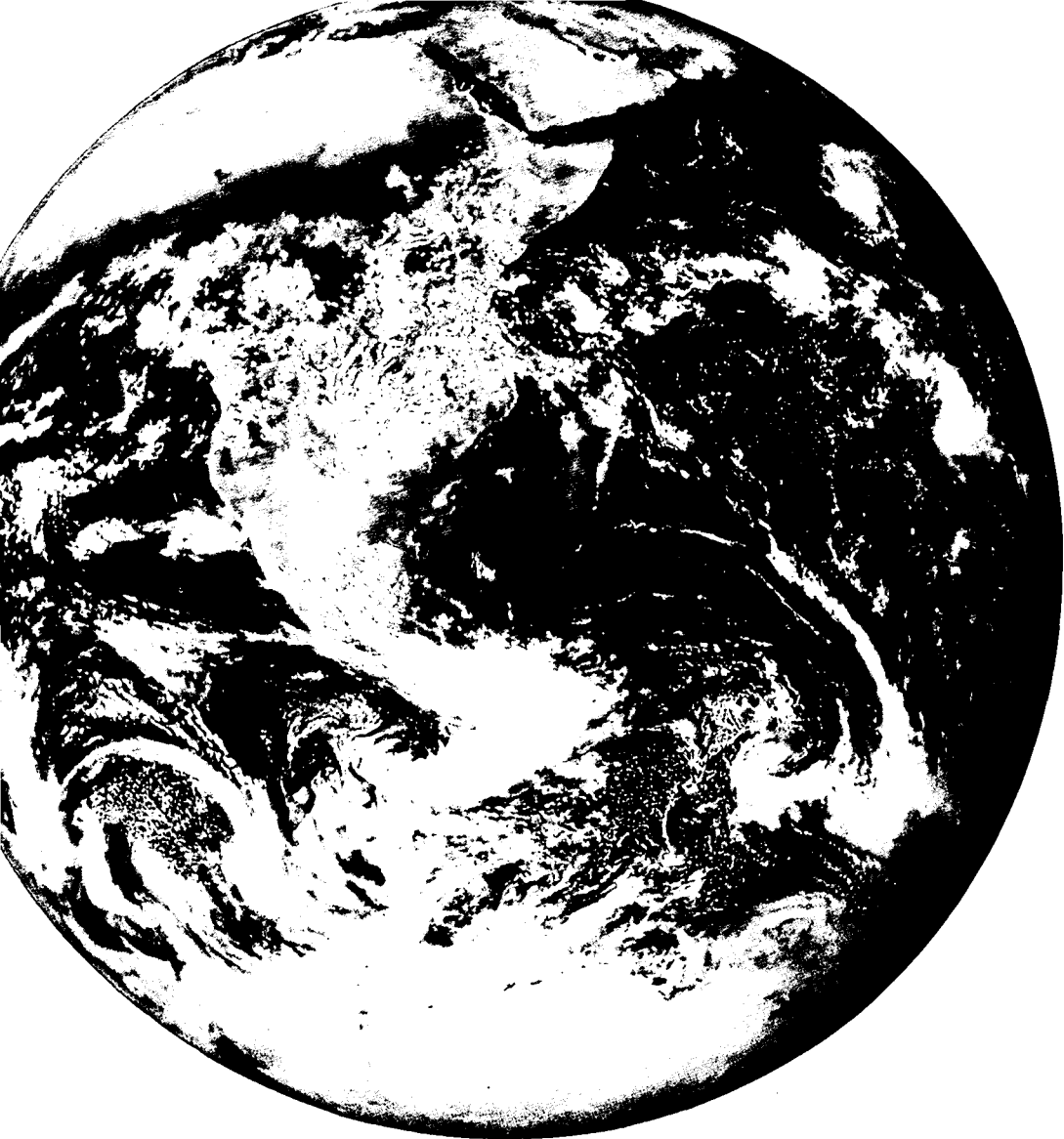
The result is a long, troublefree lifetime and a reliable water supply for the people depending on the system.

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INSTRUMENTATION, CONTROL AND ANALYSIS

by Margaret Ince, Water, Engineering and Development Centre (WEDC)

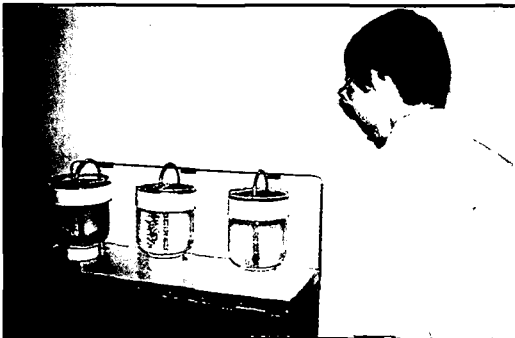
Process optimisation in water supply and wastewater treatment systems is needed at all stages – from planning and design, and construction through to operation and maintenance.

Evaluation of all project stages, during and after completion, is vital to ensure sustainability of the system, and hence support the investments made. Of necessity the methods and equipment used and the scale of projects will vary both between and within countries.

Modern techniques in control, instrumentation and analysis are being increasingly applied at all levels where they are appropriate, and sometimes where they are not. Factors determining appropriateness include: size and location of the system; ability of local inhabitants to service all the operation, maintenance and infrastructural aspects, and – especially in the developed world – the short

and longterm environmental impacts associated with a variety of options, including the 'do nothing' option. For instance, application of a computer-driven control system in an area with an unreliable electricity supply would need rigorous cost-benefit analysis including assessment of both alternative power sources and alternative control systems.

Telemetry, communicated via radio or wire, is one technique that is widely used for a range of activities; for example data collection on meteorology, from rain gauges to satellite images and monitoring stream flows; dosing equipment and rates; pump performance and so on. Storage and analysis of this information and any necessary action can be automated to differing extents. The desirability of this is often largely dependent on the relative costs of equipment and manpower. Where labour costs are high, use of computerised methods to analyse and respond to data are usually more cost-effective than labour-intensive



LEFT: Continuous analysis of water at different steps of the treatment process enables operators to take any necessary action promptly. This system allows for visual as well as instrumental analysis.

methods, whereas the reverse is often the case in developing countries.

Computer-aided management of water resources increases with the availability of commercial packages (software) and the computer literacy of management staff. Improving training for higher levels of staff enhances the adoption of these techniques at all levels and in a multitude of areas from selecting best options for water supply sources to meet varying demands, to designing methods for treatment, flood control/prevention and pollution monitoring and control. These systems are, however, neither available nor ubiquitously appropriate. In numerous countries or regions sufficient data/records to use these methods reliably do not exist and the paramount concern is still the availability of water.

A need exists for collection and storage of baseline data and use of currently available and improved portable monitoring/data collection equipment. Simple surface and groundwater abstraction, harvesting and treatment processes, provision of high- and low-lift pumps, storage tanks (plastic, ferrocement, sectional steel etc), and drilling equipment are some of the necessary inputs. For health reasons, ie the control of disease transmission, including vector breeding, wastewater disposal/treatment processes must be considered. All these inputs require suitable instrumentation for assessment and monitoring purposes.

In general, obtaining methods to provide and monitor sufficient quantities of water of bacteriologically acceptable quality is uppermost in developing countries. In North America and Europe, where bacteriological quality is largely controlled, and stricter water quality standards are enforced, the greater concern is with chemical parameters. This concern applies not only to drinking water supplies but also to effluents from industrial and wastewater treatment plants.

Improved monitoring techniques, linked to additional treatment processes, are vital to ensure that the new standards are met and that consumer expectations are adequately satisfied. Mass media publicity in the developed countries and health education in many countries has fed public perceptions of water quality links to health.

Two well documented examples are: perceived links between aluminium concentrations and

Alzheimer's disease (and acid rain) and agriculture-dependent increases in pesticide concentrations and allergies, breeding failure and abnormalities in fish and birds due to compound accumulation up the food chain. Nitrate levels in both surface and groundwaters and links to methaemaglobulinaemia ('blue-baby syndrome') in infants has also received wide publicity.

On consideration of monitoring methods used for inorganic and organic components in water, a list of the many techniques used would include thin layer chromatography, photometry, spectrophotometry, colourimetry, mass spectroscopy, high performance liquid chromatography and titrimetry.

When microbiological and biological techniques are also considered, it is obvious that the apparatus required and the skilled personnel to operate and maintain it, if all parameters were to be determined, would necessitate large laboratories and substantial financial expenditure. Many of the more specialised techniques and equipment are, therefore, available only at regional or even central laboratories; with more routine analyses

BELOW: Modern instrumentation and control methods have impacts on workers' skills and environments.



being performed at local/district labs.

Collection and transport of samples to laboratories before they deteriorate is a problem in many countries of the developing world and in some rural areas worldwide. The development of increasingly accurate field methods for analysis, such as portable colourimeters with readily available reagents for a number of physical and chemical determinants, is greatly improving the situation.

Whereas bacteriological analysis using membrane filtration can easily be started on site, it still requires incubation facilities. These are less readily available in the field because of the cost in relation to the number of analyses possible at one time. It is anticipated that current research will lead to more rapid and less costly methods for microbiological analysis early this decade.

Increasing problems with species of *Giardia* and *Cryptosporidium* in the western hemisphere have highlighted the need for such analytical methods, as well as the need for treatment methods to remove cysts of these organisms. Possible reasons for the increased incidences of

such organisms include changes in the size of towns and cities, the composition of effluents and the capability of treatment works to process the necessary volumes of raw and wastewater.

The dual pressures of population and urban growth on both water supply and disposal have a considerable impact on water quality – assessment and control – and water transmission and distribution. Not only do new systems need to be put in place but existing systems need rehabilitation.

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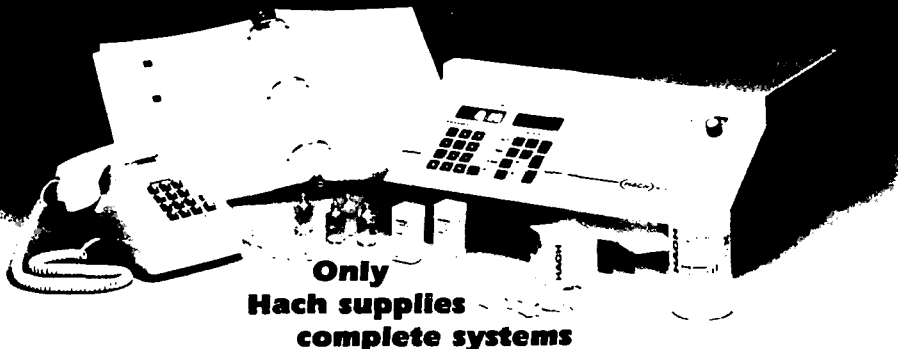
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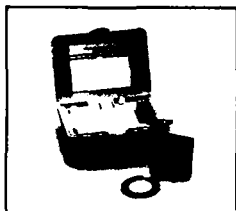
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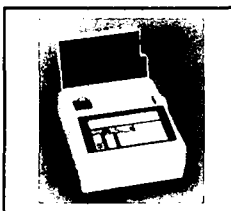


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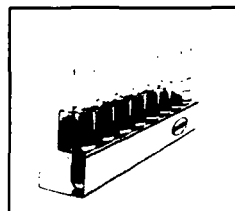
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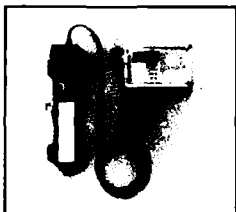
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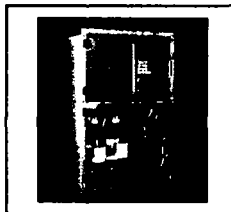
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PO Box 608, Suffle 66100, Sweden. Tel: +46-533 15060. Telex: 5347 SPA AB. Fax: +46-533 16931. Saab Process Automation is a leading Swedish manufacturer of measurement and control equipment for municipal and industrial water and sewage plants. Product range consists of sophisticated supervisory and control systems as well as measurement equipment for pH, redox, oxygen, flow, level, pressure and temperature.

SERCK GLOCON,

St Luke's St, Southgate St, Gloucester GL1 5RE, UK. Tel: +44-452 308030. Telex: 43139. Fax: +44-452 506062. Serck Glocon market and manufacture a wide range of instrumentation designed for use in the potable and waste water industries. These include portable, laboratory and on-line turbidimeters, colour monitors and self cleaning suspended solids monitors as insertion or flow through versions. Also available are ultrasonic level monitors and insertion flow magmeters.

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36 Avenue Hoche, Paris 75008, France. Tel: +33-1-456 1150/4563 3514. Telex: 270618. Fax: +33-1-2251206. Supplies monitoring units for analysis of water purity, using a process of osmosis.

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3401 Aerojet Avenue, El Monte, CA 91734, USA. Tel: +1-818-571 2771. Manufacturer of flows and analytical instrumentation specialising in pH, conductivity/resistivity, temperature and pressure applications.

SPECTRO ANALYTICAL INSTRUMENTS GMBH,

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Contact Name: Ludger Seesing. Spectro AI designs and manufactures instrumentation for the elemental analysis of water. Products include Inductively Coupled Plasma Atomic Emission Spectrometers (ICP-

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464 6500. Manufacturer of continuous on-line water chemistry monitoring instruments.

WESTINGHOUSE ELECTRIC SA,
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YSI Scientific Ltd, Lysons Avenue, Ash Vale, Aldershot, Hants GU12 5QR. UK. Tel: +44-252 513006. Telex: 858210 INSTCOG. Fax: +44-252 511855. YSI dissolved oxygen and conductivity instruments monitor wastewater treatment and provide environmental control and enforcement. Other YSI systems help maintain pure water supplies by measuring temperature, pH, conductivity and ORP in surface water and groundwater as it's pumped from test wells. YSI instruments assure healthy crops of fish and shellfish in hatcheries and on fish farms.

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AUTOTORK CONTROLS LTD,

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29801 Euclid Avenue, Wickliffe, Ohio 44092. USA. Tel: +1-216-585 8500. Fax: +1-216-943 4609/216-585 8756. Bailey Controls is a worldwide supplier of instrumentation, controls and computer systems for the process industries. Products include control devices for flow, pressure and temperature as well as transmitters, recorders and gauges.

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Platon Park, Viables, Basingstoke, Hants RG22 4PS. UK. Tel: +44-256 460122. Telex: 858107. Fax: +44-256 63345. Platon Flowbits offer from stock a wide range of flowmeters, flow alarms, flow control valves and associated products.

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Platon Park, Viables, Basingstoke, Hants RG22 4PS. UK. Tel: +44-256 470456. Telex: 858107. Fax: +44-256 63345. Platon Instrumentation incorporates Platon Flow Control and Platon A & I Ltd, manufacturing instruments for flow measurement and control for liquids and gases, together with design and manufacture of precise pressure measuring devices.

PONT A MOUSSON SA
91 Avenue de la Liberation, 54076 Nancy Cedex.
France. Tel: +33-83-95-20-00. Telex: 961674 PAMCE.
Fax: +33-93-96-30-48. Pont A Mousson the world's

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PORTER CHADBURN ENGINEERING LTD,
Park Lane Works, Bootle, Merseyside L30 4UP. UK. Tel: +44-51-525 4155. Telex: 629576. Fax: +44-51-525 4150. Manufacturers and suppliers of mechanical hydraulic and pneumatic valve actuators and controls and pneumatic control panels. Suppliers of valve locking devices and pipework services.

PRESTO-TEK,
410 North Figueroa St, Los Angeles, CA 90065. USA. Tel: +1-213-221 1178/800 421 1178. Manufactures portable and process instrumentation pH/orp, dissolved oxygen, temperature, relative humidity, pH/conductivity, salt analysis and flow, monitoring and control. Also manufactures pH/orp recorders and controllers, colour-meters pH and rH transmitters, temperature transmitters, chemical metering pumps, drum pumps and mixers.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.

RAFFINEAU INC,
4595 Melrose Avenue, Montreal PQ H4A 2S8. Canada. Tel: +1-514-488 0336/514-636 9897. Offers water industry a compact, proven, low-cost, purpose-built adaptable microprocessor controller capable of operating various softener, DI deionizer, RO systems in simplex or any multiplex configuration. Complete customization possible with run of about 20 units.

RAYLEIGH INSTRUMENTS,
Rayle's House, Brook Rd, Rayleigh Weir Estate, Rayleigh, Essex SS6 7XH. UK. Tel: +44-268 775656. Telex: 99440. Fax: +44-268 745001. Manufacture and supply process control instrumentation including indicators, analogue/digital relays, kilowatt hour meters, transducers, generator controls, electronic/mechanical thermostats and pressure controllers.

B RHODES & SON LTD,
Danes Rd, Crow Lane, Romford, Essex RM7 0HR. UK. Tel:

+44-708 762333. Telex: 896084. Fax: +44-708 45924. Manufacture and supply of sight flow indicators, flowmeters and remote indication/totalising/alarm/batch control etc. Flow alarm switches and water meters.

RO/CO CHEMICAL SYSTEMS INC.,
4004 Volta Avenue, Brentwood, MD 20722. USA. Tel: +1-301-799 2400. Distributor of water treatment chemicals, services and related chemical feed and control equipment.

ROSEMOUNT LTD.,
Heath Place, Bognor Regis, West Sussex PO22 9SH. UK. Tel: +44-243 863121. Telex: 86218. Fax: +44-243 867554. Manufacturers of industrial instrumentational control systems.

ROSSELL FLUID CONTROL/JESCO,
Mead Lane, Lydney, Glos GL15 5EU. UK. Tel: +44-594 42219/42488. Telex: 437150. Fax: +44-594 41781. Manufacturer of chemical dosing pumps, chemical dry feeders, chlorination equipment, chemical transfer pumps and chemical control equipment.

SAAB PROCESS AUTOMATION,
PO Box 608, Suffle, 66100. Sweden. Tel: +46-533 15060. Telex: 5347 SPA AB. Fax: +46-533 16931. Saab Process Automation is a leading Swedish manufacturer of measurement and control equipment for municipal and industrial water and sewage plants. Product range consists of sophisticated supervisory and control systems as well as measurement equipment for pH, redox, oxygen, flow, level, pressure and temperature.

SERCK CONTROLS LTD.,
Rowley Drive, Coventry CD3 4FH. UK. Tel: +44-203 305050. Telex: 311970STRTOV. Fax: +44-203 302437. Supplier of supervisory control and data acquisition systems with a full range on intelligent remote terminal units plus real time systems software and experienced project management for major international projects.

SPACE AGE ELECTRONICS INDUSTRIAL LTD.,
Spalding Hall, Victoria Rd, London NW4 2BE. UK. Tel: +44-81-203 1132. Telex: 8811085. Fax: +44-81-203 4496. Space Age Electronics offer a range of high quality, low cost process control instrumentation covering ultrasonic level and flow equipment, as well as the new, transducer -

radio telemetry range of radio data transmission systems. These have the ability to control the duty cycle of remote transducers, depending upon the state of a switch input, or an analogue level.

STONEFIELD SYSTEMS PLC,
Lawson-Hunt Industrial Park, Guildford Rd, Broadbridge Heath, Horsham, West Sussex RH12 3JR. UK. Tel: +44-403 210345. Fax: +44-403 67828. Manufacturing of complete control and monitoring systems for industry, in particular for the water industry. The company also supplies appropriate software and undertakes project management. Other products include programmable controllers and remote outstations with communication via radio or telephone.

TECH-LINE INSTRUMENTS/ARTECH INTNT'L,
Tri Campus Park PO Box 1236, Fond du Lac, WI 54936. USA. Tel: +1-414-922 6970. Fax: +1-414-922 1085. Manufactures and sells automated laboratory and on-line respirometers, that provide real time biological information, used in monitoring and controlling the wastewater process. Applications include, process control, troubleshooting of biological processes, toxicity-treatability testing, anaerobic digestion - short term BOD testing, compost testing and plant design. Sample chambers from 250 ml - 10L and up.

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VALMONT INDUSTRIES INC.,
Valley, Nebraska 68064. USA. Tel: +1-402-359 2201. Telex: 484459 VMTVLY. Fax: +1-402-359 4429. Valmont Industries offers a variety of irrigation control equipment, including: 'P & R Surge Valve'. A cast aluminium unit with solar powered motor and programmable microprocessor for maximum efficiency in furrow irrigation. 'Valmonitor II'. A remote system for monitoring and controlling irrigation systems pumps, chemical injection systems etc. Utilising radio

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signals for control it offers printed reports of your irrigation status (air temperature, wind speed and direction and soil moisture etc).

VALTEK INC ,

PO Box 2200, Mountain Springs Parkway, Springville, Utah 84663. USA. Tel: +1-801-489 8611. Telex: 388-458. Fax: +1-801-489 3719. Valtek is an international manufacturer of precision control valves used in normal flow applications and for reducing flow noise and cavitation. Valtek manufactures Globe, angle, three-way, Ybody, nuclear, butterfly and ball valves in sizes 0.5in to 42ins in ANSI Classes 150 to 4500.

WALTHAM CHEMICAL PUMP CORP (WALCHEM) ,

PO Box 565, 1396 Main St, Waltham, Massachusetts. USA. Tel: +1-617-899 8604. Telex: 923478. Fax: +1-617-647 9507. Manufacturers and suppliers of positive displacement metering pumps, fluid control systems and thermoplastic moulded tanks up to 5000 gallons.

WATER CONSERVATION SYSTEMS INC ,

141 South Spring St, Claremont, California 91711. USA. Tel: +714-621 5805. Telex: 9102402436 WCS INC CIA. Fax: +714-621 5806. Water Conservation Systems Inc (WCS) manufactures patented fully automatic irrigation control sensors and related products. These self-contained devices measure available soil moisture and rain fall and can start, stop or interrupt irrigation by zone. Tradenamed Hydrovisor and Rain Guard these and other WCS products are available worldwide. Contact WCS for information.

WEBER SENSORTECHNIK GMBH , 2201 Kollmar, West Germany. Tel: +49-04128 591.

Telex: 218326. Fax: +49-04128 593. Flow-captor flow switches and meters provide reliable and accurate control of water and liquid flow systems and operate with high repeatability. Combined with the flow-captor Eurocard system complete measurement systems can be installed to provide central adjustment and panelling of measuring points for eg re-circulated water systems in pisciculture. Vent-captor switches and meters for air and gaseous media provide reliable monitoring of air circulatory systems and ventilating as well as of coolant and ventilation circuits for engines and motors.

YSI INC ,

YSI Scientific Ltd, Lysons Avenue, Ash Vale, Aldershot, Hants GU12 5QR. UK. Tel: +44-252 513006. Telex: 858210 INSTCOG. Fax: +44-252 511855. YSI dissolved oxygen and conductivity instruments monitor wastewater treatment and provide environmental control and enforcement. Other YSI systems help maintain pure water supplies by measuring temperature, pH, conductivity and ORP in surface water and groundwater as it's pumped from test wells. YSI instruments assure healthy crops of fish and shellfish in hatcheries and on fish farms.

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ATS TELEMETRY LTD ,

Burrell Rd, Haywards Heath, West Sussex RH16 1TP. UK. Tel: +44-444 417531. Telex: 877134. Fax: +44-444 412961. Manufacturers of a range of supervisory control and data acquisition systems based on digital equipment, corporation computers and IBM pcs. Also manufacture a range of telemetry equipment including out-stations, modems, lightning protectors and speech plus data equipment.

BRISTOL BABCOCK LTD ,

European HQ: Parsonage House, Parsonage Square, Dorking, Surrey RH4 1UP. UK. Tel: +44-306 740033. Telex: 262335. Fax: +44-306 740800. Bristol Babcock supplies advanced control, SCADA, telecontrol and data acquisition systems to the water industry, worldwide. Our systems are fully supported by our field services organisation which offers installation, commissioning and maintenance services on a worldwide basis.

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Tinyard Lane, Gosdon Common, Bramley, Guildford, Surrey GU5 0WA. UK. Tel: +44-483 898900. Telex: 858161. Fax: +44-483 898977. Contact Name: Mr Rosenberg. Design, develop and manufacture a range

of data loggers for all applications in the water industry.

DELTA TECHNICAL SERVICES LTD,

Asser House, Airport Service Rd, Portsmouth, Hants PO3 5RA. UK. Tel: +44-205 697321. Telex: 86477.

Manufacture and sell data logging systems for both direct collection of data and telemetered data. Battery powered, sealed for life. Products specifically designed for the water industry.

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RFL Systems Division, Marshfield, Chippenham, Wlts SN14 8NN. UK. Tel: +44-225 891889. Fax: +44-225

891440. Dowty produces single board outstations for major water authorities. The outstations consist of control and data processors which are capable of acquiring data relating to flows, levels and electrical power distribution.

DYNAMIC LOGIC LTD,

The Western Centre, Western Rd, Bracknell, Berks RG12 1RW. UK. Tel: +44-344 51915. Telex: 849433. Fax:

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ELE INTERNATIONAL LTD,

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52474. Contact name: Nigel Hood. A comprehensive range of water and materials testing equipment.

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manufacture equipment for water metering, flow measurement, apparatus for meter testing and calibrating as well as electronic remote control and data logging systems.

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vices on state-of-the-art data acquisition systems, computerised data storage and radio telemetry transmission within the system.

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Contact Name: Mr F W Ballard or Mr S W G Cheshire. Mechanical, electrical and control engineering company with experience in water and sewage pumping stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor convertor equipment particularly suited to the control of pumps, compressors and fans.

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3 Wedgewood Rd, Bicester, Oxon OX6 7UL. UK. Tel: +44-869 240840. Telex: 833336. Fax: +44-869 246858.

Manufacturers of remote data logging equipment specifically for the water industry to measure flow, depth, pressure etc of water supply for applications such as irrigation and disposal. All equipment powered by a 10-year battery which is also supplied.

HEEL GMBH & CO MESSTECHNIK AG,

Jaeoerstrasse 4-12, Postfach 1745, Kempten D-8960.

West Germany. Tel: +49-831-2059-02. Fax: +49-831-2-059105. Data-acquisition systems and data-transmission systems.

HORIBA INSTRUMENTS LTD,

1 Harrowden Rd, Brackmills, Northampton NN4 0EB. UK.

Tel: +44-604 765171. Telex: 311869. Fax: +44-604

765175. Horiba Instruments can supply instrumentation for use in water quality monitoring stations that automatically measure pollution parameters of sea water as well as fresh water so that pollution can be controlled in its entirety.

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INSTRUMENTAL NORTHWEST INC,

14972 NE 31st Circle, Redmond, WA 98052. USA. Tel: +1-206-885 3729. Fax: +1-206-867 0404. Instrumental Northwest Inc, provides complete systems for use in hydrological testing applications. Multi-channel capability to 16 channels with many smaller variations available. Automated water level measurement and aquifer testing programmes included.

JOHNSON CONTROLS INTERNATIONAL,

150 North Hill Drive, Brisbane, California 94005. USA. Tel: +415-468 6050. Telex: 356449 JCII SFO. Fax: +415-468 6363. Johnson Controls is a worldwide supplier of engineered and installed control systems and services. Design, manufacture, install, maintain and service supervisory control and data acquisition and process control and instrumentation, systems specifically to meet your water project requirements, with over 2000 outlets in 61 countries, Johnson offer their services anywhere in the world.

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32 Avenue Albert 1er, Rueil-Malmaison 92500. France. Tel: +33-1-47-49-0360. Joucomatic specialise in fluid control and automatic transmission, pneumatic components, electrovalves and remote controlled valves, valve actuators. Joucomatic is operational on all five continents with 350 sales outlets throughout the world.

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PO Box 507, AM Delft 2600. The Netherlands. Tel: +31-15-561 000. Telex: 38137. Fax: +31-15-620-351.

Manufacturer of flatbed recorders, low profile recorders, printer/plotters and sun measuring equipment.

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2-6 Queens Rd, Teddington TW11 0LR. UK. Tel: +44-1-977 0055. Fax: +44-1-977 9232. Distributors of high technology instrumentation and measurement products covering the fields of data communications, data logging, cable testing and mains disturbance analysis and line conditioning equipment. Main products selected from principals:- Hewlett Packard, Tektronix/Draneh, F W Bell, Schiumberger, Siemens, Square D. Full technical support offered including 'In House' service and calibration.

ML ENGINEERING (PLYMOUTH) LTD (INDUSTRIAL CONTROLS GROUP),

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MOTOROLA COMMUNICATIONS ISRAEL LTD,

16 Kremenezki St, Tel Aviv 67899. Israel. Tel: +972-3-388325. Fax: +972-3-337925. Motorola, a leading communication company, worldwide, is manufacturing, designing and installing scada, command and control systems, for water and wastewater distribution systems. Microprocessor-based remote terminal units communicating via radio or wire line with computerised control centres and colour graphics central.

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South Poinr, SOutth Accommodation Rd, Leeds, West Yorks LS10 1PP. UK. Tel: +44-532 444577. Fax: +44-532 449420. Computer software house and ICL systems distributor. Main business areas include, local government, laboratory information management and general commercial. The company has worked with Thames Water Authority (New Riverhead Laboratories and Reading Laboratory), Essex Water Co, Mid Sussex Water Co etc.

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Dessestr 5, Kaufbeuren-Neugablonz D-8950. West Germany. Tel: +49-8341 62026. Fax: +49-8341 62029. Seba Hydrometrie is a manufacturer of hydrological, meteorological and sewage measuring instruments. The instruments are installed in more than 90 countries worldwide. Range of production: data loggers and transmission systems, water sampling equipment 2ins and 4ins mechanical samplers, 2ins submersible pump with 12 l/min capacity, water level recorders and control systems, current meters/winchies and all kind of meteorological sensors.

SERCK CONTROLS LTD,

Rowley Drive, Coventry CD3 4FH. UK. Tel: +44-203 305050. Telex: 311970 STROV. Fax: +44-203 302437. Supplier of supervisory control and data acquisition systems with a full range on intelligent remote terminal units plus real time systems software and experienced project management for major international projects.

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1922 Main St, Cedar Falls, IA 50613. USA. Independent lab specialising in air, water, wastewater and hazardous waste analysis.

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6JN. UK. Tel: +44-273 474475. Fax: +44-273 474479.

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Spalding Hall Victoria Rd, London NW4 2BE. UK. Tel: +44-81-203 1132. Telex: 8811085. Fax: +44-81-203 4496. Space Age Electronics offer a range of high quality, low cost process control instrumentation covering ultrasonic level and flow equipment, as well as the new, transducer - radio telemetry range of radio data transmission systems. These have the ability to control the duty cycle of remote transducers, depending upon the state of a switch input, or an analogue level.

SPECTRASCAN LTD,

42 New Brighton Rd, Emsworth, Hants PO10 7QR. UK. Tel: +44-243 379121. Telex: 9312102018. Fax: +44-43 371471. For supply and Distribution Engineers this specialist manufacturer has developed (in conjunction with the UK Water Research Centre) a comprehensive range of portable and fixed electronic monitoring equipment outstanding for its toughness and reliability. The company has been a market leader in the UK since 1982, and 25 per cent of its turnover is currently exported to the developing world and a network of agents is being built up. Spectrascan's catalogue of data loggers, sensors, software etc is a must for every distribution manager or engineer. Their special catalogue for the Supply and Distribution industry features a wide range of pressure and flow sensors, including mechanical and electromagnetic insertion probes. Displays, data loggers and telemetry outstations and software compatible with all these transducers are available as is advice on building single installations or substantial data systems. Highly accurate pressure measurements are necessary, paramathematical model of the distribution systems for control and planning purposes. Spectrascan can provide pressure transducers accurate to within 10 cm when measuring 100m and these are supported by a comprehensive range of displays, portable data loggers, software etc where necessary. Also available are active pressure controllers using microprocessors to adjust pressure dependent on conditions.

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B L U E W H I T E I N D U S T R I E S ,

14931 Chestnut St, Westminster, CA 92683, USA. Tel: +1-714-893 8529. Fax: +1-714-894 9492. Manufacturer of chemical feed metering pumps and flow meters with factory representatives covering the USA, Canada and overseas.

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hydraulic diaphragm metering pumps, related automatic controls and accessories. Also offer complete systems, i.e pH control, liquid chlorination systems, polymer precipitation systems, etc.

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10020 Big Bend Boulevard, St Louis, MO 63122, USA. Tel: +1-314-966 3533. Fax: +1-314-966 2532. Dema Engineering Co offers a wide selection of dispensing equipment used to meter and proportion cleaning and sanitising products. Proportioners, injectors, foamers and spray clean equipment mix chemicals with water and air to provide a cleaning solution.

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ELDEX LABORATORIES INC,
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FLUID METERING INC,
PO Box 179, 29 Orchard St, Oyster Bay, NY 11771. USA. Tel: +1-516-922 6050. Telex: 5101001281. Fax: +1-516-624 8261. Metering pumps and dispensers, valveless, variable, positive displacement pumps for precise handling of solutions, slurries, concentrate and gases. Flow rates from microliters to 2300 milliliters per minute at pressures to 100 psig with repeat accuracy of 0.1 per cent or better. Choice of chemical-resistant wetted ends.

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Highland Industrial Pumps, 584 Park East Drive, Woonsocket, RI 02895. USA. Tel: +1-401-765 7500. Telex: 265398 HANNA UR. Fax: +1-401-765 7575. Specialists in small-size plastic-body pumps (7lbs). For dosing additives such as hydrozine for boilers and antifouling for cooling towers, with adjustable flow rate from 6 to 83 gpd.

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JOHNSON FILTRATION SYSTEMS,
Johnson House, Browells Lane, Feltham, Middlesex TW13 7EQ. UK. Tel: +44-1-751 4424. Telex: 935479. Fax: +44-1-890 1533. Johnson Filtration Systems market the Aquaritol, the worlds most advanced and flexible coagulation control systems, this offers flow following dosing, pH control system, choice of control. Either streaming current or inlet turbidity can be used for control. With streaming current option this is the parameter used for control with final turbidity used to trim. The turbidity control is feedback from final monitor and feed forward from raw monitor.

KEMUTEC GROUP LTD,
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SK10 2ND. UK. Tel: +44-625 28733. Fax: +44-625 27319. A full range of vibratory, volumetric and loss-in-weight metering feeders for dosing dry additives into water and sewage flows.

LIQUID METRONICS INC,
19 Craig Rd, Acton, MA 01720. USA. Tel: +1-617-263 9800. Manufacturer of chemical metering (dosing) pumps, slurry feeders and associated accessories. The metering pump line is based on pumps which include inherent pressure relief, total protective enclosure in corrosion-proof housings and easy adaptability to automatic operation.

MATCHLESS MANUFACTURING CO LTD,
St James Court, Wilderspool Causeway, Warrington WA4 6PS. UK. Tel: +44-925 50676/37585. Telex: 627702. Fax: +44-925 59249/50676. This unique pump is made from Nylon 66 with a percentage glass fill, all food quality. The accurate 0.5 litre chamber dispenses light of viscose fluid from plastic or steel drums. Ideal for most liquids.

MAZZEI INJECTOR CORP,
11001 Mt View Rd, Bakersfield, CA 93307. USA. Tel: +1-805-845 2253. Manufacture and market high efficiency venturi type injectors for use in a wide variety of industrial and commercial treatment applications.

MILTON ROY CO,
201 Ivyland Rd, Ivyland, PA 18974. USA. Tel: +1-215-441 0800. Telex: 4761138. Fax: +1-215-441 8620. The coagulant control centre represents the best available technology for coagulant/flocculant dose monitoring and automatic control in treatment of raw surface waters, waste sludge dewatering and process water.

MILTON ROY CO HARTELL DIVISION,
70 Industrial Drive, Ivyland, PA 18974. USA. Tel: +1-215-322 0730. Manufacturer of chemical metering pumps.

MOOR CONTROL INC,
Po Box 632, 3400 South 24th St, Muskogee, OK 74402-0632. USA. Tel: +1-918-683 0238. Telex: 492087. Fax: +1-918-683 4858. Instrumentation manufacturer specialising in conductivity, pH and biocide, for cooling towers, boilers etc. Also ancillary equipment such as pumps, valves and other associated products.

DOSING SYSTEMS & EQUIPMENT

MPL PUMPS LTD,

Eton House, Waterside Drive, Langley, Slough SL3 6EZ. UK. Tel: +44-753 49970. Telex: 847471. Fax: +44-753 46472. MPL Metering Pumps Ltd offer a range of metering, dosing and transfer pumps for handling waste water and water treatment applications, eg aluminium, soda, activated silica, lime slurries, polyelectrolytes, ferrous sulphate, pH correction, chlorination, softening, control of scale formation and corrosion and boiler feed treatment.

PLASTIC PUMPS LTD,

Hanworth Trading Estate, Hampton Rd, West Hanworth, Feltham, Middlesex TW13 6DJ. UK. Tel: +44-1-898 2799. Telex: 935282. Plastic Pumps for handling various chemicals used for water treatment. Electronically operated dosing pumps and controllers for all applications.

PORTACEL LTD,

10 Tannery Rd, Soverign Way, Tonbridge, Kent TN9 1PR. UK. Tel: +44-732 364411. Telex: 95467 PORTAC G. Fax: +44-732 362575. Portacel Ltd specialises in control systems for disinfection by chlorine and sulphur dioxide gas. Both simple control using flow signals to control the gas output or combined residual and flow control are available. The equipment is designed for reliable operation in hot, humid and dusty environments, yet is easy to install, maintain and operate. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

PRECISION DOSING PUMPS LTD,

Alma Park Rd, Grantham, Lincs NG31 9SE. UK. Tel: +44-476 77677. Telex: 37538. Fax: +44-476 75233. Manufacturers of chemical dosing pumps for the handling of free flowing liquids for both high and low capacity and pressure ranges. Chemical treatment packaged units and full accessory equipment. Double diaphragm, piston membrane and metal membrane units ensure zero gland leakage.

PREUSSAG ANLAGENBAU GMBH, Karl-Wiechert-Allee 4, D-3000 Hannover 61.

Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828. Fax: +49-0511-5-66-39-00.

PWT PROJECTS LTD,

632-652 London Rd, Isleworth, Middlesex TW7 4EZ. UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G. Fax: +44-81-568 5479. Chemicals storage, feeding, batching and dosing systems for powders, slurries,

solutions and gases appropriate to all aspects of municipal and industrial water and wastewater plants. Automated monitoring and control of chemical dosing and flow-proportioning. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

RO/CO CHEMICAL SYSTEMS INC,

4004 Volta Avenue, Brentwood, MD 20722. USA. Tel: +1-301-779 2400. Distributor of water treatment chemicals, services and related chemical feed and control equipment.

ROSSELL FLUID CONTROL/JESCO,

Mead Lane, Lydney, Glos GL15 5EU. UK. Tel: +44-594 42219/42488. Telex: 437150. Fax: +44-594 41781. Manufacturer of chemical dosing pumps, chemical dry feeders, chlorination equipment, chemical transfer pumps and chemical control equipment.

MICHAEL SMITH ENGINEERS,

Oaks Rd, Woking, Surrey GU21 1PH. UK. Tel: +44-4862 71871. Telex: 859306 MSEWOK. Fax: +44-4862 23110. Engineers and distributors for specialised pumping equipment. Pumping systems and packaged dosing systems designed to customer requirements. Chlorination equipment and pumps.

WALLACE & TIERNAN LTD,

Priory Works, Tonbridge, Kent TN11 0QL. UK. Tel: +44-732 771777. Telex: 95278. Fax: +44-732 771800. Manufacturers of equipment for precise metering and control of chemicals used in water and waste treatment, including: V-Notch chlorinators, on-site electrolytic chlorination, residual recorders/controllers, precision dosing pumps, packaged pumping units, dry chemical feeders/meters, lime slakers, polyelectrolyte preparation, variable area flowmeters, ozonators for deodorisation.

WEBER SENSORTECHNIK GMBH, 2201 Kollmar, West Germany. Tel: +49-04128 591.

Telex: 218326. Fax: +49-04128 593. The flow-captor programme for the monitoring of liquid and semi-solid media provides small, compact and maintenance free sensors for applications wherever flow has to be accurately and reliably monitored eg in dosing systems and mixing pumps. The stainless steel sensing surface of the flow-captor renders it highly resistant to aggressive media of most kinds. Flush mounting or

inline fitting allows sensing which does not affect flow profile. Weber's latest development is the analog metering flow switch which has not only an analog display of the actual flow rate but also provides an adjustable set-point.

FIELD & ON-SITE TESTING

ABEM AB,

PO Box 20086, Bromma S-16102. Sweden. Tel: +46-8-764-60-60. Telex: 13079. Fax: +46-8-28-11-09. ABEM Chemmac measures and evaluates deep ground water characteristics such as the physicochemical parameters pH, redox potential and the free sulphide content, in open holes, within a packed off section of a well or on-line during test pumping. ABEM Piezomac measures natural piezometric pressure distribution in a borehole. ABEM Terrameter maps ground water pollution plumes downstream from landfill and other pollutants.

AZTEC ENVIRONMENTAL CONTROL LTD,

8 Hawksworth Rd Southmead Industrial Park, Didcot, Oxon OX11 7HR. UK. Tel: +0235 512000. Fax: +0235 512020. Aztec manufactures and supplies a range of portable field and on-site test equipment. These can range from sedimentation and flotation jar test equipment to chemical analysis kits and on-line quality monitors.

THE BEN MEADOWS CO INC,

PO Box 80549, Atlanta, GA 30366. USA. Tel: +1-404-455 0907. Fax: +1-404-457 1841. The Ben Meadows Co warehouses and distributes over 8,000 items from 500 different manufacturers. These products are designed to improve the productivity of the professional or worker out in the field. We offer water analysis equipment, sampling and measuring devices, water pollution detection and on-site sewage lab kits, among many other instruments and equipment your people can use in the field.

BRAILSFORD & CO INC,

670 Milton Rd, Rye, NY 10580. USA. Tel: +1-914-967 1820. Fax: +1-914-967 1836. We manufacture portable automatic water sampling instruments, battery or A/C operated, featuring long battery life good reliability and modest prices.

CHEMETRICS INC,

Route 28, Calverton, VA 22016. USA. Tel: +1-703-788

9026. Telex: 292861. Fax: +1-703-788 4856.

Manufacture over 200 different test kits for determining more than 40 water quality parameters. All products are simple to use and have a virtually unlimited shelf life.

CW COX INC,

PO Box 3214, South El Monte, CA 91733. USA.

Tel: +1-818-443 5090. Instruments for field testing water supply pumps and water wells. Insertion flowmeters, electric well sounders, bottom sounders, software packages for pump efficiency calculations. Up to 2 per cent accuracy. Adaptors for multiple pipe sizes.

EM SCIENCE,

111 Woodcrest Rd, Cherry Hill, NJ 08034. USA. Tel: +1-609-354 9200. Manufacturer of reagent chemical specialities including EM Quant® test strip kits for semiquantitative analysis and colourphast pH test strips and liquids.

ELE INTERNATIONAL LTD,

Eastman Way, Hemel Hempstead, Herts hp2 7hb. UK. Tel: +44-442 218355. Telex: 825239. Fax: +44-442 52474. Contact name: Nigel Hood. A comprehensive range of water and materials testing equipment. Including the Paqualab, the only comprehensive portable water testing laboratory. With 30 years experience as the major supplier of water, concrete soils and asphalt testing equipment worldwide. In addition a state of the art range of laboratory and field loggers are produced. Distributors for sales and service in over 100 countries.

ENGINEERED SYSTEMS & DESIGNS,

3 South Tatnall St, Wilmington, DE 19801. USA. Tel: +1-302-571 1195. Telex: 757674. Fax: +1-302-571 9264. Engineered Systems and Designs manufactures a variety of instruments to measure pH, conductivity, dissolved oxygen and turbidity. The instruments are available in portable units or laboratory models. Catalogues available on request.

ENVIRONMENTAL TEST SYSTEMS INC,

PO Box 4659, 23575 CR 106, Elkhart, IN 46514. USA. Tel: +1-219-262 2060. Telex: 6008382. Fax: +1-219-264 2495. Manufacture a dip and read test strip for free chlorine, total bacteria and yeast mould.

FIELD & ON-SITE TESTING

GEOTECH ENVIRONMENTAL EQUIPMENT INC,

Unit 17, 1441 West 46th Avenue, Denver, CO 80211. USA. Tel: +1-303-433 7101. The Geotech Barrel Filter is an acrylic pressure filtration unit designed for the convenient and rapid filtration of water samples prior to chemical analysis. It is lightweight, compact, rugged and is particularly convenient for field use.

HACH CO,

5600 Lindbergh Parkway, Loveland, CO 80537. USA. Tel: +1-303-669 3050. Hach Co offers analytical systems for field, laboratory and on-line water testing: laboratory and on-line turbidimeters and chlorine analysers; preprogrammed spectro-photometers; pH meters and electrodes featuring advanced hach One™ Technology; microbiological tests; and over 200 test kits ranging from single-parameter kits to complete portable laboratories, including premeasured reagents and step-by-step instructions.

HACH EUROPE,

B P 51, Namur 1, B5000. Belgium. Tel: +32-81-445381. Fax: +32-81-441300. Hach produce a complete range of systems for water quality analysis. Products include test kits, portable laboratories, lab instruments and special process analysers.

HANBY ANALYTICAL LABORATORIES INC,

4400 South Wayside, Suite 107, Houston, Texas 77087. USA. Tel: +1-713-649 4500. Fax: +1-713-649 6237. HAL Inc has developed an extremely accurate Field Test Kit for on-site analysis of soil and water for contamination by aromatic compounds. Detection of fuels, pesticides, solvents, etc in water down to parts-per-billion level. Field Test Kit comes complete for thirty tests with written and video instructions.

LAMOTTE CHEMICAL PRODUCTS CO,

PO Box 329, Chestertown, MD 21620. USA. Tel: +1-301-778 3100. Manufacture water analysis equipment for on-site demonstration and laboratory use.

LEXINGTON SCIENTIFIC LABORATORY LEXLAB INC,

PO Box 3080, Lexington, OH 44904. USA. Tel: +1-419-884 1340. Sanitation testing service for regeneration plants, EPA waste water analysis, well testing.

MCCULLOUGH/LEAKTEK INC,

1105 Park Avenue, Murfreesboro, TN 37130. USA. Tel: +1-615-890 9030. Mobile Meter Tester, designed to test meters from 0.75-16ins in the field. Completely portable, all testing equipment mounted on 6ft x 8ft steel trailer. Entire testing operation can be done by one man. Eliminates guess work, improves labor efficiency dramatically, all with greater accuracy.

MILLIPORE CORP,

80 Ashby Rd, Debford, MA 01730. USA. Tel: +1-617-275 9200. Telex: 4430066. Fax: +1-508-875 2050. Offers several microbiological analysis kits providing a complete array of filters and equipment for field testing procedures.

PRAKLA - SEISMOS

GEOMECHANIK GMBH,

PO Box 1247, D-3162 Uetze, West Germany. Tel: +49-5173 693193. Telex: 175173812. Fax: +49-5173 693245. Contractor for well and borehole testing: pump tests, borehole logging, chemical and bacteriological analysis, hydraulic tests: - drill stem tests - constant rate injection tests (type Lugeon) - slug tests (type Lefranc-Maag).

RÜF - GERÜTEBAU GMBH,

Bahngasse 15, Dornbirn A-6853. Austria. Tel: +43-5572-626-55. The Environment Test Kit by Ruf (Dr Passeger) is a portable field laboratory for the quick analysis of special waste at the receiving point. The kit is very easy to handle, which means that personnel without chemical training can be employed to operate it. It comprises a comprehensive set of instruments and includes a large selection of quick environment-related tests, eg cyanide, peroxide, chromate, nitrite, copper, zinc tests, pH measuring strips, oil and water detection tests, etc as well as safety and cleaning material.

SPECTRO ANALYTICAL INSTRUMENTS GMBH,

Boschstr 10, D-4190 Kleve, Federal Republic of Germany. Tel: +49-2821 8920. Fax: +49-2821 23144. Contact Name: Ludger Seesing. Spectro AI designs and manufactures instrumentation for the elemental analysis of water. Products include Inductively Coupled Plasma Atomic Emission Spectrometers (ICP-AES) in sequential, simultaneous, and combination configurations. The instruments conform to the requirements of EC, DIN Norm, and US EPA for the measurements of priority pollutants. Spectro also

designs and manufactures portable and mobile spectrometers for on-site sorting, identification, and semi-quantitative analysis of metals such as pipe and tubes.

TAYLOR TECHNOLOGIES INC,
31 Loveton Circle, Sparks, Maryland 21152. USA. Tel: +1-301-472 4340. Telex: 710-232-9363. Fax: +1-301-771 4291. Water test kits and reagents.

TECATOR AB,
PO Box 70, S-263 21 Höganäs. Sweden. Tel: +46-42-361500. Fax: +46-42-340349. Tecator is the world's leading company for automated routine analysis in water. Tecator is a world-wide supplier of analytical instruments for water and environmental analysis. Standard manual methods cannot meet today's requirements for speed, accuracy and safety. Therefore there is an increasing demand for automated and flexible water analysers, which are easy to start up, simple to use and provide fast and accurate results. Tecator offers a broad range of automated, flexible and accurate analysers fulfilling various needs and requirements in the water laboratory. Tecator provides complete application information and specialist support with each instrument. Ask for more information today.

TINTOMETER LTD,
Waterloo Rd, Salisbury SP1 2JY. UK. Tel: +44-722 27242 Telex: 47372. Fax: +44-722 412322. Manufacturers of Lovibond comparators and water analysis test kits for on site chemical analysis of treated and untreated water supplies. Ideal for semi skilled operators who require to carry out essential analysis on a low budget.

WATER DYNAMICS INC,
375 Central Avenue, Bohemia, NY 11716. USA. Tel: +1-516-567 5198. Specialising in test kits for hardness, calcium, iron, phosphate, copper, ammonia, sulphate, phenol, chlorine, nitrite, sulphide and nitrate etc.

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PRESSURE & TEMPERATURE GAUGES & REGULATORS

A1 INDUSTRIAL,
London Rd, Pampisford, Cambridge CB2 4EF. UK. Tel: +44-223 834420. Telex: 817536. Fax: +44-223 835050. Air flow and pressure measuring instruments.

ARKON INSTRUMENTS LTD,
Unit C3, Liddington Trading Estate, Old Station Drive, Leckhampton, Cheltenham, Glos GL53 0DL. UK. Tel: +44-242 573444. Telex: 437269. Fax: +44-242 221701. Specialist suppliers of instrumentation for flow level, pressure and vacuum for water, gas and air. Also supply analytical instruments for the water industry ie: pH, redox, dissolved oxygen etc.

BAILEY & MACKAY LTD,
Baltimore Rd, Birmingham. UK. Tel: +44-21-357 5351. Fax: +44-21-357 8319. Bailey and Mackay are involved in the development and manufacture of all types of pressure transducers and gauges from 0-20ins of water upto 6000 psi. Also produced are: special materials for wetted parts on dosing equipment

CAMBRIDGE INSTRUMENTS LTD,
Oakfield Rd, London SE20 8EW. UK. Tel: +44-81-659 2424. Telex: 262716. Fax: +44-81-778 1776. Cambridge Instruments manufacture a wide range of industrial controls under the brand names Lindex, Baldwin and Black. These include energy, pressure and flow controls, alarm annunciators, mimics and customised systems.

DELTA CONTROLS LTD,
Island Farm Avenue, East Molesey, Surrey KT8 0UZ. UK. Tel: +44-1-941 5166. Telex: 27109. Fax: +44-1-783 1163. Manufacturers of standard and custom built pressure, pressure difference, temperature, flow, vacuum and level switches, liquid level transmitters and fibre-optic based sensors for use in all areas. Instrument needle valves and manifolds and pressure transducers.

DRUCK NEDERLAND BV,
PO Box 232, Barendrecht, AE 2990. The Netherlands. Tel: +31-1806 11555. Telex: 28164. Fax: +31-1806 18131. Specialists in level and measuring devices including calibration and pressure measuring equipment, transducers.

LABORATORY EQUIPMENT

IMI BAILEY BIRKETT LTD,
Sharp St, Worsley, Manchester M28 5NA. UK. Tel:
+44-061-790 7741. Fax: +44-061-703 8451. IMI
Bailey Birkett's celebrated G4 pressure regulator is a
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facilitate the selection/sizing process is available from
the marketing department.

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Crompton Way, Crawley, West Sussex RH10 2YZ. UK.
Tel: +44-293 25151. Telex: 87235. Specialising in
flowmeters, pressure and level transmitters, KDG products
are used in applications such as reservoir level and storage
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and wall-mounted tank contents monitors, flow monitors and
telemetry systems - proven in use by major UK water authori-
ties - KDG is one of the few companies capable of
manufacturing and installing complete measurement/monitor-
ing systems.

NORGREN MATONAIR LTD,

PO Box 22, Eastern Avenue, Lichfield, Staffs WS13 6SB.
UK. Tel: +44-543 414333. Telex: 338555. Fax: +44-543
268052. Manufacturers of pneumatic and electro-pneumatic
equipment including ball valves, quick release hose cou-
plings, pressure regulators and cylinders.

OCV CONTROL VALVES,

7400 East 42 Place, Tulsa, Oklahoma 74145. USA. Tel:
+1-918-627 1942. Telex: 910-845 2227. Fax: +1-918-
622 8916. OCV manufactures and internationally markets
a complete line of automatic, hydraulically operated,
diaphragm actuated, pilot controlled valves. The line
includes the series 108, 127 and 120 for pressure relief,
pressure reducing and rate of flow respectively.

SAAB PROCESS AUTOMATION,

PO Box 608, Suffle 66100. Sweden. Tel: +46-533
15060. Telex: 5347 SPA AB. Fax: +46-533 16931. Saab
Process Automation is a leading Swedish manufacturer of
measurement and control equipment for municipal and indus-
trial water and sewage plants. Product range consists of
sophisticated supervisory and control systems as well as
measurement equipment for pH, redox, oxygen, flow, level,
pressure and temperature.

SPAN INSTRUMENTS INC,
1947 Avenue K, Plano, Texas 75074. USA. Tel: +1-214-
423 5320. Manufacturer of pressure instrumentation
including gauges, switches and transmitters.

VERNON MORRIS & CO LTD,
Chester Rd, Bretton, Chester CH4 0DH. UK. Tel: +44-244
660794. Telex: 01556CARIBAGI. Fax: +44-244
314635. Manufacturers and distributors of mechanical and
electronic flow gauges; pressure recorders; flow and pres-
sure test kits; back flow prevention devices; sand pipes;
valve keys; test pumps and waterwork fittings etc.

ALEXANDER WIEGAND GMBH & CO,

Postfach 1180, Klingenberg/Main D-8763. Wes:
Germany. Tel: +49-9372-132-0. Fax: +49-9372-132-406-
414. Wika Products are: pressure gauges, measurement of
pressure and vacuum, chemical seals, sensor application
protection system, tronic line, electronic instrumentation for
pressure and temperature measurement, mechanical ther-
mometers, bimetal thermometers, dial thermometers,
industrial thermometers and thermowells.

LABORATORY EQUIPMENT

ANALYTICAL PRODUCTS INC,
3339 Arden Rd, Hayward, CA 94545. USA. Tel: +1-415-
732 5400. Fax: +1-415-732 6109. Manufacturers of
laboratory reagents and supplies. Applicable to this market
is the safety bulb to eliminate mouth pipetting and two and
three-decimal place pH calibrating buffers, useful for the
newer automatically calibrating meters.

AQUALANG AG,

Albisriederstr. 5, PO Box, Zurich CH-8040.
Switzerland. Tel: +01-491-14-23. Fax: +01-492-00-
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units in laboratories, hospitals, universities, wherever
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by our ion-exchanger is of the quality of multiple dis-
tilled water. Connect it to any water tap. Turn on the
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pure water, always under strict control by the
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300 8886. Telex: 8951810. Fax: +44-1-300 2247.
Manufacturers of water sampling equipment for pollution detection and control. Suppliers of a wide range of plastic lab equipment.

AZTEC ENVIRONMENTAL CONTROL LTD,

8 Hawksworth Rd Southmead Industrial Park, Didcot, Oxon OX11 7HR. UK. Tel: +0235 512000. Fax: +0235 512020. Aztec manufactures and supplies laboratory jar test equipment with variable speed, back lighting and G valves to test coagulation and treatment requirements for both sedimentation and dissolved air flotation processes.

BDH LTD,

Broom Rd, Poole, Dorset BH12 4NN. UK. Tel: +44-202 745520. Telex: 41186/418123. Fax: +44-202 738299. Manufacturers and suppliers of laboratory apparatus and instruments.

CAMLAB LTD,

Nuffield Rd, Cambridge CB4 1TH. UK. Tel: +44-223 62222. Telex: 817664. Fax: +44-223 460856. Suppliers of water quality test kits, turbidimeters and other equipment for the testing of water quality.

CHEMLAB-INSTRUMENTS LTD,

Hornminster House 129 Upminster Rd, Hornchurch, Essex RM11 3XJ. UK. Tel: +44-4024 57011. Telex: 8951347. Chemlab Instruments is an acknowledged leader in the field of water analysis, sterilisation and laboratory purification. Products include peristaltic pumps, reverse osmosis, multi-channel analysers, monitors, sterilisers, flow injection and laboratory equipment.

CHEMTRIX INC,

5285 North East Elam Young Parkway, Suite A-400, Hillsboro, OR 97124. USA. Tel: +1-503-648 0762. Catalogue operation selling instruments and equipment to laboratories and industry.

CLANDON SCIENTIFIC LTD,

Lysons Avenue, Ash Vale, Aldershot, Hants GU12 5QR. UK. Tel: +44-252 514711. Telex: 858210. Fax: +44-252 511855. Suppliers of a range of conductivity and dissolved oxygen meters, total organic carbon analysers and a range of water filters.

DR BRUNO LANGE GMBH,

Willstaetter 11, Dusseldorf 99, 4000. West Germany. Tel:

+49-211-503-061. Telex: 8588757. Fax: +49-211-500-97143. Dr Bruno Lange GmbH is one of Europe's leading producers of photometers and reagents for waste water, drinking water and quality controls.

DRAGERWERK AKTIENESELLSCHAFT,

Moislinger Allee 53-55, D-2400 Lubeck 1. Germany. Tel: +49-451 8820 Telex: 268070. Fax: +49-451-882 2080. Gas Analysis Division. In order to reduce the number of potentially hazardous situations at the workplace and minimise any damage resulting from these hazards, many different gases, vapours, and aerosols must be monitored. For that purpose Drager offers easy-to-handle and economical measuring systems. With more than 200 different Drager-Tubes, over 350 separate hazards can be determined in air, soil and water samples.

ELE INTERNATIONAL LTD,

Eastman Way, Hemel Hempstead, Herts hp2 7hb. UK. Tel: +44-442 218355. Telex: 825239. Fax: +44-442 52474. Contact name: Nigel Hood. A comprehensive range of water and materials testing equipment. Including the Paqualab, the only comprehensive portable water testing laboratory. With 30 years experience as the major supplier of water, concrete soils and asphalt testing equipment worldwide. In addition a state of the art range of laboratory and field loggers are produced. Distributors for sales and service in over 100 countries.

ENGINEERED SYSTEMS & DESIGNS,

3 South Tatnall St, Wilmington, DE 19801. USA. Tel: +1-302-571 1195. Telex: 757674. Fax: +1-302-571 9264. Engineered Systems and Designs manufactures a variety of instruments to measure pH, conductivity, dissolved oxygen and turbidity. The instruments are available in portable units or laboratory models. Catalogues available on request.

FOXBORO CO,

Foxboro, MA 020235. USA. Tel: +1-508-543 8750. Fax: +1-508-549 6750. The most complete line of instrumentation available from a single manufacturer. These include flowmeter; pressure, level, temperature and pH transmitters; liquid and gas analyzers; pneumatic and electronic controllers and control systems; computer based systems; control valves and actuators.

LABORATORY EQUIPMENT

GALLENKAMP INTERNATIONAL,

Belton Rd West, Loughborough, Leics LE11 0TR. UK. Tel: +44-509 237371. Telex: 34391. Fax: +44-509 231893. Gallenkamp International is a leading supplier of scientific equipment to educational, medical and industrial establishments throughout the world. The company stocks over 30,000 different items for shipment to over 100 countries.

GCA - PRECISION SCIENTIFIC,

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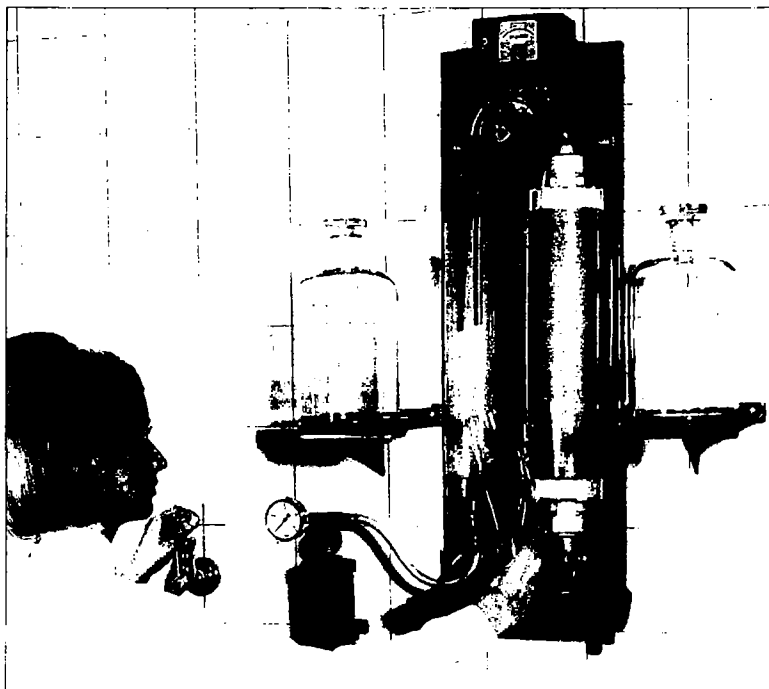
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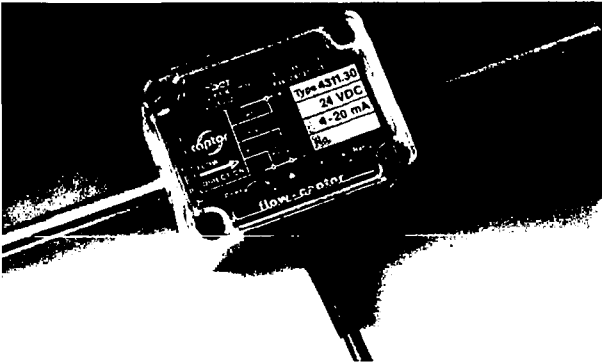
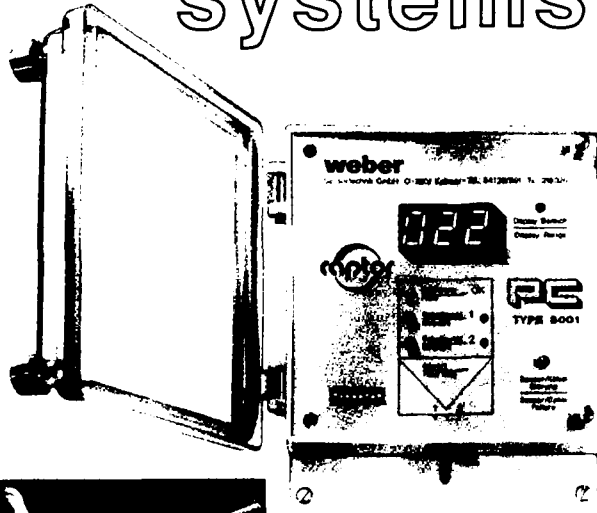
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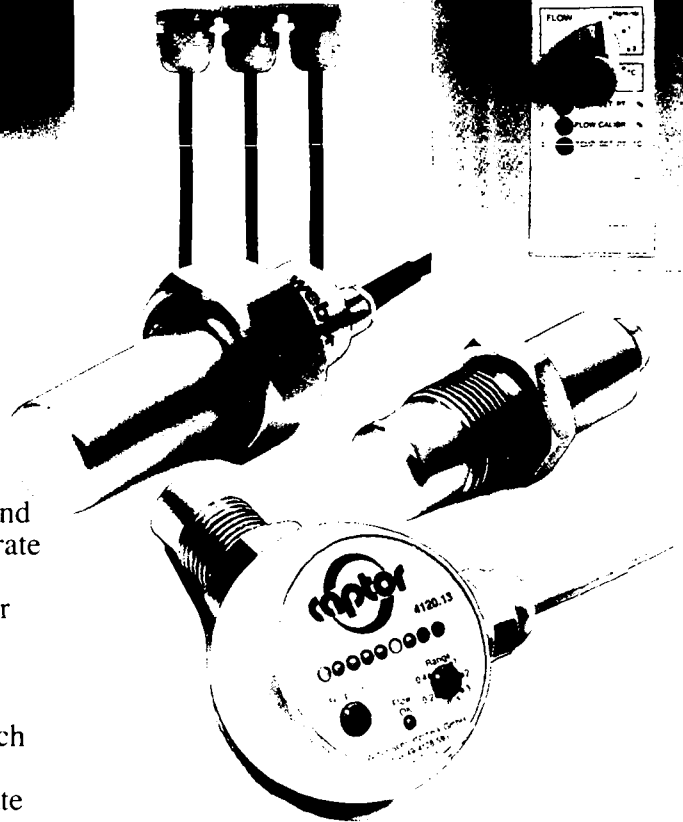


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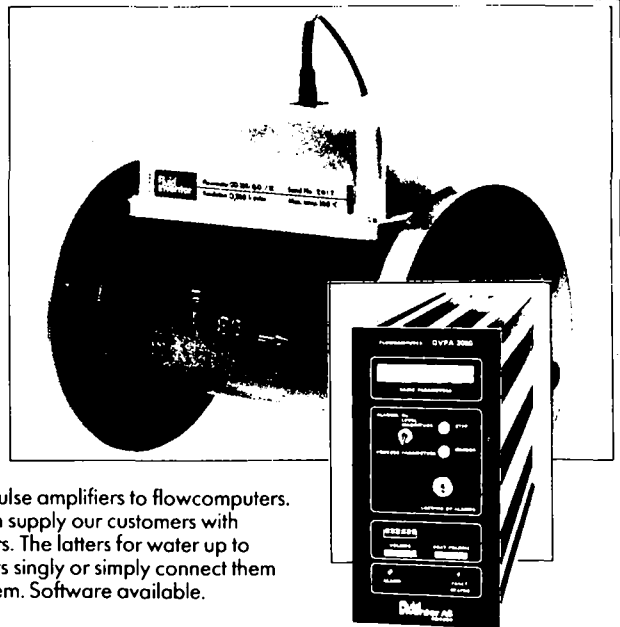
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Water Meter Works of Israel, Doar Dalia 38920. Israel. Tel: +972-4-897911. Telex: 46383. Fax: +972-4-897960. Arad - 50 years a pioneering force in the production of technologically superior water meters, hydraulic and electronic control systems and irrigation valves. Arad systems are designed to meet modern needs of municipalities, agriculture and industry.

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190-196 Bath Rd, Slough, Berks SL1 4DN. UK. Tel: +44-753 34646. Telex: 848875. Fax: +44-753 693603. Controls and instrumentation. Design and manufacture of electro-mechanical, electronic and microprocessor based equipment for liquid level, flow measurement, energy saving, pollution monitoring and boiler safety.

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BLUE WHITE INDUSTRIES,

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714-893 8529. Fax: +1-714-894 9492. Manufacturer of chemical feed metering pumps and flow meters with factory representatives covering the USA, Canada and overseas.

BUSH BEACH ENGINEERING LTD,

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METERS - FLOW MEASUREMENT

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312-345 8050. Fax: +1-312-345 8993. Manufacture a complete line of portable pumps, flow testing equipment, leak locators, dipping needles, pitots and offer a complete municipal supplies catalogue.

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2121 North Glenville Drive, Richardson, Texas 75082. USA. Tel: +1-214-234 4491. Telex: 6502721938. Fax: +1-214-234 1134. Vendors of meter reading systems for utilities throughout the world.

DETECTRONIC LTD,

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DIGITAL FLOTRONICS,

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PO Box 5, Penzinger Strasse 76, Wien A-1141, Austria.
Tel: +43-1-829000. Telex: 1-12763. Elin's line-up of water supply equipment embraces devices for water flow measurement and equipment for testing and calibrating these. The emphasis here is upon vane water meters. Elin are interested mainly in the export of domestic water meters.

ELIN-WASSERWERKSTECHNIK GMBH,

Hainburger Strasse 33, Wien 3, A-1030, Austria. Tel: +43-726621. Telex: 132142. Fax: +43-8285199. Elin manufacture equipment for water metering, flow measurement, apparatus for meter testing and calibrating as well as electronic remote control and data logging systems.

ENDECO INC,

13 Atlantis Drive, Marion, MA 02738, USA. Tel: +1-617-748 0366. Telex: 92945 ENDECO MNMS. Fax: +1-617-748 2543. Enaeco Inc designs and manufactures instruments for monitoring water flow, water level, ocean wave spectra and ocean chemistry. In addition, the company produces complete marine data acquisition systems customised for the needs of specific customers.

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Workington, Cumbria CA14 5DS. Tel: +44-946 830611. Telex: 64114. Manufacturers of complete instrumentation and control systems for water and wastewater treatment. Major products are - flowmeters, including obstructionless electromagnetic flowmeters, gas dispensers for disinfection and water treatment, panel board instrumentation and analytical instrumentation for pH, DO and chlorine residual control.

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PO Box 390, Umatilla, OR 97882, USA. Tel: +1-503-567 1966. Flosonics Inc offers state-of-the-art flow measurement equipment ranging from the sophisticated Westinghouse Calorimetric, four path system to lower cost ultrasonics, doppler and intrusive flowmeters. With over 10 years experience with the electronics design, production and use of flowmeters, Flosonics Inc also offers a wide range of services related to flow measurement.

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PO Box 27871, Houston, Texas 77227, USA.

Tel: +1-713-623 2143. Telex: 762649.

Manufacture flow meters for liquid flow in various applications. Also three non-contact meters measuring flow from the outside pipe.

FLUID INVENTOR AB,

Box 81037, 104 B1 Stockholm, Sweden. Tel: +46-08-44-08-05. Telex: 13440. Fluid Inventor is a Swedish company with one main product: flowmeters according to the fluidistor principle. As the meters measure the flow without moving parts they will get unique advantages at a low cost. There are meters for gas and for liquids and both manufacturing and calibration is done on the company's premises in Stockholm, Sweden. About 40,000 meters have been made so far and are used mostly in Scandinavia, Italy and Switzerland - now the company are looking for representatives in England and Germany.

THE FORD METER BOX CO INC,

PO Box 443, Wabash, Indiana 46992-0443, USA. Tel: +1-219-563 8441. Telex: 023-2654 FORD WASH. Fax: +1-219-563 0167. The Ford Meter Box Co Inc manufactures the industry's most complete line of water works brass valves and fittings, meter setting and testing equipment and main line pipe repair products.

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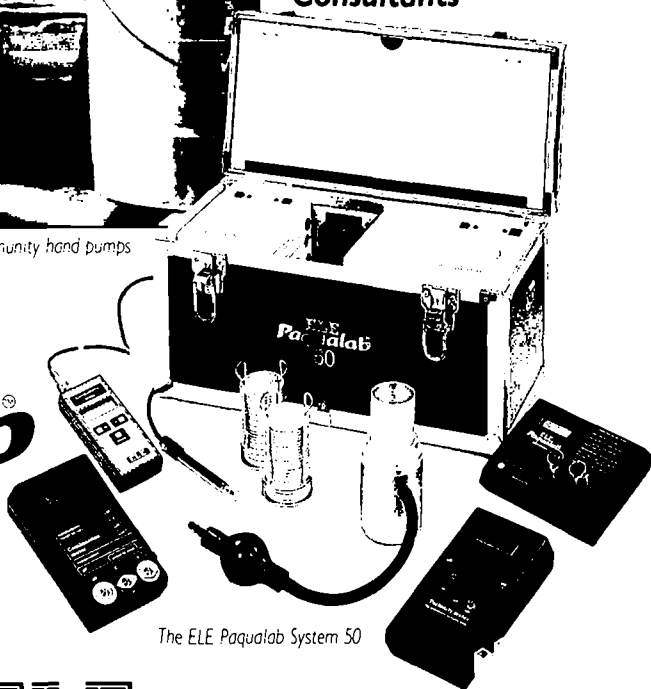
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8595 Grovemont Circle, Gaithersburg, MD 20877. USA. Tel: +1-301-869 4700. Telex: 7108280083. Fax: +1-301-926 6620. Since 1971, Marsh-McBirney Inc has been a manufacturer of flow measuring instrumentation for water and wastewater applications. Several illustrated brochures feature the products offered at Marsh-McBirney. Permanent and portable configurations are available for a variety of applications.

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1495 Zephyr Avenue, Hayward, CA 94544. USA. Tel: +1-415-471 8300. Fax: +1-415-471 8647. Monitek Technologies Inc is a manufacturer of measurement and control instrumentation for industrial and municipal markets. We make products for measuring flow, level, suspended solids, turbidity, sludge blanket level, dissolved oxygen and turbidity. We make both in-line and laboratory models.

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Manufacturers of flow measurement instrumentation and associated control and display systems. Specialists in the supply of portable flow monitoring equipment for distribution analysis and waste water detection and permanent flow metering installations.

B RHODES & SON LTD,
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ROBAN ENGINEERING LTD,
18 Avenue Rd, Belmont, Surrey SM2 6JD. UK. Tel: +44-1-643 8070. Telex: 946918. Fax: +44-1-642 1104.
Manufacturers and distributors of liquid handling equipment including pumps and flow meters.

SAAB PROCESS AUTOMATION,
PO Box 608, Sjöflö 66100. Sweden. Tel: +46-533 15060. Telex: 5347 SPA AB. Fax: +46-533 16931. Saab Process Automation is a leading Swedish manufacturer of measurement and control equipment for municipal and industrial water and sewage plants. Product range consists of sophisticated supervisory and control systems as well as measurement equipment for pH, redox, oxygen, flow, level, pressure and temperature.

SARASOTA AUTOMATION LTD,
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Sarasota produce flow and level gauges for rivers and sewers using ultrasonic and electromagnetic techniques. Sherpa loggers and viewlog software are used in water distribution to monitor flow and pressure in a network.

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46-62-26. Contact Name: Mr Steve Ditcham.
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 Germany. Tel: +49-8341 62026. Fax: +49-8341 62029.
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 control systems, data loggers and transmission systems and
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SENSUS TECHNOLOGIES INC,
 Bailey & Gallatin Avenues, PO Box 487, Uniontown,
 Pennsylvania 15401. USA. Tel: +1-412-439 7700. Fax:
 +1-412-430 3959. Contact Name: Mr David J Gestler -
 Manager, Business Development. Sensus is the successor to
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 Measurement & Flow Control Division which was acquired
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 of flow measurement equipment and automated meter read-
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 Products include positive displacement, turbo - and com-
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ECONOMIES THROUGH NEW TECHNOLOGIES

Anis Haider and Philip Roseberg of Schlumberger Industries report on the advantages of using a higher accuracy meter class C vs class B and the economies gained through automatic reading of meters.

The idea of using a higher accuracy meter is increasingly gaining audience around the world. This can easily be explained by examining the economies achieved by using for example a class C 15mm meter instead of a class B.

Main characteristics of the two types of meters:

	Class B	Class C
Starting flow	15 l/h	3 l/h
Minimum flow $\pm 5\%$ accuracy	30 l/h	15 l/h
Critical flow $\pm 2\%$ accuracy	60 l/h	22 l/h

Several studies have confirmed the following consumption pattern for a typical domestic water user:

Flowrates (l/h)	Consumption (per cent of total)
Between 3 and 15	7.0 per cent
Between 15 and 22	1.5 per cent
Between 22 and 30	1.5 per cent
Between 30 and 60	2.5 per cent
Above 60	87.5 per cent

The difference of consumptions measured therefore between the two meters can be calculated:

- Between flowrates of 3 and 15 l/h the class C meter has an average accuracy of -10 per cent and the class B meter is stopped. Therefore the difference is: $7 \times (100 \text{ per cent} - 10 \text{ per cent}) = 6.3 \text{ per cent}$ of the total consumption.
- Between 15 and 22 l/h the class C meter has an average accuracy of -3 per cent and the class B meter of -15 per cent. Therefore the difference is: $1.5 \times (15 \text{ per cent} - 3 \text{ per cent}) = 0.2 \text{ per cent}$ of the total consumption.

• Similarly, one can calculate the average difference of reading between the two meters for flows between 22 and 60 l/h: 0.2 per cent.

The total difference between the two therefore being 6.7 per cent of the total consumption.

Assuming an average daily domestic consumption of 200 litres per capita we see that the total yearly consumption lost by using a class B meter is: $(200 \times 365 \times 6.7) / 100,000 = 4.9 \text{ m}^3$ per capita per year.

Obviously, the figures can vary as far as daily consumption is concerned. In particular if there are leakage problems, use of reservoirs or water tanks controlled by ball-valves or consumers drawing water at night at very low flows, the percentage of total consumption at flows between 5 and 15 l/h will obviously increase making the higher accuracy meter even more attractive.

Several metering technologies that meet class C specifications exist today. The most popular being the volumetric piston type. Unfortunately this technology is unsuitable for water containing a lot of solid particles as these tend to block the piston. But recent developments in the jet type water metering technology have opened up new prospects. Class C jet type water meters are currently available in two basic forms: single jet and multi jet. The single jet class C concept was initially developed in France by Farnier and refined by Schlumberger. This technology is becoming increasingly popular as it has certain obvious and proven advantages over the multi jet: lower start-

ing flows and a greater accuracy over time.

More and more countries in the world are opting for the accuracy of the class C and find the increase in revenue easily outweighs the extra cost of the more accurate meter.

THE ECONOMICS OF AUTOMATIC REMOTE READING

AMR (Automatic Meter Reading) systems for domestic water meters are emerging from a period of evaluation and for two years have been installed on a large scale.

What are the factors contributing to this enthusiasm for AMR?

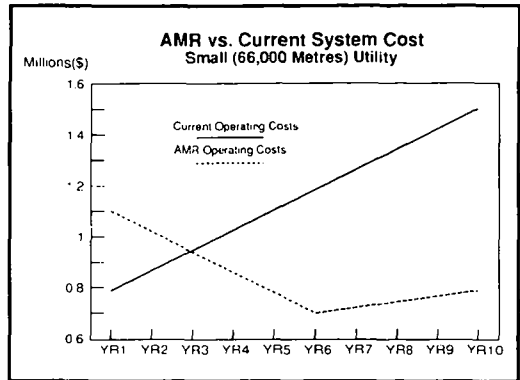
Automatic Meter Reading is a generic term used to describe systems which relay utility meter readings from the subscriber's home directly to the utilities' central offices without the intervention of a meter reader.

Current systems use an encoder to translate the mechanical meter index reading into an electronic digital signal, and transmit that signal through modems via the most convenient communication medium available (eg phone, radio, cable TV, mains wiring etc) to a central computer.

AMR is currently earning a lot of publicity due to the advantages it offers, and is gaining popularity particularly in the US where the number of installed points is rapidly approaching one million. However, from a utility's point of view what are the benefits of such a system over conventional meter reading?

The main motivations behind utilities' adoption of such a system which in today's terms still represents a substantial investment (upwards of US\$ 70 per point) are nevertheless economic: they reflect firstly the increasing difficulties experienced in gaining access to meter readings due to absent householders, and secondly the escalating costs of running a meter reading service. Water meters in particular present the greatest challenge to the meter reader due to their awkward location, in pits, in cellars, under bath-tubs etc where they are often submerged and require a great deal of ingenuity and courage to be read. The cost of reading water meters is therefore correspondingly higher (by up to 50 per cent) than for gas and electricity equivalents.

There is also a distinct trend towards increasing the frequency of reading meters, driven by the desirability of billing more often. Monthly bills can lead to a significant improvement in cash flow, and



an increased likelihood of prompt payment due to the smaller amount of the bill. Frequent billing however has inevitably to be supported by frequent reading, due to the unpopularity of estimated bills. With an AMR system, the reading frequency is no longer the leading variable affecting cost.

Besides the obvious savings which can be gained by eliminating the costs related to meter readers, AMR can provide further economies in a number of ways.

A shortening of the billing cycle can easily be achieved by having instantaneous access to readings and also by avoiding the lengthy and costly transfer of manually retrieved data to the company's billing computer.

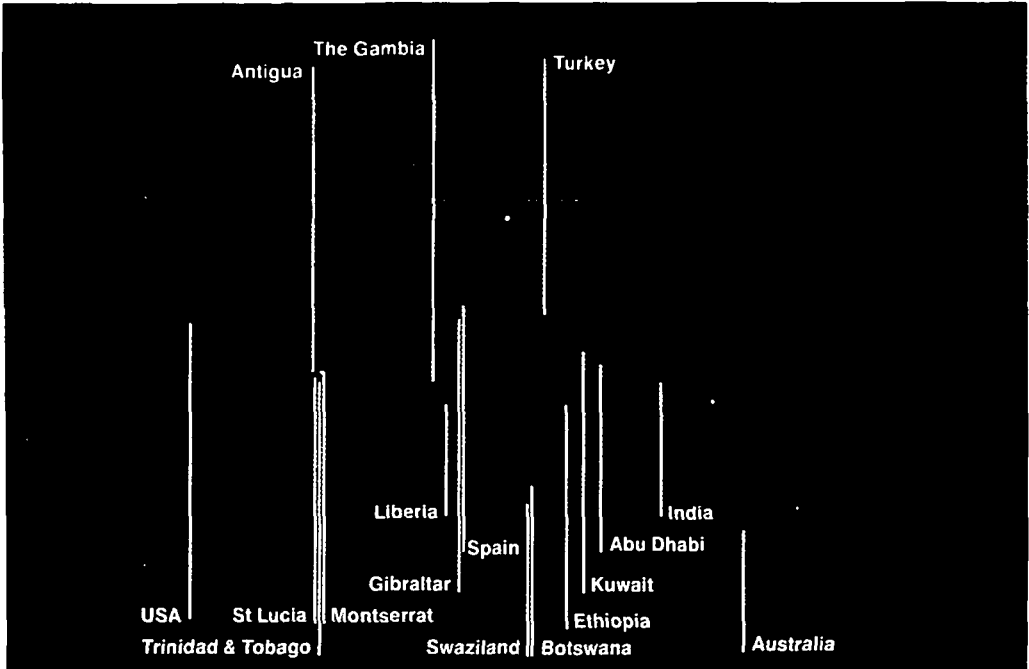
A great deal of administration work can also be avoided by minimising the number of customer complaints over inaccurate bills, and eliminating the liability of having meter readers involved in accidents at work, or for damage to customers' property.

AMR has also been known to create additional revenue by reducing theft, and aiding in leak detection. Frequent reading can provide consumption profiles which highlight these anomalies and help in network management.

Only recently have these benefits started to outweigh the equipment cost of AMR, and the systems begun to establish themselves as reliable; which has led to this sudden upsurge of interest. The typical AMR installation in the US is now expected to break-even in under five years, and to steadily increase in profitability as conventional meter reading costs escalate with inflation. (See Figure 1.)

Finally the houseowner should be delighted to hear that he will no longer be disturbed for his meter reading, and that his bill will correspond faithfully to the quantity of energy he has consumed.

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CONSULTANTS & CONTRACTORS

TRENDS TOWARDS DIVERSIFICATION & INTER- DISCIPLINARY WORK

by Ian Smout, Water, Engineering and Development Centre (WEDC).

Many consultants and contractors have diversified their activities in recent years, both to take advantage of opportunities for expansion, and to protect themselves against excessive financial exposure in a particular market and the dangers of a downturn.

Diversification has occurred into different sectors, different countries and different activities, and consultants and contractors have not limited this to filling in gaps in their civil engineering activities. For example, some of the best known civil engineering firms in the UK are now involved in such diverse activities as property investment and management, ship repairs, and project finance. China has presented new opportunities in the water sector in recent years, and many firms are now looking to eastern Europe to see if there are new opportunities there, for example in pollution control.

Some of this flexibility has included joint ventures with other firms, to achieve a wider expertise and a multi-national identity which can win internationally funded contracts. In development work, this has led to joint ventures between international and local firms, with the local company sometimes taking the lead. In another innovation, joint ventures comprised of consultant, contractor and utility have sought to undertake 'build, operate and transfer' projects, where the joint venture designs the scheme (consultant),

builds it (contractor) and operates it for some years (utility) before handing it over to the client.

Mergers have been another method of diversification, especially among consultants in recent years. It has been argued that clients like 'one-stop shopping', preferably from a local office with familiar staff. The acquisition of small firms has provided the larger consultancies with new clients, local offices and expertise, and a number of larger firms have merged to strengthen their financial base, widen their activities and share the high costs of international marketing.

Other contributory factors towards joint venture and merger have been the large size and complex nature of some current civil engineering projects. These demand technical and financial resources which can only be provided by the largest contractors and consultants.

INTER-DISCIPLINARY CONSULTANCY WORK ON DEVELOPMENT PROJECTS

This article focuses on consultants' inter-disciplinary work, which is an area where consultants

have adapted to changes in their markets and business environment, while leaving some basic consultancy features unchanged. It is also an area where consultants tend to catch the public eye – and criticism at times.

Consultants are used to working in inter-disciplinary teams. The design of a water system has long required the combination of expertise in water resources, hydraulic engineering, chemistry, and mechanical, electrical and structural engineering. The objective of the design process is to integrate these various aspects into a coherent package which simultaneously satisfies each discipline's criteria. Clients recognise that the bringing together and management of such teams is an important service provided by the consultancy firm, and aid agencies which field teams themselves, are well aware of the difficulties of doing this successfully. Nowadays, this teamwork process has become somewhat more complicated, involving co-operation between foreign consultant, local consultant, and government staff on many projects.

NEW TYPES OF INTER-DISCIPLINARY WORK

Some years ago, consultancy work in the water

sector widened beyond engineering design to include co-operation with architects, and the use of economists on planning/feasibility studies. More recently, consultancy firms have become involved in new types of inter-disciplinary work, such as the following, which are discussed in more detail below:

- Non-technical aspects of development projects;
- Appropriate technology, small scale and rural works;
- Institution strengthening, and assistance to programmes, rather than projects.

It has become increasingly recognised that water schemes are not simply technical systems, and as a result, the critical problems are frequently not technical ones. This has led observers to criticise consultants, and the governments and aid agencies for whom they work, for failing to take proper account of factors such as existing social structure and practices, operation and maintenance requirements, financial management and environmental issues. The importance of these aspects is now widely accepted. As an example, it is said that in many countries the World Bank is now reluctant to finance water supply projects which do not include management and operation

BELOW: Community participation: village interview for rural water supply in West Africa.





ABOVE: Management training: project managers learning to use computer spreadsheets in Indonesia.

and maintenance components.

As a result, aid agencies and governments are including such additional components in projects and in consultants' terms of reference, and consultancy firms are stressing their capability to provide specialist services in these fields.

Similarly, the ideas of appropriate technology, and experience in rural water supply and sanitation, have convinced planners of the need to combine technical perspectives with perspectives from the human sciences, to obtain workable designs. Involvement of the users or beneficiaries is one aspect of this, which is important both for the design and implementation of many small-scale works.

New types of project have arisen from increased awareness of the importance of management, operation and maintenance, resulting in components such as institution strengthening, management information systems, and training in operation and maintenance at all levels. Also, aid agencies now provide substantial funding for programmes in some countries, as well as projects, and consultants are providing assistance in a number of new areas as a result.

INTER-DISCIPLINARY WAYS OF WORKING

The consultancy firm aims to incorporate these new disciplines into a project team, as with the traditional disciplines, so as to produce workable plans and designs, through the integration and reconciliation of various specialists' points of view. It is a solution-orientated approach, which fits well with the planners' requirements, but may be unfamiliar to some of the disciplines: social scientists,

for instance, are less accustomed than engineers to making specific recommendations after a short study – and not used to being asked to adjust these to fit in with other aspects of the project! Yet this must be done to obtain a consistent inter-disciplinary result.

At the individual level, new consultancy specialisms have emerged such as engineer-economist, consultant sociologist, institutions specialist, etc. Some new roles are taken by engineers, moving from hardware into the software of water development. This is part of a greater awareness among engineers of the importance of the non-technical factors in preparation and implementation of engineering works.

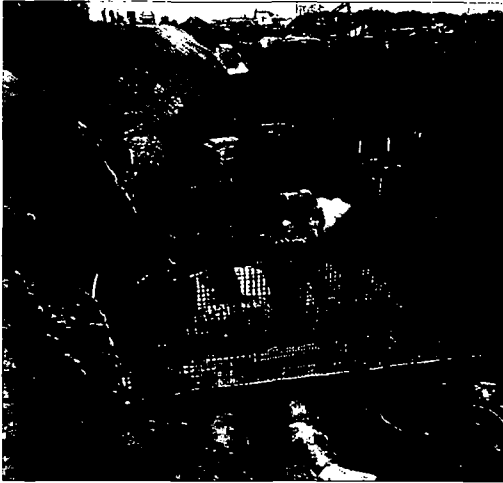
A different situation arises with small-scale works, where the aggregate potential benefit from a scheme may be too low to allow for a large number of specialist professionals to be involved, and it may fall to one person to cover all the disciplines. For example, assessment of a proposed site in a remote area in Nepal may be carried out by one engineer in a few days, collecting and assessing data on engineering, hydrology, socio-economics and institutions, according to criteria drawn up earlier with specialist professionals.

Incidentally, these wide ranging roles are those which WEDC aims to equip its students to undertake successfully. This is done through courses which include study of the community, management, health, economics and environmental aspects of water development, and both individual and group projects where the different perspectives are integrated into a coherent development plan.

CONCLUSION

As part of a general trend of diversification in the civil engineering industry, consultants are increasingly becoming large multi-disciplinary organisations which are able to carry out a broad range of work, including large and complex projects. One feature of current consultancy is the undertaking of inter-disciplinary work, the essence of which is the integration of the different disciplines, either in a team, or in an individual. The task of the consultancy firm is to mould what may start as a collection of disparate ideas from different disciplines, into a co-ordinated practical package. This requires skills in team management.

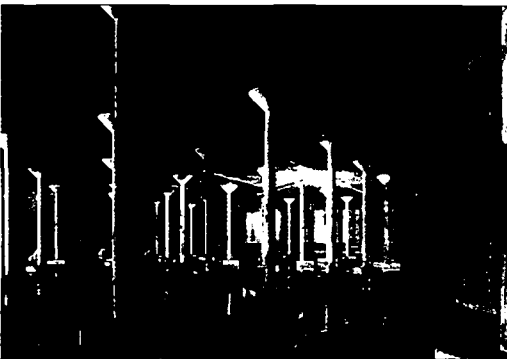
OVE ARUP AND PARTNERS



ELAN AQUEDUCT

For increased security, overground crossings of rivers etc. have been put underground. This photograph shows 2 x 1500mm and 3 x 1100mm diameter steel pipes being laid under a railway.

CLIENT *Severn Trent Engineering,*
CONTRACTOR *George Law Limited,*
CONSULTANT *Ove Arup and Partners, Water Engineering.*



LINTRATHEN WATER TREATMENT WORKS ALYTH TAYSIDE

The new works is noted for its harmonious reconciliation within an area of acknowledged environmental importance.

PHOTO *Interior of treated water reservoir.*
CLIENT *Tayside Regional Council, Water Services Department.*
MAIN CONTRACTOR *Biwater Treatment Limited.*
LEAD CONSULTANT *Ove Arup and Partners, Water Engineering.*

OVE ARUP & PARTNERS.
13 FITZROY ST. LONDON W1P 6BQ.
TELEPHONE +44-71-636-1531
TELEX 295341 OVARPT G
FAX +44-71-580-3924

Ove Arup and Partners is an independent practice, founded in 1946. The ideals and principles of Ove Arup, founder of the firm, are a driving force throughout. These include belief in: total design - the integration of the design and construction processes and the interdependence of all of the professionals involved; the creative nature of engineering design; the value of ingenuity and invention and the social purpose of design.

The firm has, from its inception, been concerned closely with the development of water resources, water and waste water engineering and environmental improvement.

Experience of every aspect of the water cycle and associated environmental impact has been gained through working on major urban, regional, industrial and rural engineering with projects at home and overseas. Skills have been developed in designing and developing economic solutions appropriate to specific needs, capabilities and circumstances.

The firm can draw on specialist personnel from a staff of 4,700 in 49 offices throughout the world.

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IRRIGATION, DRAINAGE & FLOOD PROTECTION

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1st Stoyan Lepoev Str. Bulgaria. Tel: +21 1882. Telex: 22563. Fax: +209129. Agromachinaimpex FTO for Import, Export and Inland Trade with tractors, farming machines and equipment, dealing with engineering, technical attendance and service. The Export List of Agromachinaimpex Foreign Trade Organisation covers 16 pump families, each produced in many modifications, a range of irrigation equipment and drip irrigation.

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PO Box 9300, Arnhem 6800 SB, The Netherlands. Tel: +31-85-664593. Telex: 45-204. Fax: +31-85-663727. Civil Engineering & Industrial Systems Division of Akzo is active in agriculture, the building industry, environmental protection, erosion control, geotechnics, hydraulic engineering and industry. The activities range from consulting during the design stage to assisting with the realisation of projects.

W S ATKINS & PARTNERS,

Woodcote Grove, Ashley Rd, Epsom, Surrey KT18 5BW, UK. Tel: +44-3727 26140. Telex: 266701 ATKINS G. Fax: +44-3727 77328. Consulting services in water and public health engineering projects including water resources, hydrology, dams, water supply/distribution/treatment, leak control, sewerage, stormwater drainage, sewage treatment, effluent re-use, irrigation and ICA.

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Oude Stationsstraat 144, Tiel 8880, Belgium. Tel: +32-51-40-36-71. Telex: 81-728. Fax: +32-51-40-05-13. Environmental engineering: water and wastewater treatment; waste treatment; waste gas and air treatment, environmental and safety audits. Energy: energy management of building

groups, energy audits. Infrastructure: design of drains, roads and sewerage, land reclamation and improvement works. Hydraulic Engineering. Structural Engineering. Industrial facilities.

BINGHAM COTTERELL LTD,

Scholes Hall, Scholes Lane, St Helens WA10 3PA, UK. Tel: +44-744 55151. Telex: 628607 BNG BLAG. Fax: +44-744 612011. Civil and structural engineering consultants, (water supply and treatment; sewage treatment; trade and industrial waste treatment; flood alleviation; river bank and flood protection).

CAMERON MCNAMARA PTY LTD,

299 Coronation Drive, Milton, Queensland, Australia. Tel: +61-7-368 9228. Telex: 41529. Broad-based organisation with multi-disciplinary skills in engineering, planning, economics, management and environmental and computer services. Varied fields of specialisation include fisheries, irrigation and flood control, dams, water storage and hydropower, drainage, wastewater, water supply and distribution.

CAMP DRESSER & MCKEE INTERNATIONAL INC,

One Cambridge Center, Cambridge, Massachusetts 02142, USA. Tel: +1-617-621 8181. Telex: 211967. Fax: +1-617-577 7504. Contact Name: Mr W D Moran. Providing specialised engineering services worldwide in irrigation, drainage and flood control, ranging from sophisticated modelling of hydraulic and water quality phenomena through detailed engineering services for irrigation service, urban storm drainage and canals, pumping stations, stormwater detention and reclamation. Programme management for irrigation advisory services throughout Asia and the Near East.

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3-12-3 Nishi-Waseda, Shinjuku-Ku, Tokyo 160, Japan. Tel: +81-3-207 1711. Telex: 232-4365. Fax: +81-3-732 3625. Wide international experience in many aspects of the water industry including fisheries, irrigation, flood control etc.

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consultancy organisation providing planning, architectural and engineering services in multi-disciplinary fields. Wide experience in water resources, irrigation, flood control and drainage etc.

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CPGF HORIZON,

Horizon House, Azalea Drive, Swanley, Kent BR8 8JR. UK. Tel: +44-322 680111. Fax: +44-322 613650. Contact Name: Dr J C Davey. Consultants in a wide range of geoscientific services to the water, environmental and construction sectors specialising in hydrogeological investigations, groundwater geophysics, mathematical modelling and well-field design, waste disposal studies, pollution investigations and the design of preventative and remedial measures; EIA's and civil engineering geophysics for foundation design.

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13229 Ronehill Drive, Beltsville, Maryland 20705. USA. Tel: +1-301-572 7674. Fax: +1-301-572 5306. Contact Name: Brendan E Lynch. Boston office: 12 Pine St, Pepperell, MA 01463. USA. Irrigation consultants for: residential, estate, commercial, agricultural, golf and wastewater. Seminars, water management, master planning of irrigation systems for staged development.

ECKENFELDER INC,

227 French Landing Drive, Nashville, Tennessee 37228. USA. Tel: +1-615-255 2288. Fax: +1-615-256 8332. Contact Name: Lisa Robinson. Eckenfelder Inc, formerly

Aware Inc, is an environmental consulting firm specialising in industrial wastewater treatment, wastewater treatment plant troubleshooting and upgrading, industrial toxicity reduction programmes, hazardous waste management, air quality services and groundwater contamination assessment and remediation.

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801-753 5651. Fax: +1-801-753 6139. Keller-Bliesner Engineering is a consulting engineering company specialising in irrigation and agricultural development. Our specialities include: computerised project development analysis from a multi-disciplined view point, emphasising optimisation of nearly any set of goals; vast experience in advanced technology irrigation; evaluation of existing projects and second opinion consulting and project reviews.

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1110 Dorchester Boulevard West, Montreal, Quebec,
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Established to provide civil engineering consultancy throughout South East Asia. Predominantly engaged in civil and structural engineering and offers a full consultancy service for all projects - irrigation and flood control, river regulation, drainage, wastewater, water supply and water distribution.

OVE ARUP & PARTNERS,
13 Fritzroy St, London W1P 6BQ. UK. Tel: +44-71-636 1531. Fax: +44-71-580 3924. Arups is the largest UK Consultancy and has 37 overseas offices. The firm is multi-disciplinary and has all the skills, capabilities and specialists required for the engineering and economics of every aspect of the water cycle and environment. Engineers have extensive experience on major projects in the UK and developing and other countries as lead consultant or specialist.

POSFORD DUVIVIER,
Rightwell House, Bretton Centre, Peterborough PE3 8DW.
UK. Tel: +44-733 262468. Telex: 32651. Fax: +44-733 262243. Consulting engineers offering a full range of services in the fields of water resources, water supply, sewerage, sewage treatment, waste disposal, land drainage, flood alleviation, irrigation and coastal works.

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1505 Planning Research Drive, McLean, Virginia 22102.
USA. Tel: +1-703-556 1000. Telex: 248372. Fax: +1-703-556 1174. Serves government and industry in

planning, engineering, architecture, construction management and the design, commissioning, operation and maintenance of a diverse range of facilities. Irrigation, flood control, river regulation, dams, drainage, wastewater, water supply and distribution, hydroelectric power.

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Alameda de Recalde, 27-50, 48009 - Bilbao, Spain. Tel: +4-4236446. Fax: +4-4246685. Pridesa is a company devoted to the study, procurement and performance of all kinds of water and waste water treatment plants.

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Water Resources & Research Institute, 2 Yeniseiskaya St, 129344 Moscow, USSR. Tel: +1892196. Telex: 412198 INWOD SU. Fax: +1892355. It is a major Soviet organisation in surveys, planning and studies relating to land reclamation and water management. It offers: engineering services, know-how, ready-to-use engineering and process developments, training of personnel, joint activities in design and construction on a turnkey basis operation and maintenance of water-resources and irrigation projects.

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PO Box 5038, Linnegatan 2, Stockholm S-102 41,
Sweden. Tel: +46-8-663-03-70. Telex: 17597. Fax: +46-8-660 9217. Sweco is a company of consulting engineers, working worldwide in all fields of urban, industrial and infrastructure development. Important fields of activities are: water resources, water conveyance, water treatment including desalination and water distribution.

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Fax: +1-212-697 6354. Consulting firm of engineers, architects and planners providing professional services for projects throughout the world. Fields of specialisation include water resources - planning, design and construction supervision services for dams, hydroelectric power, flood control, irrigation systems and river basin planning.

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A-9020 Klagenfurt, Hoffmangasse 12. Austria. Tel: +43-4222/55-1-25. Telex: 42109 ALPCO A. Alpenconsult are a team of independent consulting engineers. In the water technology field Alpenconsult's activities embrace studies and investigation, planning and design, tender documents, building supervision and acceptance, personnel training, technical consultation and management.

R W BECK & ASSOCIATES,
Fourth & Blanchard Building, 2121 Fourth Avenue, Seattle, Washington, USA. Tel: +1-206-441 7500. Fax: +1-206-441 4962. Services span the disciplines of civil, mechanical, electrical, sanitary and structural engineering, computer systems, economics, environmental sciences and construction management with the complete range of feasibility, planning, design, project and programme management, start up and operations assistance.

BETECH N V,
Vestinglaan 32-34, Mortsel 2510. Belgium. Tel: +32-3-440

5930. Telex: 73290. Fax: +32-3-440 4847. BETECH is an engineering company, providing services for water treatment and disposal projects. The scope of activities includes: feasibility studies, design and engineering and construction supervision.

CAMP DRESSER & MCKEE INTERNATIONAL INC,
One Cambridge Center, Cambridge, Massachusetts 02142. USA. Tel: +1-617-621 8181. Telex: 211967. Fax: +1-617-577 7504. Contact Name: Mr W D Moran. Providing specialised management and financial consulting services worldwide to government agencies responsible for water resources, urban infrastructure, and environmental systems. Institutional development and training, financial planning and systems development, utility revenue structures and billing systems, GIS and AM/FM computer applications to management of urban infrastructure, operations and maintenance consulting, counterpart advisory services.

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22 Upper Grosvenor St, London W1X 0AP. UK. Tel: +44-71-491 4864. Telex: 21179. Fax: +44-71-409 3505. The multi-disciplinary consultancy undertakes feasibility studies, detailed engineering design, preparation of contract documents, evaluation of tenders and supervision of construction for all aspects of water supply and sanitation engineering.

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60 Albert Rd, South Melbourne, Victoria, Australia. Tel: +61-3-697 8333. Telex: 32071. Fax: +61-3-697 8444. Civil and structural engineering for transport, environment and industry design, planning; earth sciences and implementation in land and water feasibility studies, drainage, wastewater, water supply and distribution.

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A-1030 Wien, Zaunergasse 4. Austria. Tel: +43-222-75-21-65. Telex: 132277. The engineers and technicians of Consulco plan installations and equipment for water supply and sewage disposal purposes, including all the necessary infrastructure. Consulco also undertake to supervise the installation and operation of the plants. For the Near and

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Royal Oak House, Brighton Rd, Purley, Surrey CR2 2BG. UK. Tel: +44-1-668 0711. Telex: 947020 COODE G. Fax: +44-1-668 4216. The Coode Blizard Group, consulting engineers, provide consulting services for investigation, design and construction of water supply, public health and water resource development projects in developing countries worldwide.

CROOKS MITCHELL PEACOCK STEWART PTY LTD,

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ILF CONSULTING ENGINEERS,

A-6020 Innsbruck, Framsweg 16 Austria. Tel: +43-5222/63-3-33. Telex: 53733 LAIBK A. Special activities of ILF include water management studies, long-distance water pipelines with pumping stations, reservoirs and auxiliary facilities, water supply, water treatment, sewage clarification and sewage disposal. The line-up of services offered embraces expertises, studies, feasibility studies, preliminary and detailed plans, checking of tenders, supervision and coordination of building work and start-up, critical path planning and personnel training.

INGENIEURBURO PROF DR ERWIN LANG,

A-2700 Wiener Neustadt, Wiener Strasse 12. Austria. Tel: +43-2622/33-76/45-07. Engaged in planning and calculation, but not installation work. There are two main areas of activity. The first, water management and hydraulic engineering. The second, domestic water supply and disposal, covers sewer and sewage treatment plant construction (mechanical and biological), wells for water supply and water treatment plants.

INTERSIGMA CO LTD,

Václavské nám 60, 111 87 Praha 1,

Czechoslovakia. Tel: +42-2357748 56. Telex:

21205. Fax: +42-2369537. INTERSIGMA exports

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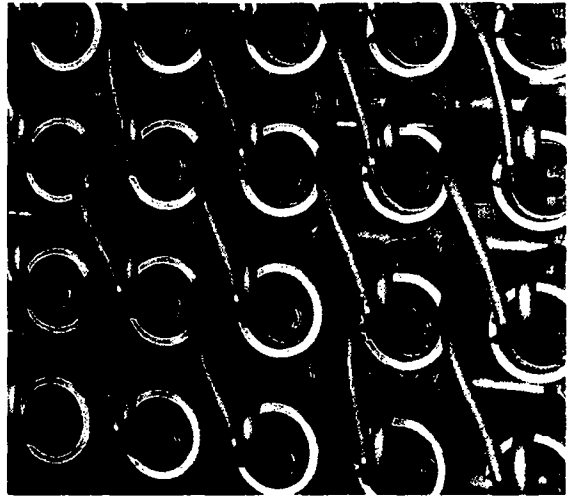
But appropriate technologies can also mean expert use of new and emerging technologies that have ready application to critical water supply and management needs in diverse settings.

Ultra-low-pressure membranes capable of treating local water supplies of marginal quality at less cost than developing remote water supplies.

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offices worldwide



Consultancy for water and environment



External Wastewater Treatment of a Pulp Mill, Oy Metsä-Botnia Ab, Äänekoski, Finland

Hanoi Water Supply Project, Vietnam

Company's profile

Soil and Water Ltd. is an independent multidisciplinary consulting company founded 1949 employing currently 400 professionals. The current billing is about USD 30 million, one quarter of that coming from international projects.

The company belongs to Juva Group of Consulting Engineers, a Finnish consulting group employing about 760 people.

Services rendered

The company offers a great variety of consulting services related primarily to water supply and sanitation and environmental aspects of development. The staff comprises expertise of water supply and sanitation engineers, water resources engineers, process engineers, biologists, foresters, environmentalists, geologists, civil, structural, mechanical and electrical engineers, architects and physical planners.

The fields of activities cover:

- Water supply and sanitation
- Wastewater treatment
- Water resources studies
- Environmental impact assessment
- Environmental forestry
- Erosion control, soil conservation
- Solid waste management
- Traffic and transportation engineering
- Geotechnical engineering
- Physical planning
- Building design
- Tunneling
- Survey and mapping

The scope of services comprises:

- Preliminary investigations
- Feasibility studies
- Design and engineering
- Project management, site supervision
- Operation and maintenance services
- Institution building and training

References

The international career of the company started in late 60's and since that a great number of projects in more than 20 countries have been carried out. The following recent assignments can be mentioned:

Portugal: Effluent treatment plant of Cacia pulp mill; design, engineering and project management. (90,000 m³/d)

Sri Lanka: Kandy District Water Supply and Sanitation Project: rural pump wells, pipes schemes, latrines.

Vietnam: Hanoi Water Supply Project; urban population of 900,000, water production 300,000 m²/d.

Vietnam: Hanoi Sanitation Strategy Study

USSR: Effluent treatment plant of a pulp and paper complex; design and engineering (264,000 m³/d)

Nepal: Integrated Watershed Management Project; soil conservation and erosion control of two critical watersheds.

Egypt: Underground Utilities Data Center Project of Greater Cairo; establishment of a computerized utility data system serving the whole Cairo, population of 13 million, institution building, staff training, pilot area surveys.



SOIL AND WATER LTD
Consulting Engineers

P.O.Box 14, SF-00210 HELSINKI, FINLAND
Telephone +358-0-682661, Telefax +358-0-6826600, Telex 121963 swcon sf

MERALCO INDUSTRIAL ENGINEERING SERVICES CORP,

3rd-5th Floors, TSG Building, Meralco Cmpo, Ortigas Avenue, Pasig MM, Philippines. Fax: +63-721-9951. Broad-based operations including most aspects of water distribution and use. Services include, design planning, implementation, construction management and supervision, purchasing and project management.

JAMES M MONTGOMERY CONSULTING ENGINEERS INC,

PO Box 7009, 250 North Madison Avenue, Pasadena, California 91109/7009. USA. Tel: +1-818-796 9141. Recognised internationally for expertise and unique capabilities in water and wastewater engineering. Offer a complete range of services including master plans and feasibility studies, detailed design, construction management services and facilities start-up and operation. Experience in aquaculture.

MOTOR COLUMBUS CONSULTING ENGINEERS INC,

Parkstrasse 27, Baden CH-5401. Switzerland. Tel: +41-56-20-11-21. Telex: 825-045. Fax: +41-56-22-1828. Water related fields are: Resources inventories and master planning; water resources development and management; hydraulic engineering, water power and dams; sanitary engineering; environmental impact assessment and risk analysis.

OVE ARUP & PARTNERS,

13 Fritzroy St, London W1P 6BQ. UK. Tel: +44-71-636 1531. Fax: +44-71-580 3924. Arups is the largest UK Consultancy and has 37 overseas offices.

The firm is multi-disciplinary and has all the skills, capabilities and specialists required for the engineering and economics of every aspect of the water cycle and environment. Engineers have extensive experience on major projects in the UK and developing and other countries as lead consultant or specialist.

PARKMAN CONSULTANTS,

Cunard Building, Liverpool L3 1ES. UK. Tel: +44-51-236 6066. Fax: +44-51-236 1276. Consultants in water resources and supply, irrigation and public health engineering providing technical, economic and environmental studies, engineering design, contract documentation, bid evaluation, construction management and supervision and computer services.

ROFE KENNARD & LAPWORTH,

Raffety House, 2/4 Sutton Court Rd, Sutton, Surrey SM1 4SS. UK. Tel: +44-1-643 8201. Telex: 946688. Fax: +44-1-642 8469. Consulting engineers specialising internationally in water engineering and management, including water resources, dams & reservoirs, ground water, treatment, dam safety, operations and institutional management. Scherres have been designed in all continents.

SAFEGE CONSULTING ENGINEERING,

76 Rue des Suisses, Nanterre 92000. France. Tel: +33-47-24-72-55. Fax: +33-47-24-77-88. Five companies with various locations and expertise form the SAFEGE group. Safege is presently working in more than 30 countries in Europe, Asia, Africa and America. Specialities include: environment; water and sanitation, civil and urban engineering; management of public utilities, and computer applications for engineering and management.

SGI - CONSULTING ENGINEERS,

PO Box 158, 71 Avenue Louis-Casari, 1216 Cointrin, Geneva. Switzerland. Tel: +41-22-986611. Telex: 22044. Fax: +41-22-980800. SGI provide a complete range of consultancy services (feasibility studies, design and supervision) in the field of water engineering, covering water supply and treatment, water resources development, sewage treatment, irrigation and drainage and hydro-power schemes.

SOYUZGIPROVODKHOZ,

Water Resources & Research Institute, 2 Yeniseiskaya St, 129344 Moscow. USSR. Tel: +1892196. Telex: 412198 INWOD SU. Fax: +1892355. It is a major Soviet organisation in surveys, planning and studies relating to land reclamation and water management. It offers: engineering services, know-how, ready-to-use engineering and process developments, training of personnel, joint activities in design and construction on a turnkey basis operation and maintenance of water-resources and irrigation projects.

SPIE-CAPAG,

Parc Saint-Christophe, 95864, Cergy-Pontoise, Cedex. France. Tel: +33-1-34-22-70-00. Telex: 609689. SPINCAA F. Fax: +33-1-34-22-79-60. Contact Name: Daniel Mallet. Subsidiary of the Spie Batignolles Group, Spie-Capag is involved worldwide in the execution of major water, irrigation and sewerage schemes, the restoration of water and sewerage network being a further speciality using the latest technology.

WASTEWATER TREATMENT & DISPOSAL

WASTEWATER TREATMENT & DISPOSAL

A E C C (A Q U A E N G I N E E R I N G & C O N T R A C T I N G C O) ,

Altenburgerstrasse 49, Brugg CH-5200. Switzerland. Tel: +41-56-41-69-61. Telex: 825139 INGH CH. Fax: +41-56-41-15-75. The specialist for: general planning, detail design, consulting, supervision, including civil works, general contracting for mechanical-electrical equipment, for all potable, industrial, waste water facilities, wells, pumping, treatment cooling and distribution.

A I B C O N S U L T I N G E N G I N E E R S ,

PO Box 1315, Solna S171 25. Sweden. Tel: +46-8-734 5500. Fax: +46-8277684. Consulting engineers with a broad experience of water supply and sewage treatment in Sweden and in developing countries master plans, feasibility studies, detailed design, supervision, operation and maintenance.

A L L O T T & L O M A X ,

Fairbairn House, Ashton Lane, Sale, Manchester M33 1WP. UK. Tel: +44-61-962 1214. Fax: +44-61-969 5131. Allott & Lomax provides consulting services in the fields water of engineering in the design and project management of water abstraction, treatment and distribution systems, service reservoirs, sewerage, sewage treatment and pumping stations.

A N T W E R P W A T E R C O N S U L T I N G ,

Mechelsesteenweg 64, Antwerp B-2018. Belgium. Tel: +32-3-238 7830. Telex: 32139. Fax: +32-3-237 9766. An interdisciplinary partnership firm providing services in drinking water supply and treatment, wastewater treatment, including consulting and expertise, feasibility studies, design and engineering, technical assistance, education and training.

A S H A C T ,

11 Wycombe Rd, Prestwood, Great Missenden, Bucks HP16 0NG. UK. Tel: +44-2406 6014. Fax: +44-2406 5395. Ashact is an Environmental Management Consultancy working mainly in the fields of water, wastewater and solid wastes. The company is independent and it has extensive experience in the developing world.

B A B T I E S H A W & M O R T O N ,

95 Bothwell St, Glasgow G2 7HX. UK. Tel: +44-41-204

2511. Telex: 77202. Fax: +44-41-226 3109. Resource studies, system analysis, hydrology, hydrogeology, geotechnical investigations, design and inspection of dams, treatment works, distribution systems, service reservoirs, sewage process design and treatment works, sewers, pollution control. Design and supervision of construction of water and public health works.

B A L F O U R S ,

Yeoman House, 63 Croydon Rd, London SE20 7TW. UK. Tel: +44-81-659 2221. Telex: 946448. Fax: +44-81-659 5702. Consulting engineers specialising in water treatment and supply; drainage and sewerage; treatment and disposal of sewage, solid and hazardous wastes; air pollution control; environmental impact assessment.

B A S S E T T C O N S U L T I N G E N G I N E E R S ,

70 Albert Rd, South Melbourne, Victoria 3205. Australia. Tel: +61-3-699 2411. Telex: 32185. Fax: +61-3-690 5596. Specialists in mechanical, electrical and industrial engineering installations for commercial, institutional and industrial buildings, design, planning and implementation in many field, including pipelines, wastewater collection and treatment, water supply and distribution. International experience includes, Bangladesh, China, Nigeria, Indonesia and Brazil.

B E L C O N S U L T I N G N V ,

Oude Stationsstraat 144, Tielt 8880. Belgium. Tel: +32-51-40-36-71. Telex: 81-728. Fax: +32-51-40-05-13. Environmental engineering: water and wastewater treatment, waste treatment, waste gas- and air treatment, environmental and safety audits. Energy: energy management of building groups, energy audits. Infrastructure: design of drains, roads and sewerage, land reclamation and improvement works. Hydraulic Engineering. Structural Engineering. Industrial facilities.

B I N G H A M C O T T E R E L L L T D ,

Scholes Hall, Scholes Lane, St Helens WA10 3PA. UK. Tel: +44-744 55151. Telex: 628607 BNG BLAG. Fax: +44-744 612011. Civil and structural engineering consultants, (water supply and treatment; sewage treatment; trade and industrial waste treatment; flood alleviation; river bank and flood protection).

B I O T E C H I N D U S T R I A L P R O D - U C T S L T D ,

3 Blenheim Rd, Sherwell, Plymouth, Devon PL4 8JJ. UK. Tel: +44-752 262652. Telex: 45795. Fax: +44-752 261664. Design and consultancy on water and waste management; supplier of OBC plus BIO Augmentation Media (Flow Laboratories Inc) and Osprey Oil Spill Recovery Media.

**CAMP DRESSER & MCKEE
INTERNATIONAL INC,**

One Center Plaza, Boston, Massachusetts 02108. USA. Tel: +1-617-742 5151. Telex: 94-0120. Fax: +1-617-227 3995. Ranks among the largest consulting firms in the environmental field. Worldwide experience ranges from complete engineering services for water supply and sewerage for urban areas to rural sanitation for developing countries.

**CAMP DRESSER & MCKEE
INTERNATIONAL INC,**

One Cambridge Center, Cambridge, Massachusetts 02142. USA. Tel: +1-617-621 8181. Telex: 211967. Fax: +1-617-577 7504. Contact Name: Mr W D Moran. Providing specialised environmental engineering services worldwide to industry and government, including pollution control program planning, detailed engineering for wastewater collection and treatment, industrial wastewater pre-treatment, water reclamation and reuse, turnkey design/construction management, sludge processing, urban and rural sanitation programs, outfall engineering, water quality management planning.

COODE BLIZARD,

Telford House, Hulse Rd, Southampton SO9 3JQ. UK. Tel: +44-703 228455. Telex: 47338. Fax: +44-703 639665. Full consultancy services offered in: irrigation, drainage and flood alleviation, sewerage, wastewater and trade effluent treatment, water supply, treatment and distribution, mechanical/electrical services, ports, harbours and coast protection.

**COOPER MACDONALD & PART-
NERS,**

Loxford House, East St, Epsom, Surrey KT17 1HG. UK. Tel: +44-3727 28511. Telex: 928439. Fax: +44-3727 42129. From UK and overseas offices a full consulting service is offered in most branches of civil engineering including water supply and distribution, sewerage and sewage disposal irrigation and drainage.

CYRUS RICE CONSULTING GROUP,
C/O Nus Corp Two Park West Cliff Mine Rd, Pittsburgh, PA 15257. USA. Tel: +1-412-788 1080. Consulting work in all phases of water treatment and trouble shooting, including cooling, steam generation, wastewater, clarification, demineralisation, specification writing and review, and seminars.

**SIR HERBERT HUMPHRIES &
MCDONALD,**

Rookery Park, Kingsbury Rd, Erdington, Birmingham B24 9SF. UK. Tel: +44-21-377 6515. Fax: +44-21-377 6516. Consulting engineers specialising in water supply, sewerage and sewage treatment

IMI BAILEY BIRKETT LTD,

Sharp St, Worsley, Manchester M28 5NA. UK. Tel: +44-061-790 7741. Fax: +44-061-703 8451. IMI Bailey Birkett Ltd has been one of the UK's leading specialist valve manufacturers for over 150 years. One of the company's most priceless assets is its considerable wealth of experience in all types of valve specification and application. A team of highly trained specialists is on hand to provide effective solutions to any valve related problem, whatever the application, wherever in the world it might be. Contact the marketing department for further details.

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6 Lower Grosvenor Place, London SW1W 0EW. UK. Tel: +44-71-828 7733. Telex: 917864 RTJLON G. Fax: +44-71-828 4148. Civil and structural engineers with specialist design experience in trade effluent treatment works, drainage systems, gravity and pumped sewage schemes, pipeline and associated structures. Also experience in total project management.

KASKAD IRRIGATION,

Kaskad Engineering Ltd, 26-30 Station Rd, Epworth, Nr Doncaster, South Yorks DN9 1JU. UK. Tel: +44-427 873034. Fax: +44-427 874260. Our experienced team can provide you with advice on all aspects of wastewater disposal. Our low cost hoses (also ideal for clear water use) are lightweight and only require low pressure but we can also design and install larger systems. Contact us with your requirements (See main advertisement).

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SULTING ENGINEERS,**

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WASTEWATER TREATMENT & DISPOSAL

NE1 8AR. UK. Tel: +44-91-232 4383. Telex: 537681/2/3 ALWRLD G FOR MPL. Fax: +44-91-261 0986. Consultants for civil, mechanical and electrical engineering associated with sewage treatment, water and effluent treatment.

MAUNSELL CONSULTANTS ASIA,
1 Kowloon Park Drive, Kowloon. Hong Kong.
Tel: +852-3-695-251. Telex: 44458. Fax: +852-3-7224070. Established to provide civil engineering consultancy throughout South East Asia. Predominantly engaged in civil and structural engineering and offers a full consultancy service for all projects - irrigation and flood control, river regulation, drainage, wastewater, water supply and water distribution.

METCALF & EDDY INTERNATIONAL INC,
PO Box 4043, Woburn, Massachusetts 01888-4043.
USA. Tel: +1-617-246 5200. Telex: 6817067. Fax: +1-617-245 6293. Full range of services from planning and financing and design and construction to operations and maintenance. The firm has worked to provide cost-effective, technologically sound solutions for water, wastewater, solid waste and hazardous waste management, natural resource utilisation and the infrastructure crucial to industrial and agricultural development.

OVE ARUP & PARTNERS,
13 Fritzroy St, London W1P 6BQ. UK.
Tel: +44-71-636 1531. Fax: +44-71-580 3924. Arups is the largest UK Consultancy and has 37 overseas offices. The firm is multi-disciplinary and has all the skills, capabilities and specialists required for the engineering and economics of every aspect of the water cycle and environment. Engineers have extensive experience on major projects in the UK and developing and other countries as lead consultant or specialist.

PENCOL ENGINEERING CONSULTANTS,
20 Grosvenor Place, London SW1X 7HP. UK. Tel: +44-71-235 4300. Telex: 27515. Fax: +44-71-235 5695.
Multi-disciplinary consultancy providing services for water, sewage and liquid waste, public health, oil and gas engineering, with particular emphasis on pipeline and high technology applications for mechanical, electrical, control and communication systems.

POSFORD DUVIVIER,
Rightwell House, Bretton Centre, Peterborough PE3 8DW.
UK. Tel: +44-733 262468. Telex: 32651. Fax: +44-733 262243. Consulting engineers offering a full range of services in the fields of water resources, water supply, sewerage, sewage treatment, waste disposal, land drainage, flood alleviation, irrigation and coastal works.

PREUSSAG ANLAGENBAU GMBH,
Karl-Wiechert-Allee 4, D-3000 Hannover 61.
Germany. Tel: +49-0511-5-66-00. Telex: 9-22-828.
Fax: +49-0511-5-66-39-00.

SAFEGE CONSULTING ENGINEERING,
76 Rue des Suisses, Nanterre 92000. France. Tel: +33-47-24-72-55. Fax: +33-47-24-77-88. Five companies with various locations and expertise form the SAFEGE group. Safege is presently working in more than 30 countries in Europe, Asia, Africa and America. Specialities include: environment; water and sanitation, civil and urban engineering; management of public utilities, and computer applications for engineering and management.

SCHUFFL & FORSTHUBER CONSULTING ENGINEERS,
Reichenhallerstrasse 6, Salzburg A 5020. Austria. Tel: +43-662 845221. Telex: 633892. Fax: +43-662 845221-8.
The company can offer experience and know-how for projects such as: water prospecting, water distribution, water-loss analysis, water treatment, sewage systems, pumping stations, treatment plants for domestic and industrial wastewater, refuse composting, refuse incineration, waste disposal, special waste disposal, old surplus disposal and gas disposal technology.

SOCIETE D'EPURATION ET D'ENTREPRISES SA,
Rue de la Science 5, Brussels 1040. Belgium. Tel: +32 2 230 93 14. Fax: +32 2 230 76 13. For several decades SEE has actively worked to control and neutralise pollution in rivers that comes from a variety of sources - urban and industrial.

SOIL & WATER LTD,
PO Box 14, SF-00210 Helsinki. Finland. Tel: +358-0-682 661. Telex: 121963 SWCOM SF. Fax: +358-0-682 6600. The scope of services comprise feasibility studies, planning, design and engineering of facilities,

project management, procurement management, commissioning and start-up services, institutional development and training of personnel for: sewage treatment plants, aerobic and anaerobic sludge treatment, effluent recycling, external wastewater treatment plants of pulp and paper industries and other industries.

TAMS-PIRNIE INTERNATIONAL,
655 Third Avenue, New York, NY 10017. USA. Tel: +1-212-867 1777. Telex: (ITT) 422188/ (RCA) 233055.
Fax: +1-212-697 6354. TPI was formed to offer environmental planning, sanitary engineering and water resources development on a worldwide basis. Fields of specialisation include water supply systems (all types), wastewater systems and industrial water and pollution control.

THAMES WATER INTERNATIONAL,
Nugent House, Vastern Rd, Reading, Berks RG1 8DB. UK.
Tel: +44-734 593353. Telex: 848054 TODTWA G. Fax: +44-734 593747. Thames Water International is a division of Thames Water, which is one of the world's largest water undertakings concerned with water resources, treatment and distribution, sewerage, sewage treatment, sludge disposal, pollution control, flood control, river management and recreation. Offers advice and assistance on the above operational matters with particular reference to institutional studies, process optimisation and training.

VERBUND-PLAN GMBH,
Am Hof 6A - A-1010 Vienna, Austria. Tel: +43-1-0222-53113 4800. Telex: 115978 VPLWN A. Fax: +43-1-0222-53113 4848. Verbund-Plan Consulting Engineers are working in the field of Wastewater Treatment and Disposal and can give tailor-made solutions also in the field of industrial wastewaters, eg out of thermal power plants.

WATER SUPPLY CO OF MARSEILLES,
25 Rue Edouard Delanglade, Marseille 13006. France. Tel: +33-91-57-60-87. Telex: 440884. Fax: +33-91-57-60-97.
Water supply and sanitation company specialist in consultancy, training and project design for water supply networks, sewerage, water treatment and distribution and master plans.

WATER-INTERNATIONAL LTD,

PO Box 49, Oakland House, Talbot Rd, Old Trafford, Manchester M16 0QY. UK. Tel: +44-61-848 0683. Telex: 665682. Fax: +44-61-872 5581. Water International Ltd is the overseas consultancy company formed by three of the UK's largest water undertakings - Northwest, Welsh and Yorkshire Water. Key activities are: institutional development, resource management, water and sewage treatment; distribution and disposal, operation contracting, training.

WATER RESOURCES DEVELOPMENT

BINNIE & PARTNERS,
Grosvenor House, 65 London Rd, Redhill, Surrey RH1 1LQ. UK. Tel: +44-737 774155. Telex: 24552. Fax: +44-737 72767. Provides comprehensive worldwide consulting engineering services in water resource development including water and waste water treatment, low cost sanitation, pollution control, environmental protection, irrigation and power; technology transfer and training.

BINNIE & PARTNERS (HONG KONG),
51st Floor, Hopewell Centre, 183 Queens Rd East. Hong Kong. Tel: +852-5-292961. Telex: 74679. Fax: +852-5-272560. Specialists in all aspects of water resources, supply and treatment with experience in Brunei, China, Hong Kong, Macau, South Korea and Taiwan.

C LOTTI & ASSOCIATES,
Via del Fiume 14, Rome 00186. Italy. Tel: +39-6-3613341. Telex: 611113. Fax: +39-6-3607298.
Consulting engineering firm operating in the field of water resources development and management, large hydraulic works, hydroagriculture infrastructure, transport, building industry and urban infrastructure and environment engineering.

CAMP DRESSER & MCKEE INTERNATIONAL INC,
One Cambridge Center, Cambridge, Massachusetts 02142. USA. Tel: +1-617-621 8181. Telex: 211967. Fax: +1-617-577 7504. Contact Name: Mr W D Moran. Providing specialised water resources and environmental engineering services worldwide to industry and government, including planning and development of surface-water and groundwater supplies; engineering for water transmission, distribution, and pumping; water filtration/treatment; desalination; restoration of contaminated supplies; advanced

computer modelling for waste supply development and protection; SCADA, AM/FM and GIS technologies.

DAMES & MOORE,

Booth House, 15-17 Church St, Twickenham TW20 3NJ, UK. Tel: +44-1-891 6161. Telex: 92986. Fax: +44-1-891 447. International consultants in environmental and applied earth sciences, planning and economics, with offices worldwide. Services include investigation and management of water resources; hazardous wastes; pollution control, geotechnical and structural engineering; civil design etc.

DUNN GEOSCIENCE CORPORATION,

12 Metro Park Rd, Albany, NY 12205, USA. Tel: +1-518-458 1313. Fax: +1-518-458 2472. Consulting hydrologists and geologists in the field of ground water development, analysis, polluted water cleaning, contaminate movement and remediation studies.

GERAGHTY & MILLER INC,

7 Atlantic St, Hackensack, NJ 07601, USA. Tel: +1-201-646 1400. Fax: +1-516-249 7610. Services address all aspects of groundwater, including resource development, supply and management; contamination investigations; monitoring; closure plans; contamination cleanup/containment; permits; and expert testimony.

HYDROTECHNICA LTD,

Abbey Foregate, Shrewsbury, Shrops SY2 6HP, UK. Tel: +44-743 236464. Telex: 35156 (HYTECH G). Fax: +44-743 236303. Water resources consultants specialising in groundwater resources assessment and development, hydrology, hydrometry, geophysical exploration, aquifer modelling, wellfield modelling, downhole geophysics, geochemistry and environmental appraisal. Also offers services in geotechnics, hydraulics and computing. Hydrotechnica is part of the Robertson Group, which provides support in the fields of oil and mineral geology, laboratory services, cartography and remote sensing.

KISO-JIBAN CONSULTANTS CO LTD,

Mimura Building, Kanda, Jimbo-Cho 1/34, Chiyoda-Ku Tokyo, Japan. Tel: +81-3294 7261. Telex: J28457 Fax: +81-3-292 8010. Comprehensive capabilities in the field of geotechnical engineering - subsurface investigation, soil and rock mechanics and groundwater management. International experience in the water fields of agriculture and public utilities.

KRTA LTD,

Quay Tower, 29 Customs St West, Auckland, New Zealand. Tel: +64-9-795-700. Telex: NZ 21385. Fax: +64-9-393-876. Specialist services in all the major exploration and development disciplines. Specialist project skills also include water supply and sanitation. Worldwide experience.

I KRÜGER AS,

363 Gladsaxevej, Søborg DK 2860, Denmark. Tel: +45-169 0222. Telex: 27033. Fax: +45-1690806. I Kruger AS are consulting engineers and contractors in the fields of water resources development, water supply, sanitation and sewage treatment.

LAHMEYER INTERNATIONAL GMBH,

PO Box 710 651 Lahmeyer Strasse 22, Frankfurt/Main 71, D-6000, West Germany. Tel: +49-69-6677-0. Telex: 0413 478 11 D. Fax: +49-69-6677-572. Lahmeyer International is your worldwide partner in developing water and offers all required consulting and planning services. Water resources utilisation, environmental engineering and rural development form only part of a comprehensive scope of engineering services for the energy, water, environmental and transport sectors. Interdisciplinary co-operation between departments enables the company to provide the appropriate solutions to challenging problems of different magnitudes under a single responsibility.

LUMMUS DEVELOPMENT CORP,

712 10th Avenue, PO Box 2526, Columbus, GA 31902-2526, USA. Tel: +1-404-323-1081. Telex: 4611158. Fax: 1-404-324 4899. Manufactures portable earth drilling equipment. Equipment ranges from a small free-standing tripod drilling machine to larger hydraulically-controlled rotary drilling rigs. Several units can be skid or truck mounted.

OVE ARUP & PARTNERS,

13 Fritzroy St, London W1P 6BQ, UK. Tel: +44-71-636 1531. Fax: +44-71-580 3924. Arups is the largest UK Consultancy and has 37 overseas offices. The firm is multi-disciplinary and has all the skills, capabilities and specialists required for the engineering and economics of every aspect of the water cycle and environment. Engineers have extensive experience on major projects in the UK and developing and other countries as lead consultant or specialist.

SOCIETE D'EPURATION ET D'ENTREPRISES SA,

Rue de la Science 5, Brussels 1040, Belgium. Tel: +32 2 230 93 14 Fax: +32 2 230 76 13. SEE manufactures and installs plants all over the world for treating drinking water from both surface water (rivers, lakes and dams) and underground sources.

SOIL & WATER LTD,

PO Box 14, SF-00210 Helsinki, Finland. Tel: +358-0-682 661. Telex: 121963 SWCOM SF. Fax: +358-0-682 6600. The scope of services comprise feasibility studies, planning, design and engineering of facilities, project management, procurement management, commissioning and start-up services, institutional development and training of personnel for: hydrological studies, hydrogeology, groundwater surveys and modelling, water intakes, wells and well fields, artificial groundwater development, raw water transmission in pipes and tunnels.

SOYUZGIPROVODKHOZ,

Water Resources & Research Institute, 2 Yeniseiskaya St, 129344 Moscow, USSR. Tel: +1892196. Telex: 412198 INWOD SU. Fax: +1892355. It is a major Soviet organisation in surveys, planning and studies relating to land reclamation and water management. It offers: engineering services, know-how, ready-to-use engineering and process developments, training of personnel, joint activities in design and construction on a turnkey basis operation and maintenance of water-resources and irrigation projects.

SWECCO,

PO Box 5038, Linnegatan 2, Stockholm S-102 41, Sweden. Tel: +46-8-663-03-70. Telex: 17597. Fax: +46-8-660 9217. Sweco is a company of consulting engineers, working worldwide in all fields of urban, industrial and infrastructure development. Important fields of activities are: water resources, water conveyance, water treatment including desalination and water distribution.

TAMS CONSULTANTS INC,

655 Third Avenue, New York, NY 10017, USA. Tel: +1-212-867 1777. Telex: (ITT) 422188/ (RCA) 233055. Fax: +1-212-697 6354. Consulting firm of engineers, architects and planners providing professional services for projects throughout the world. Fields of specialisation include water resources - planning, design and construction supervi-

sion services for dams, hydroelectric power, flood control, irrigation systems and river basin planning

TAMS-PIRNIE INTERNATIONAL,

655 Third Avenue, New York, NY 10017, USA. Tel: +1-212-867 1777. Telex: (ITT) 422188/ (RCA) 233055. Fax: +1-212-697 6354. TPI was formed to offer environmental planning, sanitary engineering and water resources development on a worldwide basis. Fields of specialisation include water supply systems (all types), wastewater systems and industrial water and pollution control.

VERBUND-PLAN GMBH,

Am Hof 6A - A-1010 Vienna, Austria. Tel: +43-1-0222-53113 4800. Telex: 115978 VPLWN A. Fax: +43-1-0222-53113 4848. For more than 30 years Verbund-Plan Consulting Engineers have done water resources development in Austria and in other countries in the world and therefore can offer all necessary consultancy services at every project-stage.

WESSEX WATER INTERNATIONAL,

Wessex House, Passage St, Bristol BS2 0JQ, UK. Tel: +44-272 290611. Telex: 444130. Fax: +44-272 293137. Wessex Water International is a division of Wessex Business Services Ltd, one of the companies within Wessex Water plc, and as much can draw on its resources, expertise and experience. It has a reputation for efficiency, a progressive outlook and use of appropriate technology, and can offer the full range of operational, organisational, environmental, technical and training services within the water industry.

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AGRAR UND HYDROTECHNIK GMBH,

PO Box 10 01 32, Huysenallee 66-68, Essen 1, D-4300. West Germany. Tel: +49-201 2016-0. Telex: 857-557 AHT D. Fax: +49-201 2016-211. Hydrological and hydrogeological investigations, groundwater modelling, water management planning and hydraulic engineering. Feasibility studies, design, construction supervision and management for water supply, waste water disposal, irrigation and drainage systems.

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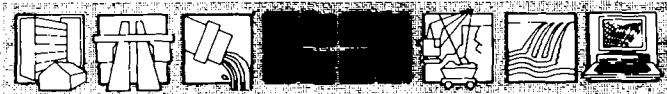
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It was founded by six parent firms, which in their character as public utilities, plan, supervise the construction of, and operate the greater part of Austria's power facilities.

The approximate number of staff available to Verbund-Plan Ges. mbH for works abroad amounts to 640 highly qualified persons and has its head office in Vienna, Am Hof 6A, Austria.

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- Analysis of pollution
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- Energy policy
- Long and medium term energy
- Planning on national and international level

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WATER SUPPLY, TREATMENT & DISTRIBUTION

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PO Box 93224, The Hague 2509 AE, The Netherlands.
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2019 West County Rd, St Paul, MN 55113, USA. Tel: +1-612-631 8082. Telex: 298414 Fax: +1-612-647 1870. C3 International is a consulting engineering company specialising in water purification, waste treatment, food and chemical process. Our areas of expertise are micro filtration, ultra-filtration, reverse osmosis, electro dialysis, absorption and ion exchange.

CAMP DRESSER & MCKEE INTERNATIONAL INC,

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industry and government, including planning and development of surface-water and groundwater supplies; engineering for water transmission, distribution, and pumping; water filtration/treatment; desalination; restoration of contaminated supplies; advanced computer modelling for waste supply development and protection; SCADA, AM/FM and GIS technologies.

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WATER SUPPLY, TREATMENT & DISTRIBUTION

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655 Third Avenue, New York, NY 10017. USA. Tel: +1-212-867 1777. Telex: (ITT) 422188/ (RCA) 233055. Fax: +1-212-697 6354. TPI was formed to offer environmental planning, sanitary engineering and water resources development on a worldwide basis. Fields of specialisation include water supply systems (all types), wastewater systems and industrial water and pollution control.

THAMES WATER INTERNATIONAL,

Nugent House, Vastern Rd, Reading, Berks RG1 8DB. UK. Tel: +44-734 593353. Telex: 848054 TODTWA G. Fax: +44-734 593747. Thames Water International is a division

of Thames Water, which is one of the world's largest water undertakings concerned with water resources, treatment and distribution, sewerage, sewage treatment, sludge disposal, pollution control, flood control, river management and recreation. Offers advice and assistance on the above operational matters with particular reference to institutional studies, process optimisation and training.

WATER SUPPLY CO OF MARSEILLES,

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Water International Ltd is the overseas consultancy company formed by three of the UK's largest water undertakings - Northwest, Welsh and Yorkshire Water. Key activities are: institutional development, resource management, water and sewage treatment; distribution and disposal, operation contracting, training.

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Consulting and analytical chemists. Analyses of water and effluents, assessment of problems and recommendations for treatment, negotiation on behalf of clients with authorities and contractors, limited contract research.

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Consulting engineers - undertake design of water supply and drainage products.

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Consulting engineers at all stages from feasibility studies to construction, environmental scientists, geotechnical consultants, rock and soil consultants.

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Clinton Bogert Associates, Consulting Engineers, have been assist-

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DANISH AQUACULTURE INSTITUTE,
11 Agern Alle, Horsholm, DK 2970, Denmark. Tel: +45-42-57-28-11. Fax: +45-42-76-66-19. The Danish Aquaculture Institute (DAI) is an autonomous nonprofit institution affiliated to the Danish Academy of Technical Sciences. The DAI offers consultancy services on all aspects of aquaculture, and amongst its clients, are private fish farms, local authorities and industrial companies both in Denmark and abroad. The institute consists of three divisions, the head office situated north of Copenhagen, an experimental fish farm in conjunction with a power plant in the southern part of Jutland and a Far East Pacific Division in Singapore.

DUNN BURT & PARTNER,
Thames House 58, Southwark Bridge Rd, London SE1 0AS. UK. Tel: +44-71-620 1388. Fax: +44-71-620 1481. Civil, structural, claims and water engineering consultancy.

ESPEY HUSTON & ASSOCIATES,
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service environmental and engineering consulting firm specialising in all areas of water related services, with offices throughout the USA and in the UK.

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HILL INTERNATIONAL,
2020 SW 4th Avenue, Portland, Oregon, USA. Tel: +1-503-224 9190. Telex: 474-2047. CH2M Hill International has been supplying services to public and private clients in about 50 countries worldwide. The international operation is backed by a 3,000-employee firm, one of the largest in the USA.

HYDRAULIC ANALYSIS LTD,
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KENNEDY & DONKIN SYSTEMS CONTROL LTD,

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KILLAM ASSOCIATES,

27 Bleeker St, Millburn, New Jersey 07041, USA. Tel: +1-201-379 3400. Fax: +1-201-376 1072. Activities: civil, sanitary and environmental planning, design and management services, domestic and industrial wastewater (collection, treatment, disposal, plant operations and maintenance, I/I studies), water resources (supply, treatment, transmission, distribution); stormwater, flood control, solid waste (landfills, transfer/recycling facilities, resource recovery); hazardous waste (remedial investigations, feasibility studies, ECRA, UST); environmental studies (due diligence environmental audits, environmental impact statements, hydrogeological investigations, wetland delineations); site development; marine, mining engineering.

KTA-TATOR INC,

115 Technology Drive, Pittsburgh, PA 15275, USA. Tel: +1-412-788 1300. Telex: 510697333. Fax: +1-412 788 1306. KTA consulting services provide assistance in coating specifications, material selection and failure analysis.

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64 Newman St, London W1A 4SE, UK. Tel: +44-71-637 9111. Telex: 27200. Fax: +44-71-637 8229. Logica has worked in the water industry for many years contributing to improved methods of water management. Services offered include consultancy, systems specification and design, project management, software and electronics engineering and systems supply.

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PO Box 30, Budapest H-1400. Hungary. Tel: +36-1-225-849. Telex: 223066 PUPKK H. Fax: +36-1-229-228. Consultancy in water supply projects - especially in clarifiers and sedimentation.

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670121. Telex: 121963. Fax: +358-0-692-3454.

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undertaking water, waste water and pollution studies, base-line studies and monitoring, water quality modelling and ecotoxicological testing, environmental impact assessments and chemical analysis.

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WATER-INTERNATIONAL LTD,

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A-8010 Graz, Austria. Tel: +43-316/792-22. Telex: 32171 GPA. Generalplan GesmbH employ civil engineers, engineers, master builders and technicians qualified in various special disciplines. Of the many projects handled (civil engineering and building, industrial plant and road, rail and bridge construction etc) water supply and disposal plants deserve special mention. The company undertakes the planning of complete large-scale projects, including supervision of execution.

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4 Rue Galilie, Paris F75116. France. Tel: +33-1-47236064. Telex: 613525. Fax: +33-1-472209590. Gersar is an international engineering company which pools the technical capabilities of the French regional development companies, gathering 2,500 people including 1,400 engineers and technicians.

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15A Jalan Bachang Batu 2 1/4 off Jalan Ipoh, Kuala Lumpur 51200. Malaysia. Tel: +60-3-29878142920935. Fax: +60-2432223. Established in 1981, Hydro is involved in general civil engineering contracting with local authorities, public work departments and other government agencies in Malaysia. They are expanding and hope to have dealings in overseas markets.

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BP 172-X, Grenoble Cedex 38042. France. Tel: +33-76334000. Telex: 980876. Fax: +33-76-33-42-96. SOGREAH Consulting Engineers in hydraulics and development: regional development, agricultural development, urban and industrial hydraulics, dams and hydro power, port and coastal engineering, river engineering and water resources, hydraulic scale model studies.

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212-867 1777. Telex: (ITT) 422188/ (RCA) 233055.
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+263-4-703316. International Aid Supplies & Consultants. Sourcing and procurement of supplies of any nature for aid agencies projects throughout Africa. References available.

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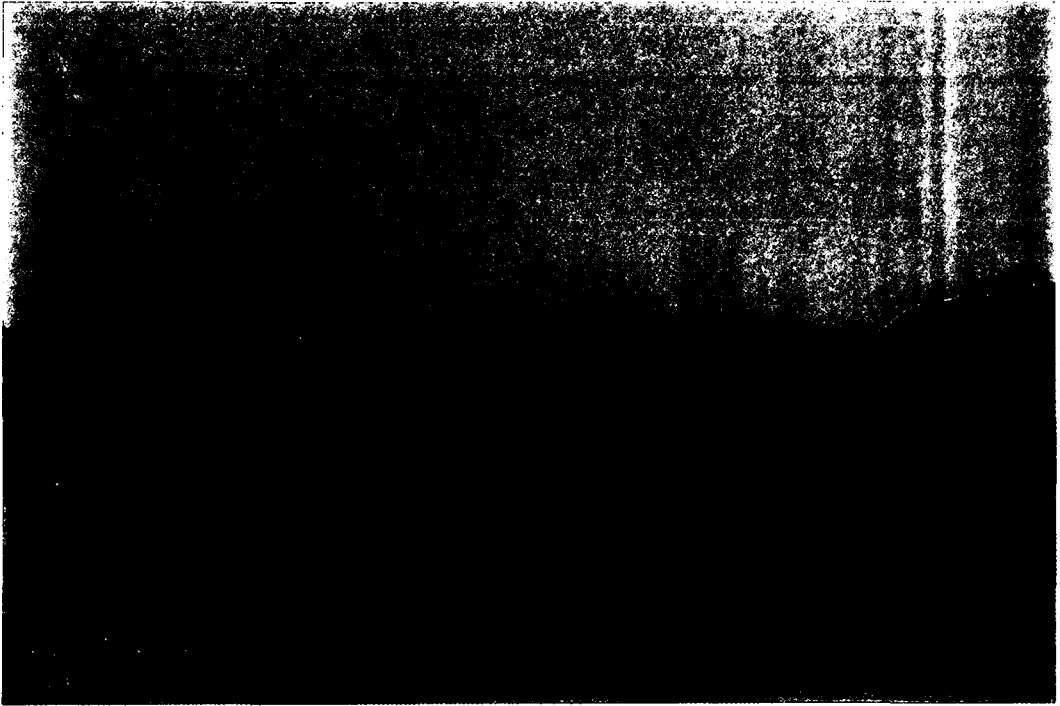
Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-788 542144. Telex: 311335. Fax: +44-788 60767. Contact Name: Mr F W Ballard or Mr S W G Cheshire. Mechanical, electrical and control engineering company with experience in water and sewage pumping stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor converter equipment particularly suited to the control of pumps, compressors and fans.

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GEC Electrical Projects has expertise that comes from years of experience in the environment market. From sewage pumping in Cairo to water pumping in Birmingham, from sewage treatment in Libya to water treatment in Manchester, from combined heat and power systems in Liverpool to reservoir control in Kuwait, our

company has provided solutions for major mechanical and electrical projects throughout the world.

Environmental issues are our business. For all your mechanical and electrical requirements GEC Electrical Projects has the solution.

*GEC Electrical Projects –
engineers to the environment.*

GENERAL INDUSTRIES DIVISION
GEC ELECTRICAL PROJECTS LTD., BOUGHTON ROAD, RUGBY, WARWICKSHIRE CV21 1BU.
TEL: 0788 542144. FAX: 0788 60767.



PROJECT MANAGEMENT

INTERSIGMA CO LTD,
Václavské nám 60, 111 87 Praha1, Czechoslovakia.
Tel: +42-2357748 56. Telex: 121205. Fax: +42-2369537. **INTERSIGMA exports and imports: devices, parts, components and materials needed for branches of water economies, chemistry, power engineering, building industry and ecological systems. INTERSIGMA offers and accepts service for/from foreigners in the following forms: designing; author's supervision over building project realisation; investment and engineering activities; building work; assembling, repairing and maintenance work; consultations. INTERSIGMA advertises its own foreign trade activities within the framework of the product and system realisation stated at point 1.**

JOHNSTON IRRIGATION INC,
Post Office Box 2076, Fort Pierce, FL 34954, USA. Tel: +1-407-466 4500. Fax: +1-407-466 6087. Johnston Irrigation serves the US and the international marketplace with complete irrigation services including overhead and drip irrigation systems, engineering/design, project management/installation, wholesale materials, pump design, and consulting. Johnston Irrigation is one of the largest agricultural irrigation contracting companies in the United States.

LLOYD'S REGISTER INDUSTRIAL DIVISION,
Lloyd's Register House, 29 Wellesley Rd, Croydon CR0 2AJ, UK. Tel: +44-1-681 4040. Telex: 28636. Fax: +44-1-681 6814. Project management, quality assurance and independent third party inspection.

MERALCO INDUSTRIAL ENGINEERING SERVICES CORP,
3rd-5th Floors, TSG Building, Meralco Cmpo, Ortigas Avenue, Pasig MM, Phillipines. Tel: +63-721 9951. Telex: 14730. Broad-based operations including most aspects of water distribution and use. Services include design, planning, implementation, construction management and supervision, purchasing and project management.

JAMES M MONTGOMERY CONSULTING ENGINEERING INC,
PO Box 7009, 250 North Madison Avenue, Pasadena, California 91109/7009, USA. Tel: +1-818-796 9141. Recognised internationally for expertise and unique capabilities in water and wastewater engineering. Offer a complete range of services including master plans and feasibility stud-

ies, detailed design, construction management services and facilities start-up and operation. Experience in aquaculture.

MORRISON-KNUDSON ENGINEERS INC,
180 Howard St, San Francisco, CA 94105, USA. Tel: +1-415-442 7300. Telex: (WUI) 677058/ (ITT) 470040/ (RCA) 278362/ (WUD) 34376. Full-service engineering, procurement and construction management company offering single-source responsibility for the design and management of large and small projects worldwide. The water resources field is a major aspect of the company's expertise.

NEI POWER PROJECTS LTD,
PO Box 13, Saltmeadows Rd, Gateshead, Tyne & Wear NE8 1YZ, UK. Tel: +44-91-477 6666. Telex: 53116. Fax: +44-91-477 8200. Project engineering and project management for turnkey water utility contracts.

OBERMEYER PROJECT MANAGEMENT GMBH,
Hansastraße 40, München 21, D-8000, West Germany. Tel: +1-49-89-5799/1. Telex: 6-323-566 & 898-588. Fax: +1-49-89-5799/3333. Provides integrated planning services for overseas clients in the sectors of regional and urban planning, infrastructure and detailed projects, operational organisation and data handling and undertakes project management. Fields of specialisation include fisheries, irrigation and flood control, drainage, pipelines, water supply, water distribution and wastewater.

PRC ENGINEERING INC,
1505 Planning Research Drive, McLean, Virginia 22102, USA. Tel: +1-703-556 1000. Telex: 248372. Fax: +1-703-556 1174. Serves government and industry in planning, engineering, architecture, construction management and the design, commissioning, operation and maintenance of a diverse range of facilities. Irrigation, flood control, river regulation, dams, drainage, wastewater, water supply and distribution, hydroelectric power.

PURAC AB,
PO Box 1146, Lund S-22105, Sweden. Tel: +46-46-135100. Telex: 8305083. Fax: +46-46-14-6988. The Purac organisation offers all the specialised skills in process, mechanical, electrical and structural engineering, coupled with total project management and assured plant performance.

PWT PROJECTS LTD,
632-652 London Rd, Isleworth, Middlesex TW7 4EZ.
UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.
Fax: +44-81-568 5479. In-house expertise and resources to engineer and project-manage a solution to all wastewater and water related problems. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

TAMS CONSULTANTS INC,
 655 Third Avenue, New York, NY 10017, USA. Tel: +1-212-867 1777. Telex: (ITT) 422188/ (RCA) 233055.
 Fax: +1-212-697 6354. Consulting firm of engineers, architects and planners providing professional services for projects throughout the world. Fields of specialisation include water resources - planning, design and construction supervision services for dams, hydroelectric power, flood control, irrigation systems and river basin planning.

TURNER & COATES LTD,
 Faulkner House Faulkner St, Manchester M1 4DY, UK. Tel: +4461-228 6420. Fax: +4461-228 6425. Turner & Coates Ltd offer a comprehensive package which addresses all aspects of a total quality management approach. We offer expertise installing quality management systems, establishing quality strategy, corrective action projects such as statistical process control and statistical defect control systems. Comprehensive training is available for all these services and other employee involvement programmes.

WAKUTI KARL K G,
 Loehr Strasse 15, Siegen D5900, West Germany Tel: +49-271 55085. Telex: 0872934. Specialists in water resources development, wastewater treatment, pollution control, full project development from preliminary studies to project management. Registered: World Bank, ADB, UNDP, WHO, etc. Established 1953. More than 10,000 water and sanitation projects in Germany and overseas.

TREATMENT PLANT EQUIPMENT INSTALLATION

ANSALDO SISTEMI INDUSTRIALI,
 Via Pieragostini 50, Genoa 16151, Italy. Tel: +010-41031. Telex: 283311. Fax: +010-420451. Ansaldo Sistemi Industriali is a contracting and engineering company operating, among others, in the field of water technology

systems. Specifically the company is involved in study, design, engineering, procurement, marketing and implementation activities, including supply, installation commissioning, start-up, technical assistance and training for: water distribution and sewerage systems, water treatment systems, irrigation systems, all mechanical and electrical equipment.

AQUA TECH GESELLSCHAFT MBH & CO KG,

A-5020 Salzburg, Ferdinand-Porsche-Strasse 1, Austria. Tel: +43-662/77-130/78-671. Telex: 632618 AQUA. Aqua-Tech specialises in the planning, construction and installation of water treatment plants. To meet the demand for proven and economical technology, reliable operation and quick and easy plant installation, Aqua-Tech have developed prefabricated waterworks which are tested before shipment and can be put into operation as soon as they reach the building site.

BIWATER INTERNATIONAL LTD,
 Biwater House, Station Approach, Dorking, Surrey RH4 1TZ, UK. Tel: +44-306 740740. Telex: 859529. Fax: +44-306 885233. International civil engineering contractor (reservoir and dam construction; water and sewage projects).

BIWATER SEWAGE TREATMENT,
 Milltown St, Radcliffe, Manchester M26 9NU, UK. Tel: +44-61-723 3821. Telex: 669834. Fax: +44-61-724 5605. Specialists in the manufacture and installation of sewage and industrial effluent treatment plant worldwide.

BIWATER TREATMENT LTD,
 Biwater Court, Station Approach, Dorking, Surrey RH4 1TF, UK. Tel: +44-306 740740. Telex: 859529. Fax: +44-306 889298. Portable plant specialist contractors for large and medium sized urban and rural developments.

CROSS MARINE SERVICES INC,
 565 West 2000 South, Orem, Utah 84058, USA. Tel: +1-801-225 8355. Fax: +1-801-226 4108. Equipment erection, turbines and generators. Manufacturers of gates and valves, seals and gaskets. Complete range of services in construction engineering (including underwater).

CROSSLINK SDN BHD,
 PO Box 11157, 55-1, Lorong Hj Hussein 1, Off Jalan Raja Muda, Kuala Lumpur 50738, Malaysia. Tel: +60-3-29246013 2981326. Fax: +60-3-2910190. Contractor

TREATMENT PLANT EQUIPMENT INSTALLATION

to install, supply and maintain water treatment plant and equipment like: water deioniser, softener, carbon and sand filter, clarifier, chlorination (gas) system and special ion-exchanger also the sole representative of 'PUROLITE' ion-exchange resin for Malaysia.

DELTA ENGINEERING BV,
PO Box 227, Vlaardingen 3130 AE, The Netherlands. Tel: +31-10-46-00-000. Telex: 24536. Fax: +31-10-46-00-898. Designers and contractors for complete water treatment installations.

**DRAGERWERK AKTIENE-
SELLSCHAFT,**
Moislinger Allee 53-55, D-2400 Lubeck 1, Germany.
**Tel: +49-451 8820 Telex: 268070. Fax: +49-451-882
2080. Gas Analysis Division. In order to reduce the
number of potentially hazardous situations at the
workplace and minimise any damage resulting from
these hazards, many different gases, vapours, and
aerosols must be monitored. For that purpose Drager
offers easy-to-handle and economical measuring sys-
tems. With more than 200 different Drager-Tubes,
over 350 separate hazards can be determined in air,
soil and water samples.**

EBARA CORPORATION,
11-1 Haneda Asahicho, Ohta-ku, Tokyo 144, Japan. Tel:
+81-3-743 6716. Telex: EBARATYOJ 22988. Fax: +81-3-
745 3576. London Office: Regal House, London Rd,
Twickenham, Middlesex, Tel: +44-1-892-89712. A large sys-
tems engineering department of over 200 people in the role
of main mechanical electrical contractors, which include
water pumping stations, sewage and water treatment.

**EMPRESA AUXILIAR DE LA
INDUSTRIA AUXINI SA,**
Padilla 46, Madrid 28006 Spain. Tel: +34-91-431-42-
20. Telex: 49090 AXNI E. Project and construction of water
treatment plants through peat bed system. Construction of
sewage treatment plants. Project and construction of indus-
trial water treatment plants.

**ESSENER HOCHDRUK -
ROHRLEITUNGSBAU,**
PO Box 120124, Essen 12, D4300, West Germany. Tel: +49-
201 349-25. Fax: +49-201 351423. Planning, engineering,
prefabrication, assembly and maintenance, erection of plants for
water technology in power stations, industrial and municipal
enterprises: complete water and waste water treatment plants.

GRAMAGLIA STL,
Osimo, (Ancona), 60027, Italy. Tel: +39-071-715205.
Fax: +39-071-7132427.

HOUSEMAN BV,
PO Box 190, Van Konijnenburgweg 141, Antwerp, Bergen op
Zoom 4600 AD, The Netherlands. Tel: +31-1640 55000.
Telex: 78376. Fax: +31-1640 59587. Contractors for well
water treatment, cooling water treatment and chemical cleaning.

HYDRO ENGINEERING SDN BHD,
15A Jalan Bachang Batu 2 1/4 off Jalan Ipoh, Kuala Lumpur
51200, Malaysia. Tel: +03-2987814 & 2920935. Fax: +03-
2432223. Established in 1981, Hydro is involved in treatment
plant equipment installation and projects with local authorities,
public work department and other government agencies in Malaysia.
They are expanding and hope to have dealings in overseas markets.

JOHNSON FILTRATION SYSTEMS,
Johnson House, Browells Lane, Feltham, Middlesex TW13
7EQ, UK. Tel: +44-1-751 4424. Telex: 935479. Fax:
+44-1-890 1533. Johnson Filtration Systems undertakes the
installation of complete water treatment schemes and refurb-
ishment of existing works. Generally this is carried out in
the UK but the package nature of our designs allows easy
installation together with ancillary equipment.

KEE SERVICES,
College Rd, Aston Clinton, Aylesbury, Bucks HP22 5EZ, UK.
Tel: +44-296 631499. Telex: 837545. Fax: +44-296
630263. Design, construction, maintenance and refurbish-
ment of all forms of equipment for effluent and waste treatment.

KIPSZER,
PO Box 28, Budapest X, Faszberenyi ut 36, H-1475.
Hungary. Tel: +36-1-575-122. Telex: 22-5328. Fax: +36-
1-572-958. Treatment plants for drinking water, boiler feed
water, industrial process water, water for agricultural use,
cooling water and secondary purification of waste waters.

LEE POLLUTION CONTROL LTD,
1 Station Rd Four Ashes, Wolverhampton WV10 7DQ, UK.
Tel: +44-902 791616. Telex: 335684. Fax: +44-902
791772. Contractors for custom - designed and built water
and effluent treatment plant.

**MAHON & MCPHILLIPS
(STRATFORD) LTD,**
Holford Way, Witton, Birmingham, West Midlands B6 7AX.

UK. Tel: +44-21-356 7606. Telex: 334041. Fax: +44-21-356 892. Mechanical plant contractors, designers and manufacturers in the field of municipal and industrial water and waste water treatment.

NIO - PLAN ,

A-1060 Wien, Amerlingstrasse 17. Austria. Tel: +43-1-57-11-43. Telex: 113587. Nio-Plan undertake studies, general and detailed planning of large-scale water supply plants as well as invitations to tender and awarding of contracts and direction and supervision of building.

OÜSTERREICHISCHE BROWN BOVERI-WERKE AG ,

PO Box 184, Wien A-1101. Austria. Tel: +43-1-601090. Telex: 131760. Oüsterreichische Brown-Boveri-AG are backed by 70 years of experience in the production of electrical plants and systems for industry. For the water technology sector they project, supply and erect electrical distribution, installation and telecontrol systems, electrical drives, medium-high-voltage plants, etc for water treatment, water supply, irrigation and drainage plants; sewage clarifiers and pumping stations.

PORTALS WATER TREATMENT ,

Oldfield Lodge, 156 Bridge Rd, Maidenhead SL6 8DG. UK. Tel: +44-628 771444. Telex: 849067. Fax: +44-628 771567. Process design and engineering of water, effluent, sewage and process liquids treatment project. PWT undertake contracts of any size throughout the world, and supply their own fully proven range of pre-engineered products and protect systems with a comprehensive range of speciality chemicals.

PURAC LTD ,

MCD House, Birmingham Rd, Kidderminster, Worcs DY10 2SH. UK. Tel: +44-562 820010. Telex: 338472 PURAC. Fax: +44-562 82008. Purac Ltd are project managers and process engineers to the water and effluent treatment industry. Main areas of operation are in the construction of major potable/industrial water and effluent treatment schemes incorporating dissolved air flotation, filtration and ion exchange processes.

PWT PROJECTS LTD ,

632-652 London Rd, Isleworth, Middlesex TW7 4EZ.
UK. Tel: +44-81-560 5199. Telex: 24440 PWTP G.
Fax: +44-81-568 5479. Industrial and municipal, water and wastewater, treatment process contractors; mech/elect contractors. Plant extensions, uprating,

refurbishment, plant automation. Process design, plant procurement, erection, commissioning, operation and maintenance. See PWT Worldwide advertisement and editorial under Wastewater Treatment, section 5.

SIMON - HARTLEY LTD ,

Stoke-on-Trent, Staffs ST4 7BH. UK. Tel: +44-782 202300. Telex: 36305 SIMHAR G. Fax: +44-782 261494.

Manufacturers of a full range of mechanical equipment for the treatment of sewage and industrial effluents. Also full turnkey facilities for erection and supply of complete plants for sewage and industrial effluent treatment. Penstock and valves in metals and plastic construction.

UNOX EFFLUENT TREATMENT SYSTEMS (WIMPEY ENGINEERING) ,

27 Hammersmith Grove, London W6 7EN. UK. Tel: +44-81-748 2000. Telex: 25666. Fax: +44-81-748 6083. Specialists principally in UNOX oxygen activated sludge, oxygen generation, sludge digestion, and oxygen injection systems. Wimpey Engineering provide a complete service for design, manufacture, installation and commissioning on turnkey, project management or sub-contract basis and offer comprehensive pilot plant facilities.

WASSERTECHNIK

GESELLSCHAFT MBH & CO KG ,

A-5020 Salzburg, Rücklbrunnerstrasse 41. Austria. Tel: +43-6222/72-4-25 26 27. Telex: 633499. Wassertechnik undertakes the planning and production of water purification and supply plants from design to start-up, the line-up embracing softening, full desalination plants, condensate and cooling water treatment facilities, waste water purification plants, ultrafiltration and reverse osmosis plants for industrial and municipal requirements.

WATER ENGINEERING LTD ,

International Division, Aynho Rd, Adderbury, Banbury, Oxon OX17 3NL. UK. Tel: +44-295 810581. Telex: 83655. Fax: +44-295 811913. Contact Name: Ken Brearley. Design and supply of municipal effluent and water treatment plants worldwide, either on a project management basis or as individual products and process - extending to installation and commissioning.

TURNKEY SERVICES

ADS SERVICES INC ,

2227 Drake Avenue South West, Suite 26, Huntsville, AL

TURNKEY SERVICES

35805. USA. Tel: +1-205-883 9323. Telex: 4933400.
Fax: +1-205-882 6765. Process control and remote monitoring with telemetry using distributed digital approach. ADS provides turnkey services, including equipment, installation, operation and service.

ANSALDO SISTEMI INDUSTRIALI,

Via Pieragostini 50, Genoa 16151. Italy. Tel: +010-41031. Telex: 281311. Fax: +010-420451. Ansaldo Sistemi Industriali is a contracting and engineering company operating, among others, in the field of water technology systems. Specifically the company is involved in study, design, engineering, procurement, marketing and implementation activities, including supply, installation commissioning, start-up, technical assistance and training for: water distribution and sewerage systems, water treatment systems, irrigation systems, all mechanical and electrical equipment.

AQUA ENGINEERING GESELLSCHAFT MBH,

A-5020 Salzburg, Moserstrasse 29. Austria. Tel: +43-662 33-5-11-15. Telex: 632679. Aqua Engineering are active as general contractors for the erection of turnkey water treatment plants and as planners and suppliers of mechanical equipment on a joint venture basis with local building and erecting companies. The firm undertakes the building of water treatment plants and waterworks for drinking and industrial service water supply, for agricultural purposes, sewage and industrial waste water.

BAUMEISTER KASTNER,

A-8911 Admont, Weng 127. Austria. Tel: +43-3613/2772. The Admont-based engineering office Kastner (other offices in Graz and Kapfenberg) was founded in 1970 and is engaged in the planning, invitation to tender, building supervision and operation of municipal water supply plants, sewage disposal systems, clarification plants and refuse disposal facilities. The company undertakes the execution of complete projects from the planning stage onwards and paying special attention to operating costs.

BIWATER AMES CROSTA,

Heywood, Lancs OL10 2DX. UK. Tel: +44-706 67555. Telex: 63410 AMES G. Fax: +44-706 65598. Biwater Ames Crosta is a leading process contractor specialising in complete turnkey or equipment supply services for all areas of water and wastewater treatment, including desalination by reverse osmosis.

BIWATER TREATMENT LTD,

Heywood, Lancs OL10 2DX. UK. Tel: +44-706 67555. Telex: 63410. Fax: +44-706 65598. Process plant contractor and equipment manufacturer covering the entire field of water and sewage treatment. Contracts completed range from single items of equipment to complete turnkey contracts of up to £100 million. Traditional processes are supplemented by modern technology, eg desalination of brackish or sea water by reverse osmosis.

BLACK & VEATCH INTERNATIONAL,

PO Box 8405, 1500 Meadow Lake Parkway, Kansas City, Missouri 64114. USA. Tel: +1-913-339 8700. Telex: 42523. Fax: +1-913-339 2060. One of the oldest, largest and most diversified engineering-architectural organisations in the USA with experience throughout the world. Extensive management experience and diversified capabilities enable the company to assume total responsibility for a wide range of projects of any size the world over.

JOHN BROWN ENGINEERING LTD,

Clydebank, Dunbartonshire G81 1YA. UK. Tel: +44-41-952 2030. Telex: 778395. Fax: +44-41-952 4895. Turnkey contractor offering a range of services for water and effluent applications, including: design, construction and finance packages, process engineering and refurbishment works. Particular areas of expertise encompass bioprocesses applied to sludge and effluent treatment, municipal potable water treatment and ICA engineering.

CANADIAN APPLIED TECHNOLOGY,

10 Plantehet Rd, Unit 21, Concourse, Ontario L4K 2C8. Canada. Tel: +1-416-738 8205. Telex: 06-964-887. Fax: +1-416-738 6964. Produces guaranteed turn-key environmental systems for governments and industries.

CULLIGAN ITALIANA SPA,

Via Gandolfi 6, 40057 Cardano di Granarolo E, Bologna. Italy. Tel: +39 51 766614. Fax: +39 51 765032. The company designs and manufactures waste water treatment plant

DE LANGE PLASTIC LININGS,

Neptunusweg 4, 8939 AA Leeuwarden. Holland. Tel: +31-58-884240. Fax: +31-58-884264. De Lange Plastic Linings provide a wide range of plastic linings

with many applications in the storage and distribution of water and wastewater. The service includes supply, assembly, testing, certification and delivery.

DEWPLAN GROUP LTD,

Beechwood Hall, Kingsmead Rd, High Wycombe, Bucks HP11 1LA. UK. Tel: +44-494 35671. Telex: 837139. The Dewplan Group companies design, supply and install industrial and effluent treatment plants. Systems for the full water cycle available from package to turnkey projects. Specialisations include clarification, filtration, ion exchange, reverse osmosis, biological systems and thermal deaeration.

EFLO INTERNATIONAL LTD,

Bath Rd, Padworth, Reading, Berks RG7 5HR. UK. Tel: +44-734 712648. Telex: 848673 EFLO G. Fax: +44-734 712901. Specialists in design and supply of sewage treatment on land and sea from 5 to 15,000 people. Undertake total turnkey contracts. Operate worldwide.

ENERGY & WASTE SYSTEMS LTD,

EWS House, Station Rd, Westbury, Wilts BA13 4HT. UK. Tel: +44-373 858090. Telex: 445672. Fax: +44-373 827223. EWS undertake turnkey projects in the waste treatment industry and offer a range of package treatment plants, including packaged sludge digestion and sewage plants. Products include fine screen and handling systems, fine air bubble diffuser systems and combined heat and power generation.

ENVIRONMENTAL ENGINEERING LTD,

Little London, Spalding, Lincs PE11 2UE. UK. Tel: +44-775 68964. Fax: +44-775 710294. Environmental Engineering Ltd supply and install on a turnkey basis industrial and domestic effluent treatment plants both in the UK and overseas. Hardware consists of screens, presses, wedge wire clarifiers, dissolved air units, sludge dewatering, effluent treatment and flotation cells.

ENVIRONMENTAL ENGINEERING LTD,

(Incorp the products and processes of CJB Engineering), Little London, Spalding, Lincs PE11 2UE. UK. Tel: +44-775 768964. Environmental Engineering Ltd supply and install on a turnkey basis industrial and domestic effluent treatment plants, in the UK and overseas. Hardware consists of screens, presses, wedge wire clarifiers, dissolved air units,

sludge dewatering, effluent treatment flotation cells and tilted plate separators

EQUIPOS Y PROCESOS SA,

C/Conde de Penalver, 45-30, Madrid, Madrid 28006. Spain. Tel: +34 1 401 30 01. Fax: +34 1 401 64 16. Treatment plants for raw water and industrial applications designed, constructed and installed on a turnkey basis.

ESSENER HOCHDRUK - ROHRLEITUNGSBAU,

PO Box 120124, Essen 12, D-4300. West Germany. Tel: +49-201 349-25. Fax: +49-201 351423. Planning, engineering, prefabrication, procurement, transportation, assembly/laying and construction works, commissioning and start-up plus personnel training for large turnkey plants and complex plant components.

GEC ELECTRICAL PROJECTS LTD,

Boughton Rd, Rugby, Warks CV21 1BU. UK. Tel: +44-788 542144. Telex: 311335. Fax: +44-788 60767. Contact Name: Mr F W Ballard or Mr S W G Cheshire. Mechanical, electrical and control engineering company with experience in water and sewage pumping stations and treatment plants, power generation and combined heat and power systems. Also a manufacturer of a range of HV and LV thyristor convertor equipment particularly suited to the control of pumps, compressors and fans.

GENERAL FILTER CO,

600 Arrasmith Trail, Ames, Iowa 50010-9761. USA. Tel: +1-515-232 4121. Fax: +1-515-232 2571. General Filter's engineering department handles your kind of water problem - industrial or municipal. Preliminary consultation, development and final construction of treatment plant to meet your needs. Based on thorough field and laboratory examination, General Filter engineers will see your problem through from start to finish - supervising the installation and training your personnel in proper operation.

CHARLESHASWELL & PARTNERS,

99 Great Russell St, London WC1B 3UA. UK. Tel: +44-71-580 2412. Telex: 299544. Fax: +44-71-631 4602. Charles Haswell & Partners are international consulting engineers offering planning, engineering and project management services for a wide range of water supply and

TURNKEY SERVICES

public health engineering projects. Integrated multidisciplinary teams can be formed to undertake most aspects of water engineering schemes, including environmental engineering appraisals; geotechnical investigations; detailed engineering designs; preparation of contract documentation; supervision of construction.

HIDROSERVICE,

Rua Afonso Celso, Sao Paulo 04119. Brazil. Tel: +55-11-549 3344. Telex: 1123596. Fax: +55-11-549 1590.

Hidroservice perform all aspects of project planning, investigation, design and construction management. Fields of specialisation include dams, pumping stations, water resources development, flood control, drainage, irrigation, water treatment and supply and sewerage and treatment stations. International experience throughout South America, China and Nigeria.

HYDROTECHNIK GESELLSCHAFT MBH,

A-5033 Salzburg, Alpenstrasse 54, PO Box 14. Austria. Tel: +43-662 22-4-72. Telex: 633821 HYDRO A. The company's line-up includes the planning, production, installation and sale of water treatment plants, reverse osmosis, desalination and water supply facilities and waste water purifying plants for industrial and municipal use. Hydrotechnik turn out turnkey water treatment plants with the cooperation of experienced building firms, or supply merely the necessary mechanical and electrical equipment.

ICI BIOLOGICAL PRODUCTS,

PO Box 1, Billingham, Cleveland TS23 1LB. UK. Tel: +44-642 523786. Telex: 587443 ICIAGH G. Fax: +44-642 522676. ICI has a worldwide network of licensees who can provide design, construction and commissioning of its Deep Shaft process technology. The Deep Shaft process IS increasingly used to treat a range of effluents including domestic, industrial food, alcohol, pulp and paper etc. Low running cost, low capital cost, high on transfer rate and low land area are just some of the advantages.

INKA SYSTEMS LTD,

7 Watt Rd, Hillington Industrial Estate, Glasgow G52 4RY. UK. Tel: +44-41-882 5395. Telex: 778210 INKA G. Fax: +44-41-810 5387. INKA package and turnkey sewage treatment plants and equipment including screens, screenings presses, grit removal, aeration equipment including diffused air and surface aerators both fixed and floating pontoon type, oxidation ditch equipment, rotating biological contrac-

tors, fixed and half-bridge scrapers, sludge thickeners, filtration equipment.

IRRIGATION SYSTEMS CO,

West Lodge, Adsdean, Funtington, Chichester Sussex. UK. Tel: +44-243 575708. Telex: 86333. Fax: +44-243 786930. Design, supply and installation of sprinkler and drip irrigation systems, for agriculture and horticulture etc. Turnkey contracting, management contracts and feasibility studies.

JOHNSON FILTRATION SYSTEMS,

Johnson House, Browells Lane, Feltham, Middlesex TW13 7EQ. UK. Tel: +44-1-751 4424. Telex: 935479. Fax: +44-1-890 1533. Johnson Filtration Systems possess the resources to handle complete turnkey water treatment projects, including civil works, pipelines, building and ica as required for a particular project. Work has been undertaken for Yorkshire Water and Welsh Water on both greenfield and refurbishment projects. These involved a wide range of equipment.

KENNICOTT (NEI THOMPSON LTD),

PO Box 100 Ettingshall, Wolverhampton, West Midlands WV4 6JY. UK. Tel: +44-902 353353. Fax: +44-902 405500. Design, engineering, supply, erection and commissioning of water and effluent treatment plants.

KLOECKNER INDUSTRY ANLAGEN GMBH,

PO Box 100852, Kloeckner Haus, Duisburg D-4100. West Germany. Tel: +49-203-181. Telex: 085581870 RC D. Fax: +49-203 340095. Provide a complete turnkey service to the waste water industry. Also complete mechanical and electrical packages including engineering, start up and operation maintenance if required.

DAVY MCKEE (STOCKTON) LTD,

Ashmore House, Stockton-on-Tees, Cleveland TS18 3RE. UK. Tel: +44-642 602221. Telex: 587151. Fax: +44-642 671638. A member of Davy Corporation plc, providing a total service in water technology from feasibility to design, supply, construction and commissioning of integrated water and waste water treatment systems to power generation, industrial and municipal industries.

METCALF & EDDY

INTERNATIONAL INC,

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Entries ending in WT are taken from Water Technology
Magazine's Planning & Purchasing Handbook. The
subscription Magazine, 13 Century Hill Dr, Latham, NY
12110, USA. Telephone (518) 783-1281.

RESERVE TRAINING

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KNOWLEDGE BASED SYSTEMS FOR WATER SUPPLY AND SANITATION

by Eur Ing Richard Francys, Water, Engineering and Development Centre (WEDC).

The experiences of the water supply and sanitation decade have led to a much better understanding of the range of technologies available for both rural and urban populations.

Many technical problems have been overcome as equipment has improved and new materials have been developed. Plastics and ceramics in handpumps, electronic systems for control equipment and telemetry, plastics in pipelines and water meters and even the use of ferrocement in water tanks have all played their part.

But it has also become clear that the technology by itself will not promote health and quality of life. Unless the consumers are involved, systems will not be maintained correctly and will fail. There is

therefore now a greater emphasis on community participation, ensuring that the end users are involved at all stages of the planning, implementation, operation and maintenance of their own schemes.

It is clear now that for a successful scheme the different but interrelated components of health enhancement, social acceptability, technology, economic and financial viability, institutional support and environmental awareness all need to have been considered.

This takes considerable skill, inevitably a higher level of skills per person served than the larger conventional systems. And for many projects these skills are required in the rural areas where the majority of the people still live but where the majority of the professionals are loath to live. Better design and implementation takes increased time and commitment.

How then might these problems be overcome to begin to meet the needs of millions of people who will require improved water supplies in the years to come?

Research continues but at the level of hardware the research may be seen to be more a case of fine tuning rather than anticipating any new breakthroughs. Cairncross comments that the

BELOW: On-plot pour-flush latrine, Sri Lanka.



major area of research will lie in understanding the software, that is the management and institutional support for water delivery which is the area where major problems are experienced at present.

Training of professional engineers and planners who understand the elements which go to make up a successful programme is similarly vital. From international postgraduate centres such as the Water, Engineering and Development Centre, through national universities producing engineering graduates and down to specialised units such as the newly established Kenya Water Institute or the World Bank sponsored International Training Network, all play a vital role. Publications from professional or academic institutions and from specialised groups such as the International Reference Centre for Community Water Supply or the World Bank are vital resources for transferring knowledge around the world.

However, one new approach is to enable engineers and other professionals to be more productive by use of the new information technology, that is computers. The use of computers, where they are seen as an everyday tool such as a calculator, can prevent mistakes, has the potential for improving the quality of the work and can free time for better control of construction quality or even for community discussions. There may be an added advantage in that the use of new technology such as computers is seen to confer status on their users and so enhances the level of professionals involved in low cost 'appropriate' technology.

The development of Expert Systems grew out of early research work into Artificial Intelligence on computers. Although not claiming any 'intelligence', the term expert system is usually reserved for interactive programs that enable a user to seek advice on a specific topic rather as if he were holding a conversation with an expert. The simpler systems, which work more on an algorithmic or decision tree basis rather than an inductive reasoning 'heuristic' level, are known as 'Knowledge Based Systems' (or KBS).

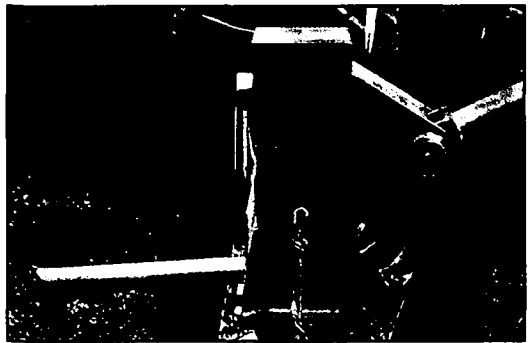
Instead of text books a micro computer is used and information is assessed in consultation between computer user and computer. Like a human expert, a KBS gives advice by drawing upon its own store of knowledge and by requesting information specific to the problem at hand from the user.



ABOVE: Improved communal sanitation facilities, Kumasi, Ghana.



ABOVE: India MkII Handpump.



ABOVE: Afrider Handpump.

Expert systems have already been successfully used in civil engineering generally and for water and waste engineering in particular. For example, systems exist to:

- Identify the need for external leak detection monitoring;
- Analyse unknown contents of waste containers;
- Interpret groundwater sample data;
- Assist operators of activated sludge plants in improving plant performance; and



ABOVE: Use of information technology for research and training

- Suggesting low cost treatment processes for rural water supplies.

Because of the limitations of adapting any rules to real life, computer systems are mostly used as human assistants (with humans always making the final decisions) rather than as 'stand alone' autonomous systems. They are not there to replace a human expert, but to extend the experience and confidence of that expert.

The most commonly available computers in the world today (PCs or IBM Compatible MicroComputers, which are now counted in the tens of millions) work to a common standard. Programs designed for one machine normally run on other machines. This makes it worthwhile to prepare more specialised programs, knowing that it will be possible to run them in a different setting.

As these computers become available for the first time in an organisation there is a danger that they become the preserve of 'the computer expert'. However, the great advantage of desktop computers is that they can become an everyday tool of the planner or engineer, to be used in the same way as a typewriter, a calculator or even a pad of paper.

A knowledge based system is one type of program to run on a microcomputer. It consists of two basic components: the 'knowledge base' and the 'inference engine'. The knowledge base contains all the rules and statements which represent the expert's decision-making logic, and the inference engine is the 'mechanism' which searches it

to extract conclusions, that is the process of developing evidence in order to arrive at new conclusions.

The major strength of a KBS over conventional computer programs is the ability to allow use to be made of qualitative knowledge (expertise and experience or 'soft' data), natural language and to allow interactive, user friendly consultations. They are normally used to model complex situations with too many variables to be solved using a linear approach.

The relevance of KBSs for developing countries lies in their potential for high level information transfer between local and international knowledge – particularly where inter-disciplinary expertise is required.

The KBS on handpump selection uses the experience gained in the UNDP/World Bank project on laboratory and field testing of handpumps. The system was developed by Eckhard Hochgrebe using a 'VP Expert' shell. This shell is reputed to be the best selling expert development system in the world. It has the advantages of low purchase cost and a single run-time license irrespective of the number of copies. It is also one of the simpler programs so that the entire program with the handpump knowledge base can be contained on a single 5.25ins floppy diskette which facilitates dissemination and use.

Because of the way in which the data was available, this particular program acts substantially as the interactive front end of a database. Information on each pump is held on disk and the user is asked a series of questions regarding the maximum lift, maximum daily output, maintenance systems, corrosion resistance, abrasion resistance and manufacturing locale. At each step there is the possibility of choosing comments to explain the question and the reasoning behind answering it. As the user becomes more experienced these comments can be omitted. On conclusion of the questioning, the program searches the database for the pump or pumps which best fit the chosen criteria. The list is displayed and the user is offered further information on each pump, including the results of the testing programme, the country of production and address of supplier and an indicative price.

From the sample screens illustrated it can be seen that the program is simple to use; it does not

require the input of specific figures but asks the user to specify a given range. Hochgrebe suggests that the comments section could be improved further, providing comprehensive information built up like a good introductory reader and supported by good visual displays, figures and graphs. Such a computer based reader could allow the user both a) to read from page to page and b) to access any particularly marked cross-references, in the style of a good dictionary. Thus one branch of the expert system would be assigned for the experienced analyst who wants fast results, while the other branch would become a combined education and selection facility.

The KBS on sanitation selection was prepared by Eugene Larbi, again on VP Expert, using an algorithm prepared by the author. The target group of users of this programme is expected to include professionally trained project engineers and project planners who will be involved in the preliminary design stages of sanitation projects. No special knowledge in computer usage is required for consultation but it is expected that users should be conversant with conditions in the project area and the requirements of the recipients for whom the excreta disposal system is required.

The program takes as its starting point the method of anal cleansing and offers comments as to why this is significant. Depending upon the answer the user is then asked about water availability, affordability, population density, demand for reuse of faecal waste, availability of mechanical pit emptier, land availability, and permeability of ground. Again, comments are offered at each stage but questions are only asked where they remain relevant. The program ends with a recommended sanitation system and a disclaimer to stress that the KBS is only a guide to the decision making process and that the final choice still depends largely on the preference of the community or household.

Larbi believes that the program could be extended to include construction details of the chosen system, operational and maintenance requirements and typical costs and potential for householder involvement in construction.

Following on from the work on these initial programs it is envisaged that a 'family' of knowledge based systems might be prepared for use in low cost water supply and sanitation programmes.

Because of the cost and complexity of joining all the sectors together into one computer program (and the danger of appearing to give a single 'correct' answer) a series of programs looks to be advisable. At the top of the hierarchy an overall planning knowledge based system would enable the user to estimate demand and potential resources and constraints. This is equivalent to the sector planning and pre-feasibility stages of the Project Cycle and could result in suggestions such as 'groundwater development with handpumps' or 'gravity flow water systems with VIP latrines'.

At a second level the feasibility of the initially recommended method of meeting the demand would be assessed in a knowledge based system. At a final level, where qualitative factors are no longer significant a conventional program would be used for detailed design such as determining pipe sizes on a branched network.

Can the use of computers ever be justified for the promotion of low cost water supply and sanitation? Or are they simply yet another inappropriate technology which will fail after an expensive trial run? The author believes that knowledge based systems have considerable potential to assist in overcoming the knowledge and skills gap which is limiting the replication of known technologies to millions of people.

However, it is always worth noting the dangers. Harper comments that 'computers can be a typical example of an inappropriate technology if they are used inadvisably; they can perpetuate dependence, reduce replicability, inhibit local participation and constrain local job opportunities.' It is necessary to 'ensure that local field staff are trained to use computers, and do use them'. We have to 'avoid any impression that computers are only to be used by a higher level of staff, or only by headquarters.'

It appears that in the long term, computer based information technology will play an ever increasing role in the storage and transfer of skills, knowledge and information. To meet the urgent needs of the millions without adequate water supply and sanitation it would be beneficial to use modern methods to enhance appropriate technology now - rather than allow these programmes to fall even further behind.

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DICTIONARY OF WASTE & WATER TREATMENT,

Borough Green, Sevenoaks, Kent TN15 8PH. UK. Definitions of around 6000 terms are contained in this dictionary, in the fields of: water treatment and supply, sewerage; sewage treatment and disposal; solid waste disposal and reclamation; pollution prevention; toxic and hazardous waste disposal. Published (1983) by Butterworths.

DICTIONARY OF WASTE & WATER TREATMENT,

Crown House, Linton Rd, Barking, Essex IG11 8JU. UK. Tel: +44-1-594 7272. Contains some 8000 technical terms and synonyms relating to water supply and wastewater dis-

posal, and providing each in German, English, French and Italian. Within the broad scope, engineering terminology is particularly well represented, whilst adequate coverage is given to the relevant vocabularies of chemistry, geology and mining, biology and public health. Published (1963) by Elsevier Publishing Co.

DICTIONARY OF WATER & SEWAGE ENGINEERING,

Crown House, Linton Rd, Barking, Essex IG11 8JU. UK. Tel: +44-1-594 7272. Contains some 8000 technical terms and synonyms relating to water supply and waste water disposal, and providing each in German, English, French and Italian. Within the broad scope, engineering terminology is particularly well represented, whilst adequate.

DIR OF ORGNISTIONS INVOLVED IN COMM EDUC & PARTICIPATION IN WATER SUPP & SANITATN,

PO Box 5500, WHO Collaborating Centre, Rijswijk, HM 2280. The Netherlands. This publication presents data on 24 organisations from 56 countries and 10 international organisations, regarding their work in community education and participation in the field of water supply and sanitation in developing countries. Published by: The international Reference Centre for Community Water Supply & Sanitation.

GUIDE TO US BASED AGENCIES INV IN WATER & SANITATION PROJ IN DEV COUNTRIES,

2121 Virginia Avenue NW, Washington DC 20037. USA. The Guide is designed to encourage information exchange and co-operation among voluntary organisations and other groups. Published by: National Council for International Health (NCIH).

INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP,

Myson House, Railway Terrace, Rugby, Warks CV21 3JT. UK. Tel: +44-788 60631. Telex: 317466. ITDG is a British charity dedicated to increasing the income generating capabilities of poor people in rural areas of the developing world. The Group gives advice in the choice of appropriate technologies and provides technical assistance to local development projects aimed at improving the productivity of communities and small enterprises. Developed the IT wind-pump and publishes "Waterlines" quarterly journal and several relevant books. IT Development Techniques Ltd is the Group's marketing channel.

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INTERNATIONAL THOMPSON PUBLISHING, ,

10 Davis Drive, Belmont, CA 94002. USA. Tel: +1-415-598 0784. Distributors in South America, South East Asia and the Far East, for Van Nostrand Reinhold Books, many on the Water Industry.

IRRICAB - CURRENT ANNOTATED BIBLIOGRAPHY OF IRRIGATION,

Headington Hill Hall, Oxford OX3 0BW. UK. Tel: +44-865 64881 Telex: 83177. Several thousands of journals, monographs, books, conference proceedings and other non-periodical literature are covered for this publication. In particular, it contains abstracts of material related to on-farm water management. Published (quarterly) by: Pergamon Press Ltd.

THE IRRIGATION ASSOCIATION,

1911 North Fort Myer Drive, # 1009 Arlington, VA 22209. USA. Tel: +1-703-524 1200. Telex: 910-250-8332. Fax: +1-703-524 9544. The Irrigation Association is a non-profit trade organisation representing the irrigation industry at the national and international levels. Its primary purpose is to provide members with comprehensive programmes and services helping them keep pace with the rapidly changing technology of the industry.

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IRRIGATION: INTERNATIONAL GUIDE TO ORGANISATIONS & INSTITUTES,

Headington Hill Hall, Oxford OX3 0BW. UK. Tel: +44-865 64881 Telex: 83177. This publication is intended for policy-makers, planners, managers, research and teaching staff interested in locating organisations concerned with irrigation - 864 organisations in 109 countries are listed. Published by: Pergamon Press Ltd.

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MACMILLAN EDUCATION (INTERNATIONAL DIVISION),

Houndmills, Basingstoke, Hants RG21 2XS. UK. Tel: +44-256 29242. Fax: +44 256 479476. Contact Name: Matthew Deans. International Division publishing covers a wide range of education and training needs throughout the developing world. Macmillan projects include collaborative publishing ventures with international aid agencies and organisations overseas. A major new title for 1990 in the field of water technology will be Rural Water Supplies and Sanitation edited by Peter Morgan - a book developed from the work of the Blair Research Laboratories in Zimbabwe.

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PERGAMON PRESS PLC,

Headington Hill Hall, Oxford OX3 0BW. UK. Tel: +44-865 64881. Telex: 83177. Fax: +44-865 60285. Pergamon Press, one of the largest STM publishers in the world, is the official publisher for the International Association on Water Pollution Research and Control (IAWPRC). Free sample copies of the IAWPRC journals Water Research, Water Science and Technology, and comprehensive IAWPRC Publications Catalogue, are available from our Oxford office. Please write for further details.

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222-3401-27. Telex: 111010 TZST A. The institute prepares various studies relating to the environment and to alternative energy. Activities include the drawing up of emission registers, assessment of environmental impact, sanitary planning, re-development planning, urban and regional environmental planning, investment planning, regional energy development planning, alternative energy surveys (eg energy from biomass), market and economic studies and feasibility studies etc.

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INSTITUTE OF HYDROLOGY,
Maclea Building, Crowmarsh Gifford, Wallingford, Oxon OX10 8BB. UK. Tel: +44-491 38800. Telex: 849-365. Fax: +44-491 32256. Part of the government grant-aided Natural Environment Research Council, the Institute carries out hydrology research in catchment areas, for the transformation of rain or snow into flowing rivers, and applied studies. Involved in the development and testing of new methods and instrumentation. Carry out extensive commissioned research on behalf of governments and private companies.

INTERNATIONAL ASSOCIATION FOR GREAT LAKES RESEARCH,
Large Lakes Research Station 9311 Groh Rd, Grosse Ile, Michigan 48138. USA. This Association is a multidisciplinary body whose objectives are to promote, publish and present results on the North American Great Lakes and other large lakes of the world.

INTERNATIONAL ASSOCIATION ON HYDRAULIC RESEARCH,
PO Box 177 Delft Hydraulics Laboratory, Rotterdamseweg 185, Delft 2600 MH. The Netherlands. Tel: +31-15-569353. Telex: 30176 HYDEL. IAHR is a worldwide independent organisation of engineers and scientists inter-

ested in or working in the field of hydraulic research. Its activities include: meetings, conferences and organisation and co-ordination of special scientific and experimental research.

INTERNATIONAL INSTITUTE FOR ENVIRONMENT & DEVELOPMENT-EARTHSCAN (IIED),
3 Endsleigh St, London WC1H 0DD. UK. Tel: +44 71-388 2117. IIED is a unique policy research centre focusing on environment and development issues in the belief that sustainable economic, social, and human development is dependent on sound environmental policies.

INTERNATIONAL INSTITUTE FOR HYDRAULIC & ENVIRONMENTAL ENGINEERING,
PO Box 3015 Oude Delft 95, 2601 DA Delft. The Netherlands. Tel: +31-15-783402.

NATIONAL ENGINEERING LABORATORY,
East Kilbride, Glasgow G75 0QU. UK. Tel: +44-3552 20222. Telex: 777888. Fax: +44-3552 36930. NEL holds the UK national standard for flow measurement and is also an international centre for the testing/approval of water tur industry with expertise and facilities in fluid mechanics, flow measurement, manufacturing technology, materials, stress analysis, reliability and control applied to flow-meters, pumps, turbines, valves and other pipeline components.

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OVERSEAS SPRAYING MACHINERY CENTRE (OSMC),
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TECHNICAL JOURNALS

ADVANCES IN WATER RESOURCES,

CML Publications, Ashurst Lodge, Ashurst, Southampton SO4 2AA, UK. Designed to act as an international forum for the exchange of scientific and technical information, this journal is an alternative for those who are interested in the more quantitative aspects of the water sciences. It publishes papers on basic developments and simulation techniques, and papers that emphasise practical applications.

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AQUALINE ABSTRACTS,
Headington Hill Hall, Oxford OX3 0BW, UK. Tel: +44-865 64881. Telex: 83177. A guide to recently published information on water, wastewater, associated engineering services and the aquatic environment. Each issue provides up to 210 summaries of articles, reports and conference papers, selected for their relevance to engineers, scientists and managers engaged in water supply or wastewater disposal. Available from Pergamon Press Ltd.

AQUATECHNIC INTERNATIONAL - AQUATECHNIC PUBLICATIONS LTD,

75 Lower Camden, Chislehurst, Kent BR7 5JD, UK. A trade journal describing products and services for the water and wastewater industries. It offers a computer-based reader enquiry service which provides further information on products and services mentioned in the journal. It also includes an indexed buyer's guide and an international diary of events.

ARAB WATER WORLD,

PO Box 135121, Beirut, Lebanon. This journal contains news and trends, contracts let or to be let, coming tenders, news on newly developed equipment and services, and reports on forthcoming exhibitions and conferences. It has a bilingual Arabic/English format.

ARGUS BUSINESS PUBLICA- TIONS,

Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, UK. Tel: +44-737 768611. Telex: 948669 TOPJNL G. Fax: +44-737 760564. Publishers of: Middle East Water and Sewage (bimonthly) Far East Water and Sewage (bimonthly) Water Services (monthly). All of these journals are aimed at those involved in all aspects of the water industry.

ASIAN ENVIRONMENTAL JOURNALS,

PO Box 900 MCC, Makati, Philippines. The official journal of the Pollution Control Association of the Philippines, and the Philippine Society of Sanitary Engineers. The journal

includes book reviews, equipment news and feature articles in addition to refereed papers. It is also a supplementary journal of the Indonesian Society of Sanitary Engineers and the Indian Association on Water Pollution Control.

ASIAN WATER & SEWAGE,
PO Box 20014, Hennessy Rd. Hong Kong. Tel: +852-5-278399 Telex: 72727 ASAMM. Short research articles, product news, information on forthcoming projects, and news of general interest - mainly on countries in the SE Asian region - are carried in this journal. Published (monthly) by: Asia Trade Journals Ltd.

AWT NEWSLETTER (ADVANCED WATER TECHNOLOGY CONSULTING SERVICE),
Water Research Centre, PO Box 85, Frankland Rd, Blagrove, Swindon, Wilts SN5 8YR. UK. Tel: +44-793 488301 This Newsletter is produced by a consortium of consultant engineers in the water technology field. Its coverage is international, and includes information on projects, conferences and publications

CHEMOSPHERE,
Headington Hill Hall, Oxford OX3 0BW. UK. Tel: +44-865 64881 Telex: 83177. An international journal designed for the rapid publication of original and important communications in English, French and German as well as review articles in English. The scope of the journal is broad, covering chemistry, biology and toxicology as related to environmental problems. Published (monthly) by: Pergamon Press.

CONFLUENCE,
Water Resources Section, ESCAP Natural Resources Division, United Nations Build, Bangkok 10200. Thailand. Tel: +66-2-282 9161/282 9200 Telex: 82392 & 82315 ESCAP. This publication is designed as the chief medium for disseminating information to the agencies and governments participating in ESCAP's (Economic and Social Commission for Asia and the Pacific) information exchange activity in the field of water resources development. Published by: ESCAP, Water Information Exchange Service.

DECADE WATCH,
1 United Nations Plaza, New York NY 10017. USA. Tel: +1-212-754 4790 UNDEVPRO New York. A news-sheet, containing items relating to the progress of the International

Drinking Water Supply and Sanitation Decade. Published by: United Nations Development Programme.

DRAGERWERK AKTIENE-SELLSCHAFT,
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ENVIRONMENTAL EQUIPMENT NEWS,
Rue Verte 216, Brussels 1030. Belgium. Tel: +32-2-242 2992 Telex: 25828. A supplement to International Equipment News, which is published bi-monthly and circulated in Europe, the Middle East and oil states to qualified buyers and specifiers of industrial products. Details are given of products for environmental protection of water, air and soil. Published by International Equipment News.

ESTUARINE COASTAL & SHELF SCIENCE,
24-28 Oval Rd, Camden Town, London NW1. UK. Refereed papers on all aspects of this subject are published in this journal. Book reviews are also included. Published (monthly) by: Academic Press.

EUROPEAN WATER & SEWAGE,
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sludge disposal, water treatment and distribution, sewer renovation, river quality and control, pumping technology, desalination, and effluent treatment and its reuse. All major articles have synopses in French and German. Published (quarterly) by: Industrial and Marine Publications.

INGEGNERIA AMBIENTALE INQUINAMENTO E DUPU- RAZIONE,

Via Flli Gorlini 1, Milano 20151, Italy. Tel: +39-2-4520354/4520543 Technical articles concerned with wastewater treatment: plants in various countries are printed in this journal. There are also sections on product information, legislation, recent news, a bibliography and a calendar of events. Published in Italian by: Istituto di Ingegneria Sanitaria del Politecnico di Milano.

INQUINAMENTO,

Via Nuova Rivoltana 952F9, Milano 20090, Italy. Tel: +39-2-92771 Telex: 331342 ETASKOI. The articles in this journal are all concerned with aspects of pollution, particularly air and water pollution. In addition, there are items on new products and a reader inquiry service. Published (in Italian) by: Etas Kompass SpA.

INTERNATIONAL JOURNAL OF WATER RESOURCES DEVELOP- MENT,

6 Crofton Terrace, Dun Laoghaire, Co Dublin, Eire. A multi-disciplinary journal covering all aspects of water development and management. It contains state-of-the-art review articles, case studies and reports on the applications of the latest research results. Published (quarterly) by: Tycooly International Publishing Ltd.

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INTERNATIONAL WATER REPORT,

North Shore Atrium, 6800 Jericho Turnpike, Syosset, NY 11791, USA. An American newsletter on developments in

products, research, pollution and waste control, water supply and treatment and legislation in Europe, Asia, Africa, South America and Oceania. Published (bimonthly) by: Water Information Centre Inc.

MARINE ENVIRONMENTAL RESEARCH,

Crown House, Linton Rd, Barking, Essex IG11 8JU, UK. Tel: +44-1-594 7272 Papers on all aspects of the marine environment in the fields of biology, chemistry and oceanography are published in this journal. It is particularly intended to provide a forum for work on marine monitoring with an emphasis on methods and results. Published (quarterly) by: Elsevier Applied Science Publishers.

MARINE POLLUTION BULLETIN,

Headington Hill Hall, Oxford OX3 0BW, UK. Tel: +44-865 64881 Telex: 83177. This bulletin contains news, comment, reviews and research reports, not only on the threat of noxious substances to marine life, but also on the management and productivity of the marine environment in general. Published (monthly) by: Pergamon Press Ltd.

THE MCVLAINE CO,

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MIDDLE EAST WATER & SEWAGE,

Queensway House 2 Queensway, Redhill, Surrey RH1 1QS, UK. Tel: +44-737 68611 Telex: 948669 TOPINL. This journal contains technical articles, concentrating on matters of relevance to the Middle East; items of general news; a calendar of forthcoming events; and a publications section. Published (quarterly) by: Fuel and Metallurgical Journals Ltd.

MUNICIPAL WASTEWATER REUSE NEWS,

6666 West Quincy Avenue, Denver, Colorado 80235, USA. A 24 page newsletter publishing items on forthcoming conferences, seminars and courses. It contains a section on published literature, with some articles printed in full. Half of the publication is taken up with a section on Water Reuse

Plans and Demonstrations, looking at various plants in operation and different techniques, from all over the world.
Published by: American Waterworks Association (AWWA).

OEBALIA,

A Cerruti, Via Roma 3, Taranto 74100. Italy. Tel: +99-25434 This journal is concerned with all aspects of marine biology and oceanography. It publishes research papers in English or French, with particular emphasis on scientific and technological innovations in the field of marine biology.
Published by: Istituto Sperimentale Talassografico CNR.

OIL & PETROCHEMICAL POLLUTION,

Crown House, linton Rd, Barking, Essex IG11 8JU. UK. Tel: +44-1-594 7272 A wide range of subjects within the field of oil pollution control are covered by this journal. Key issues include techniques for the prevention and control of oil pollution, the effects of oil and petrochemicals on the environment, human health and safety hazards, economic aspects of pollution control, and legal issues relating to pollution. Published (quarterly) by: Elsevier Applied Science Publishers.

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Headington Hill Hall, Oxford OX3 0BW. UK. Tel: +44-865 64881. Telex: 83177. Fax: +44-865 60285. Pergamon Press, one of the largest STM publishers in the world, is the official publisher for the International Association on Water Pollution Research and Control (IAWPRC). Free sample copies of the IAWPRC journals Water Research, Water Science and Technology, and comprehensive IAWPRC Publications Catalogue, are available from our Oxford office. Please write for further details.

PM INTERNATIONAL NEWSLETTER,

South Park lodge, Mayfield Lane, Wadhurst, East Sussex TN5 6JE. UK. This newsletter carries items from all over the world on pollution control, energy management, health at work, accident prevention and industrial security. It contains a buyer's guide, and carries a few pages of advertisements. Published (monthly) by: Wealden Press Ltd.

REED BUSINESS PUBLISHING LTD,
Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. UK. Tel: +44-1-661 3500 Telex: 892084. Fax: +44-1-661 8904. Publish "International Water Power and Dam Construction" - monthly magazine and annual handbook.

**REVUE INTERNATIONALE
D'OCEANOGRAPHIE MEDICALE,**

Parc de la Côte, 1 Avenue Jean Lorrain, Nice 06300. France. Papers on marine pollution topics are published in this journal, in either French or English. Published by: CERBOM.

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THE URBAN EDGE,

Room N-231 1818 High St, NW, Washington DC 20433. USA. Tel: +1-202-477 5476 Telex: IT 440098 WORLDBANK. Published in English, Spanish and French for the World Bank, this journal is concerned with practical approaches to urban problems in developing countries. Water supply and sanitation are of particular concern. Published (10 times a year) by: The World Bank.

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DER TECHNIK,**

PO Box 10 39 62, Hollestr 1G, Munich. Tel: +49-201/82-00-2-02 Fax: +49-201/82-00-2-04. Specialised technical publications for the supply industry. Most publications carry advertising by producers and service companies and are therefore efficient platforms for international marketing.

WATER QUALITY BULLETIN,

Box 5050, Canada Centre for Inland Waters, 867 Lakeshore Rd, Burlington, Ontario L7R 4A6. Canada. Tel: +1-416-637 4374 This journal includes articles ranging from pure research on problems of water quality to papers describing the administration of the water industry in different countries, and the progress of such schemes as the International Drinking Water Supply and Sanitation Decade. Published mthly by: WHO Collaborating Centre on Surface & Ground Water Quality.

WATER RESOURCES JOURNAL,

United Nations Building, Rajadamnern Avenue, Bangkok 10200. Thailand. This is a review journal of the Natural

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Resources Division of ESCAP (Economic and Social Commission for Asia and the Pacific). The contents include news of current developments of regional interest, accounts of national experience applicable elsewhere in the Asian and Pacific Region, and technical articles reprinted from various sources around the world. Published (quarterly) by: ESCAP Natural Resources Division.

WATER SUPPLY,

Headington Hill Hall, Oxford OX3 0BW. UK. Tel: +44-865 64881 Telex: 83177. This journal publishes most of the papers submitted at meetings sponsored by the WSA, including the biennial congresses, specialised conferences and workshops, and some regional conferences. Published by: Pergamon Press Ltd.

WATERLINES,

9 King St, London WC2E 8HW. UK. Tel: +44-71-836 9434 A publication dealing with appropriate technologies and appropriate solutions in the field of water supply and sanitation in developing countries. It contains papers from fieldworkers, often describing specific items of equipment which are low-cost and can be easily assembled and maintained. Published by: Intermediate Technology Publications Ltd.

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Imperial College at Silwood Park, Sunninghill, Ascot, Berks SL5 7PY. UK. OSMC provides advice, training and research on the application of pesticides and spraying machinery.

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WATER, ENGINEERING & DEVELOPMENT CENTRE (WEDC),

Loughborough University of Technology, Leics LE11 3TU. UK. Tel: +44-509 222390. Telex: 34319. Fax: +44-509 610231. WEDC offers a wide range of courses for professionals involved in water supply, wastewater engineering and other aspects of urban and rural infrastructure. Duration from two weeks to two years. The Centre also provides in-country training on consultancy in developing countries.

REGULATIONS & REGULATIONS

REGULATIONS

A LOOK AT INSTITUTIONAL DEVELOPMENT

by Alistair Wray, Water, Engineering and Development Centre (WEDC).

Worldwide the water supply and sanitation sector is characterised by the great variety of institutions and organisations operating within it. They range from national ministries and municipal water and sewerage entities to private companies to local water organisations and the activities of NGOs and community groups.

In many developing countries the pressures from urban expansion, the communications problems associated with scattered rural communities, and poor financial control and weak management has meant that many of the national and local authorities traditionally responsible for water and sanitation have not been able to provide the service required. We have seen as a response a tremendous growth in the activities of NGOs in the water sector. These charitable and religious organisations have achieved great success in providing local water supply and sanitation services notably with the development of community participation. Such organisations have their limitations, however. They are frequently reliant on grant funding, have limited geographical coverage and may lack technical expertise. The sector is therefore often characterised by a large number of involved agencies, poorly defined responsibilities, fragmented efforts, weak financial management and lack of overall policy. The need for comprehensive organisational systems and national strategies to overcome these institutional problems is now well recognised.

Institutional changes have not been restricted to the developing world. The UK water industry has experienced profound change in recent years with the creation of regional water authorities which embrace all aspects of the water cycle. These authorities centralise the responsibilities of a large number of water companies and local authorities and provide opportunities to rationalise facilities. In some cases however it took some time to find out exactly what facilities existed and how they may best be managed. The recent privatisation has meant that these authorities were relatively short-lived and, while the operating units remain large, the change of ownership has brought about some interesting transformations with the creation of a National Rivers Authority with special responsibilities for the river network, while the provision of water and sewage disposal remains the principal concern of the water companies.

Despite their different environments, are there any lessons that can be learnt from the institutional changes that have been taking place in the developed and developing world that might be mutually beneficial?

A NATIONAL STRATEGY

The proliferation of agencies trying to cope with the demand for water and sanitation services in developing countries has led to fragmented and poorly co-ordinated activities with gaps and duplication in areas of responsibility. A national strategy is required to overcome these institutional problems. This provides a framework for the development of the sector and the means of linking the various regional, municipal and local agencies and providing technical and financial support. Such a framework must define the different agencies' areas of responsibility, both sectorally and geographically. It must however allow the different institutions to operate autonomously and this implies devolving a certain amount of authority to enable them to act independently. Typically a national agency would be concerned with setting policies and programmes, providing technical and financial assistance, often through the provision of revolving funds, and encouraging the growth of financially sound implementing units.

A good example of national strategy is that which has developed in the Philippines where the National Water Resources Council (NWRC) carries out government policy related to the conservation, development and optimum utilisation of water resources overall. Implementation takes place

through the Local Water and Utilities Administration (LWUA) which provides technical and financial assistance to semi-autonomous water districts set up in the different population centres to meet local demand. A parallel programme has been developed for small rural communities with populations up to 10,000 where the facilities are ultimately owned, maintained and managed by the users through rural waterworks associations. This programme is administered nationally by the Ministry of Local Government and Community Development, and implemented with the assistance of the local government units. This national



ABOVE & BELOW: *Institutions need to be able to embrace conventional works (municipal treatment plant, San Luis Potosi, Mexico) and less conventional activities (community based construction of a water storage tank, Sierra Leone).*



strategy provides guidelines but allows considerable financial autonomy to be devolved down the implementing units, while at the same time maintaining the advantages and economies of scale related to financing, technical assistance and the procurement of goods.

Many countries have based their national strategy on a strong regional approach. Nigeria has developed a system of state utility and water boards and some of these, such as the Water Resources and Engineering Construction Agency of Kano State (WRECA), have been very successful in meeting the demands for water in their state, as well as acting as consultants throughout Nigeria. Performance between states however is quite variable.

The UK water authorities reflect a similar regional approach, although their boundaries are drawn to suit the river basins; perhaps most logical when responsibilities cover the whole of the water cycle. It might be argued that this strong regional approach has been at the expense of national strategy with policies on quality and asset renewal often inconsistent.

Elsewhere national or regional water authorities have often developed by default. Historically, water and sanitation are municipal responsibilities in many countries but lack of resources and weak management have meant that standards and quality of services have declined in many cases to the point of collapse. They are then taken over by a water institution and rehabilitated. Many Latin American countries exhibit this mix in organisational set-up with supply partially through municipal operations and partially through national or regional agencies, a situation often characterised by widely differing standards of service and charges.

It is interesting to compare the different approaches to management, costs and tariffs displayed by municipal agencies and private water supply companies. The public company is primarily concerned with equity whilst the concern of the private company is efficiency. Both systems can provide a good service given good management. Both systems can also have their failings. The municipal entity is susceptible to political pressures which can lead to distortions in water provision and a failure to maintain an adequate revenue and ensure a sound financial position. Private companies, while free from such influence,

often ignore consumers who are difficult or expensive to serve. Both often fail to give adequate attention to wastewater disposal. A well-defined national institutional framework can again ensure that the best interests of the public are served and the worst excesses of the different approaches avoided by setting target performance indicators, quality standards and financial guidelines, while still allowing autonomy.

DELINEATION OF RESPONSIBILITIES

A clear national strategy can also help eliminate gaps and confusion in responsibilities between different agencies. A satisfactory service must be provided geographically (across the national territory) and cover population centres of all sizes, and must safeguard all aspects of the water cycle. The importance of decentralising responsibilities to local implementing agencies has already been noted. Within most urban areas the water and sanitation facilities remain within the control of the local agency, be they public, semi-public or private, and in urban areas it is possible to establish an efficient centralised operation for maintenance and repair. The rapid expansion of many third world cities has however made the extension of conventional services into many of the new growth areas difficult through lack of resources and the need to consider lower service standards. Success has been obtained in some municipalities by redefining responsibilities and giving local associations the task of collecting fees, distributing water locally and carrying out simple repair operations on behalf of the local utility entity; in effect creating an additional tier in the organisational structure at the local level. A centralised operations and maintenance system has been shown to be not feasible in most rural areas (certainly in developing countries!), where the cost of routine maintenance visits to a handpump could quickly add up to the cost of the original installation. Here community based and operated maintenance systems are a feasible alternative, provided the community feels it owns the facility and is responsible for it. With pressures to decentralise, contract out services and involve recipients, are there any lessons here of relevance to developed countries?

The delineation of responsibilities must also consider whether all aspects of water management should be dealt with by one agency. Often water

is supplied by a separate utility company while sewerage and drainage remain the responsibilities of local government. Experience has shown however that treating one to the exclusion of the other is difficult and problems are best tackled through integrated, system-wide efforts. Clearly developments in water supply and consumption affect the requirements for wastewater disposal. The customers' perceived importance of good water supply can be linked and used to realise the less obvious health benefits of improved sanitation. The linking of rural water supply and sanitation programmes in this way is best achieved if the organisation responsible for promoting such schemes can take an integrated approach.

Particular circumstances may influence how far the integrated approach can be taken. The privatisation of the UK water industry made it desirable to separate out responsibility for the quality of the country's rivers and create a separate independent authority to look after these aspects. Quality monitoring can clearly only be effective within an organisation if that unit has a considerable degree of autonomy and can act in a technical audit capacity. Such work is less equivocal if a separate independent body is used. Sri Lanka has just recently taken this approach and charged the National Building Research Organisation with the responsibility of quality surveillance of the National Water Supply and Sewerage Board operations, reporting back to that organisation and other concerned ministries. Other aspects of water resource management such as irrigation and groundwater abstraction are also frequently the responsibility of separate organisations. This emphasises the importance of national strategy and a framework to co-ordinate and harmonise activities for the benefit of consumers or, in these days of privatisation, customers.

INSTITUTIONAL DEVELOPMENT

Whatever system is adopted, it must be sustainable and able to develop. A sound national framework and delineation of responsibilities will define an agency's role, but it is the people, their skills and an organisation's internal systems which will determine whether it will succeed in its tasks.

The efforts undertaken during the United Nations International Drinking Water and Sanitation Decade have underlined that the key

obstacles to successful project development are institutional. Physical projects without broad institutional improvements are all too frequently wasted efforts. Institutional development is however difficult to undertake. Changes require political support and the acceptance of consumers and they need to be affordable; above all they can only be undertaken over a reasonably long time-frame to overcome natural resistance to change; 10 years is a typical duration. The aim is sustainability and the creation of institutions that are capable of self-development; quick-fix solutions will not achieve this.

Positive performance indicators in key areas such as water quality, cost effectiveness and consumer satisfaction are indications of a developed institution. This requires proper systems and procedures, and the ability to meet the objectives of community groups in the service area. This can only be achieved by motivated and well-trained staff at all levels. A strategy of improving institutional performance indicators and training is required. Rarely can an institution that needs assistance solve its own problems, but the initiatives for change must come from within the organisation. Approaches must therefore identify key individuals, assist them in assessing needs and then in removing constraints. Institutional development is complicated and requires considerable investment in time and effort but its importance in the water sector is not recognised in many developing countries.

The UK water industry created a training organisation over 20 years ago to train for a more effective industry. In the early days it was concerned purely with water supply and distribution but, with reorganisation and changes in responsibilities, it became involved with sewage treatment and disposal, rivers, land drainage and environmental management reflecting the more integrated approach. Personnel from developing countries can avail of this training and that available from other centres.

Within a sound organisational structure that defines policies and responsibilities clearly while at the same time encouraging decentralisation and self-reliance, appropriate institutions may gradually be developed and strengthened to effectively offer all communities the service they deserve.

UNITED NATIONS AGENCIES

UNITED NATIONS AGENCIES

CROWN AGENTS FOR OVERSEAS GOVERNMENTS & ADMINISTRATIONS,

St Nicholas House St, Nicholas Rd, Sutton, Surrey SM1 1EL, UK. The Crown Agents for Overseas Governments and Administrations provide financial, professional and commercial services for some 100 governments, mostly of independent countries, and over 200 overseas public authorities and international bodies.

ECONOMIC & SOCIAL COMMISSION FOR ASIA & THE PACIFIC,

National Resources Division United Nations Building Rajacamarne Avenue, Bangkok 10100, Thailand. Tel: +66-2-282 9161/282 9200. Telex: 82392/82315 ESCAP. A regional arm of the United Nations, with a headquarters in Thailand. The Water Resources Section of the natural resources programme of ESCAP promotes a comprehensive approach to development and management of national water resources. The section's programme concentrates on improvement of water resources data systems, water policy and legislation, technical advisory services, efficiency in water use and dissemination of technical information through its publications - Confluence and Water Resources.

ECONOMIC COMMISSION FOR AFRICA (ECA),

PO Box 3001, Addis Ababa, Ethiopia. Activities include collecting information for research, recommending government and inter-government action and offering advisory services. It also promotes studies into the economic and technological development of the region.

ECONOMIC COMMISSION FOR LATIN AMERICA & THE CARIBBEAN (ECLAC),

Casilla 179-D, Santiago, Chile. Tel: +56-2-485051. Telex: 240077. Activities include collecting information for research, recommending government and inter-governmental action and offering advisory services. Has a permanent water resource unit within the secretariat.

ECONOMIC COMMISSION FOR WESTERN ASIA (ECWA),

PO Box 27, Baghdad, Iraq. Initiates and participates in

measures for facilitating concerted action for the economic reconstruction and development of Western Asia.

FOOD & AGRICULTURE ORGANIZATION (FAO),

Via delle Terme di Caracalla, Rome 00100, Italy. A specialised agency of the UN, founded in 1945, it aims to increase the efficiency of the production and distribution of all food and agricultural products, to improve the condition of rural populations and to raise levels of nutrition in the developing world.

FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS,

Via delle Terme di Caracalla, Rome 00100, Italy. Tel: +39-6-5797. Telex: 61181. Code: FOODAGRI ROME. This organisation is concerned with the beneficial uses of the environment. Its recommendations with regard to inland and coastal fisheries include control of polluting effluents.

INTERNATIONAL BANK FOR RECONSTRUCTION & DEVELOPMENT,

1818 H St, Washington DC, NW 20433, USA. Tel: +1-202-477 1234.

UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS (HABITAT),

PO Box 30030, Nairobi, Kenya. Tel: +254-2-520380. Telex: 22992. Technical co-operation projects in all developing regions, including technologies for urban and rural water supply and sanitation systems. Also covers such areas as low-cost building technology, rural and urban housing and infrastructure development and urban and regional planning.

UNITED NATIONS CHILDREN'S FUND,

866 United Nations Plaza, New York, NY 10017, USA. Tel: +212-754 1234. Telex: 127895/23952. Code: UNICEF, New York. The primary objective of UNICEF is to improve the situation of children everywhere, particularly those in developing countries who are in the greatest need. Water supply and sanitation are often a major priority.

UNITED NATIONS DEVELOPMENT PROGRAMME,

1 United Nations Plaza, New York, NY 10017, USA. Tel:

+1-212-754 4790. Telex: 983-22345. Cable: UNDEVPRO (NEW YORK). The world's largest agency for technical co-operation. Its funds are distributed to developing countries to aid technical and financial planning, particularly national and regional development planning.

UNITED NATIONS EDUCATIONAL SCIENTIFIC & CULTURAL ORGANISATION,
7 Place de Fontenoy, Paris F-75700. France. Tel: +33-1-4577 1610. Telex: 270602/204461. Cable: UNESCO PARIS. UNESCO has developed various forms of intergovernment co-operation concerned with the environmental sciences and research on natural resources. One example is the International Hydrological Programme (IHP), dealing with the scientific aspects of water resources assessment and management.

UNITED NATIONS ENVIRONMENT PROGRAMME,
PO Box 30552, Nairobi, Kenya. Tel: +254-2-333930/332383. Telex: 22068/22173. Cable: UNITERRA, Nairobi. Among the programmes administered by UNEP is the initiative on environmental assessment called Earthwatch. Earthwatch has three main components: the International Referral Service for Sources of Environmental Information (IRS), the International register.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION (UNIDO),
PO Box 300, Vienna International Centre, A-1400 Vienna. Austria. Promotes the industrialisation of developing countries and co-ordinates UN activities in this field. It is an operational as well as advisory body and derives the bulk of its technical co-operation funds from the United Nations Development Programme and from voluntary contributions.

WHO - WORLD HEALTH ORGANISATION,
20 Avenue Appia, Geneva 27, 1211. Switzerland. Tel: +41-22-912111. Telex: 27821 OMS GENEVA. WHO is a specialised agency of the United Nations with primary responsibility for international health matters and public health. It is co-operating with other international organisations to implement the United Nations International Drinking Water Supply and Sanitation Decade, which runs from 1981 to 1990. Regional offices for Africa, Eastern Mediterranean, South East Asia, Western Pacific, Europe and the Americas.

BILATERAL DEVELOPMENT ORGANISATIONS

AGENCY FOR INTERNATIONAL DEVELOPMENT,

Office of Health Room 709, US Agency for International Development, Washington DC 20523. USA. Tel: +1-703-235 8926. Telex: 44-00-01. Four regional bureaux - for Africa, near East, Asia and Latin America. AID will consider funding projects where less than 20 litres of safe drinking water per person is not available and where significant health problems are caused by poor domestic water

AUSTRALIAN DEVELOPMENT ASSISTANCE BUREAU,

PO Box 887, Canberra City, ACT 2601. Australia. Tel: +61-62-49-57-33. Telex: 62631. Grant aid in response to specific requests. ADAB has assisted water supply and sanitation schemes in South East Asia and the Pacific.

BELGIAN ADMINISTRATION FOR DEVELOPMENT CO-OPERATION,

Place Du Champ De Mars 5, Brussels 1050. Belgium. Tel: +32-2-519 0211. Telex: 21-376. Maintains co-operation missions in Algeria, Burundi, Ecuador, Gabon, Indonesia, Ivory Coast, Kenya, Malaysia, Morocco, Niger, Peru, Rwanda, Senegal, Sudan, Suriname, Tunisia, United Republic of Cameroon, Vietnam, Zaire and Zambia. Acts directly on a bilateral basis through loans and participation.

CAISSE CENTRALE DE COOPERATION ECONOMIQUE,

Cité Du Retiro, 33-37 Boissy Dangles, Paris, Cedex 08, 75379. France. Tel: +33-1-42-66-93-66. Telex: 212632. Fax: +33-1-42-66-03-31. Bilateral aid in grants or loans. Considerable experience in financing water supply projects in developing countries.

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY,

200 Promenade du Portage, Hull, Quebec K1A 0G4. Canada. Tel: +1-819-997 3803. Telex: 053-4140. CIDA was established in 1968 as a successor to the External Aid Office. Through this agency, a wide spectrum of assistance is supplied to developing countries, including financial and technical assistance, capital equipment and the services of experts.

BILATERAL DEVELOPMENT ORGANISATIONS

COMMONWEALTH DEVELOPMENT ASSOCIATION (CDC),

One Bessborough Gardens, London SW1V 2JQ, UK. Tel: +44-71-828 4488. Telex: 51-21431 VELOP G. Fax: +44-71-828 6505.

DANISH INTERNATIONAL DEVELOPMENT AGENCY,

Ministry of Foreign Affairs, Asiatisk Plads 2, Copenhagen K, DK-1448, Denmark. Tel: +45-1-920000. Telex: 31292 ETR DK. Danish assistance to developing countries through this agency is divided almost equally between grants and loans on highly concessional terms. Most of the grants are disbursed for project aid, another major component being technical (personnel assistance).

FEDERAL MINISTRY FOR ECONOMIC COOPERATION,

Karl Marx Strasse 4-6, Bonn 1, 53, Federal Republic of Germany. Tel: +49-228 5351. Telex: 8-869-452.

FINNISH INTERNATIONAL DEVELOPMENT AGENCY,

Manterheimintie 15c, Helsinki 26, 00260, Finland. Tel: +358-0-40607. Telex: 124636. Water supply and sanitation has figured strongly in recipients' use of FINNIDA'S bilateral aid.

FONDS D'AIDE ET DE COOPERATION,

Ministere de la Cooperation et Development, 20 Rue Monsieur, Paris 75700, France. Tel: +33-14-783-1010. Telex: 202-363. Fax: +33-43-06-97-40.

GERMAN AGENCY FOR TECHNICAL CO-OPERATION,

Dag-Hammarskjöld-Weg 1, PO Box 5180, Eschborn 1, D-6326, German Federal Republic. Tel: +49-6196-401-265. Telex: 417405 GIZ D. This agency is responsible for the execution of technical co-operation on behalf of the German government. Under technical co-operation, support is provided mainly for advisory services by seconded experts and by consulting firms for technical equipment: supplied to these experts (on a grant basis).

ITALIAN MINISTRY OF FOREIGN AFFAIRS FOR DEVELOPMENT COOPERATION,

Farnesina, Rome 00100, Italy. In the main, Egypt, sub-Saharan and East African countries, China, Pakistan,

Thailand, Malaysia, Colombia and Peru receive Italian aid for water supply and sanitation projects.

JAPAN INTERNATIONAL CO-OPERATION AGENCY,

Shinjuku Mitsui Building, 2-1-1 Nishi-shinjuku, Shinjuku-ku, Tokyo, Japan. Tel: +3-346 5311. Telex: 22271.

MINISTERIE VAN BUITENLANDSE ZAKEN,

Bezuidenhoutweg 67, 'S Gravenhage, Eb 2500, The Netherlands. Tel: +31-70-48-64-86. Telex: 31326.

MINISTRY OF WORKS & DEVELOPMENT,

PO Box 12-041, Wellington, New Zealand. New Zealand has been giving considerable support and aid in the fields of water and sanitation since 1974, and projects aided have included hydro-electric development, well drilling and rainwater catchments.

NORWEGIAN AGENCY FOR INTERNATIONAL DEVELOPMENT,

Victoria Terrasse 7, Oslo 3, Norway. Tel: +47-2-314055. Telex: 16548. Norway's aid aims at improving life for the poorest section of the population in the recipient countries. Thus, water supply and sanitation has for a long time been a priority sector. Aid is supplied mainly in the form of funds and personnel.

OVERSEAS DEVELOPMENT ADMINISTRATION,

Eland House, Stag Place, London SW1E 5DH, UK. Tel: +44-71-213 4937/4954/4963. Telex: 263907/8. The Overseas Development Administration is part of the Foreign and Commonwealth Office of the UK. It provides the framework through which the UK gives capital aid, technical co-operation on a project basis, emergency aid and other components, including training, which go to make up an integrated overall development plan.

THE OVERSEAS ECONOMIC CO-OPERATION FUND,

Takekashi-Godo Building, 1-4-1 Otemachi, Chiyoda-Ku, Tokyo, Japan. Tel: +3-215 1311.

SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY (SIDA),

Stockholm, S-105 25, Sweden. Tel: +46-8-15-01-00. Telex:

11450. Fax: +46-8-32-21-41. Domestic water supply activities supported by SIDA should be partnered by measures to prevent water-related diseases. Funds have been made available for special programmes including low-cost technology.

SWISS DEVELOPMENT CO-OPERATION, DIRECTORATE OF DEV CORP & HUMANITARIAN AID, Berne, 3003. Switzerland. Generally, Swiss aid to water supply projects includes financial assistance for buying equipment and materials as well as technical assistance. Support in this field is seen as long-term, involving the training of local personnel.

WATER SUPPLY & ENVIRONMENTAL SANITATION DEPARTMENT, 1-2-2 Kasumigaseki, Chiyoda-Ku, Tokyo. Japan. Tel: +3-503 1711.

INTERNATIONAL ORGANISATIONS

AIDIS - INTER-AMERICAN ASSOCIATION OF SANITARY & ENVIRONMENTAL ENGINEERING, Apartado Aereo-5820 Bogota. Colombia. Tel: +57-1-244 6597. Telex: 45328. Aidis is an international professional association, with regional branches in all the countries in the Americas. It publishes technical documents, journals and newsletters and organises conferences and seminars on various topics in water pollution research and control, including a regular biennial Latin American conference, the venue for which alternates north and south of the equator.

COMMONWEALTH SCIENCE COUNCIL (CSC), Marlborough House, Pall Mall, London SW1Y 5HX. UK. Established in 1946, the CSC aims to promote scientific collaboration between member countries of the Commonwealth and to increase the capabilities of individual nations to use science and technology for their economic, social and environmental development. Membership is open to all members of the Commonwealth.

DRAGERWERK AKTIENGESELLSCHAFT, Moisinger Allee 53-55, D-2400 Lubeck 1. Germany.

Tel: +49-451 8820 Telex: 268070. Fax: +49-451-882 2080. Gas Analysis Division. In order to reduce the number of potentially hazardous situations at the workplace and minimise any damage resulting from these hazards, many different gases, vapours, and aerosols must be monitored. For that purpose Drager offers easy-to-handle and economical measuring systems. With more than 200 different Drager-Tubes, over 350 separate hazards can be determined in air, soil and water samples.

ICID - INTERNATIONAL COMMISSION ON IRRIGATION & DRAINAGE, 148 Nyaya Marg, Chanakyapuri, New Delhi 110021. India. Tel: +91-11-376-837. This organisation has members in 77 countries. Its activities include a programme of conferences and various publications.

INTERNATIONAL ASSOCIATION ON WATER POLLUTION RESEARCH & CONTROL (IAW-PRC), 1 Queen Anne's Gate, London SW1H 9BT. UK. Tel: +44-71-222 3848. Telex: 918518. Fax: +44-71-222 1811. International Association on Water Pollution Research and Control (IAWPRC) - international membership organisation with members in 75 countries worldwide, for professionals working on water pollution control and water quality management problems. Publishes journals (Water Research, Water Science and Technology), books, scientific and technical reports and a magazine (Water Quality International). Organises some 15-20 conferences worldwide each year. Has 20 expert groups working on a wide range of problems in water pollution control. Wide range of member benefits. Individual, corporate (companies) and student membership available.

INTERNATIONAL COMMISSION ON IRRIGATION & DRAINAGE THE INST OF CIVIL ENGINEERS, 1-7 Great George St, London SW1P 3AA. UK. Tel: +44-71-630 0726. Fax: +44-71-222 7500.

INTERNATIONAL COMMISSION ON LARGE DAMS, 151 Bld Haussmann, Paris 75008. France. Tel: +33-1-4764 6733. This Commission has a programme of triennial

INTERNATIONAL ORGANISATIONS

congresses. It produces various publications and 71 countries are now represented in its membership.

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS,

51 Bld de Montmorency, Paris 75016. France. Tel: 33-1-4525 0329. Telex: ICSU 630553 F. The principal objective of ICSU is to encourage international scientific activity for the benefit of mankind. It does this by initiating, designing and co-ordinating international scientific research projects. ICSU acts as a focus for the exchange of ideas, the communication of scientific information and the development of standards in methodology, nomenclature, units etc. Its activities include conferences, seminars, workshops and a wide range of publications.

INTERNATIONAL DEVELOPMENT ASSOCIATION, EUROPEAN OFFICE,

66 Avenue d'Iena, Paris 75116. France. Tel: +33-1-47-23-54-21.

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE (IIMI),

PO Box 2075, Colombo. Sri Lanka. IIMI is funded by a number of donor countries and organisations. The Institute concentrates on irrigation problems and carries out its operational activities through a network of programmes attached to existing institutions.

INTERNATIONAL OZONE ASSOCIATION,

Wasserversorgung Zurich, Hardhof 9, Postfach, Zurich CH-8023. Switzerland. Tel: +41-1-435 2111. The IOA assembles and disseminates information about ozone technology. It arranges seminars and workshops on the subject and several publications.

INTERNATIONAL REFERENCE CENTRE FOR COMMUNITY WATER SUPPLY & SANITATION,

PO Box 5500, 2280 HM Rijswijk, The Hague. The Netherlands. Tel: +31-70-949322. Telex: 33296 IRC NL. Cable: WORLDWATER. The Hague An information-oriented organisation with an emphasis on support to national programmes for rural and urban-fringe water supply and sanitation. IRC operates through a worldwide network of national and regional institutions both in developing and industrialised countries. IRC is a non-profit foundation and a WHO collaborating centre for community water supply.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE,
Avenue du Mont-Blanc, 1196 Gland. Switzerland. Tel: +41-22-647181. The main aim of IUCN is to promote action directed toward sustainable use and conservation of natural resources. It operates a Conservation Monitoring Centre and an Environmental Law Centre, and publishes various books and papers on conservation-related topics as well as environmental policy and law papers.

INTERNATIONAL UNION OF PURE & APPLIED CHEMISTRY,
Bank Court Chambers, 2-3 Pound Way, Cowley Centre, Oxford, Oxon OX4 3YF. UK. Tel: +44-865 717744. Telex: 83147 ATTN IUPAC. The objectives of IUPAC are: to promote continuing co-operation among chemists of its member countries, to study topics of international importance to pure and applied chemistry which need regulation, standardisation, or codification, to co-operate with other international organisations which deal with topics of a chemical nature, to contribute to the advancement of pure and applied chemistry in all its aspects.

INTERNATIONAL WATER SUPPLY ASSOCIATION,

1 Queen Anne's Gate, London SW1H 9BT. UK. Tel: +44-71-222 8111. Telex: 918518 WASSOC ATTN IWWSA. IWWSA aims to improve knowledge of public water supplies - technical, legal and administrative - and to encourage a maximum exchange of information on research, methods of water supply, statistics, etc. To this end it organises seminars, conferences and workshops, and produces various publications.

THE IRRIGATION ASSOCIATION,

1911 North Fort Myer Drive, # 1009 Arlington, VA 22209. USA. Tel: +1-703-524 1200. Telex: 910-250 8332. Fax: +1-703-524 9544. The Irrigation Association is a non-profit trade organisation representing the irrigation industry at the national and international levels. Its primary purpose is to provide members with comprehensive programs and services helping them keep pace with the rapidly changing technology of the industry.

ISWA INTERNATIONAL SOLID WASTES & PUBLIC CLEANSING ASSOCIATION AGHTM - ISWA,
9 Rue de Phalsbourg, Paris F-75017. France. An international professional society concerned with all aspects of city

OTHER RELEVANT NON-GOVERNMENTAL ORGANISATIONS

cleaning, waste collection, treatment, recycling and disposal. It operates as a membership organisation and publishes a technical journal: *Waste Management and Research*.

IWRA - INTERNATIONAL WATER RESOURCES ASSOCIATION,

University of Illinois, 208 North Romine Street, Urbana, Illinois 61801, USA. (IAWPRC) Reproduced from the 1987-88 Yearbook of the International Association on Water Pollution Research and Control (IAWPRC) with the Association's consent. IAWPRC, 1, Queen Anne's Gate, London SW1H 9BT, UK.

SOCIETY FOR INTERNATIONAL DEVELOPMENT (SID),

Palazzo Civiltà del Lavoro, Rome 00144, Italy. SID, with headquarters in Rome, is the largest and geographically most extensive international, non-governmental and non-profit-making development organisation in the world. A quarterly journal, 'Development', is published in three languages together with a regular newsletter, 'Compass'.

TECHNICAL CENTRE FOR AGRICULTURAL & RURAL CO-OPERATION (CTA),

PO Box 380, 6700 AJ Wageningen, The Netherlands. The Centre was established under the Second Lomé Convention to facilitate the exchange of scientific and technical information between the European Community and African, Caribbean and Pacific states.

WORLD FEDERATION OF ENGINEERING ORGANISATIONS,

19 rue Blanche, Paris 75009, France. Tel: 133-1-526 3482. Telex: 650594 FIWO. WFEO was founded in 1968 under the sponsorship of UNESCO. Its main activities are: promotion of training in the scientific and technical professions, instigating co-operation between national members and other international bodies, and assuring efficient

WORLD METEOROLOGICAL ORGANISATION,

41 Avenue Giuseppe-Motta, Case Postale 5, 1211 Geneva 20, Switzerland. Tel: +41-22-346400. Telex: 23260. The objectives of the WMO are: worldwide co-operation in making meteorological and hydrometeorological observations and in standardising their publication, promotion of rapid weather information services, encouragement of

research and training in meteorology, and promotion of activities in operational hydrology.

OTHER RELEVANT NON-GOVERNMENTAL ORGANISATIONS

AMERICAN WATER WORKS ASSOCIATION,

6666 West Quincy Avenue, Denver, CO 80325, USA. Tel: +1-303-794 7711. Telex: 45-0895. Fax: +1-303-794 7310. AWWA's publications cover the water supply industry. More than 350 titles are available on water source, quality, treatment and distribution, utility management, employee training and safety. Catalogue available.

BRITISH WATER INTERNATIONAL LTD,

9 Harley St, London W1N 2AL, UK. Tel: +44-71-436 7541. Telex: 937400. Fax: +44-71-436 7393. Co-ordinating role for UK water industry. Promotion of overseas water and sewage projects, sponsorship and organisation of overseas and inward trade missions, 100 member companies comprising consultants, contractors, public sector authorities and research

CATHOLIC FUND FOR OVERSEAS DEVELOPMENT (CAFOD),

2 Garden Close, Stockwell Rd, London SW9 9TY, UK. CAFOD is the national overseas aid fund of the Catholic Church in England and Wales and works through local Catholic churches. It provides grants without distinction of race or creed for developing communities overseas.

CEDRE,

Pointe de Diable, Plouzane - BP 308, Brest F-29274, France. Tel: +33-98-491266. Telex: 940145 F. Centre de Documentation de Recherche et d'Experimentations sur les Pollutions Accidentelles des Eaux. This organisation, in addition to carrying out research, will respond to pollution alerts and will initiate cleaning up operations.

CHRISTIAN AID,

PO Box 1, London SW9 8BH, UK. The official relief and development agency of the 22 member churches of the British Council of Churches, of which it is a division. It co-ordinates with the World Council of Churches Division of Inter-Church Aid, Refugee and World Service, it also works through UN agencies.

OTHER RELEVANT NON-GOVERNMENTAL ORGANISATIONS

CONCAWE,

Babylon - Kantorena, Koningin Julianaplein 30-9, 2595 AA Den Haag. The Netherlands. CONCAWE is the oil companies' international study group for conservation of clean air and water.

CONCRETE PIPE ASSOCIATION,

60 Charles St, Leicester LE1 1FB. UK. Tel: +44-533 536161. Fax: +44-533 514568. Promotion, development and advisory service for design, specifications and construction of pipelines for sewage, service water, highway and agricultural drainage, consisting of precast concrete pipes, bends and junctions, pipes for jacking manholes, soak-aways and road gulleys.

ENVIRONMENTAL LIAISON CENTRE,

PO Box 72461, Nairobi. Kenya. Tel: +254-2-24770/340849. The aims of the ELC are to strengthen Non-Governmental Organisations working in the fields of environment, sustainable development and connected issues, particularly in the Third World, through the provision of information, financial assistance and training, and to build links between environmental NGOs around the world. It disseminates information through the Environmental Data System, publications, conferences and symposia. Advice is provided to Third World NGOs on project design and implementation, administration, fund raising and media relations. Water management is a main issue for the ELC.

GROUP OF EXPERTS ON THE SCIENTIFIC ASPECTS OF MARINE POLLUTION,

Via delle Terme di Caracalla (F10-F5315), Rome I-00100. Italy. An advisory body consisting of specialised experts nominated by various sponsoring agencies (IMCO, FAO, UNESCO, WMO, WHO, IAEA, UNEP, UN). Its principal task is to provide scientific advice on marine pollution problems to the sponsoring agencies and to the Intergovernmental Oceanographic Commission (IOC).

HYDROPLAN ASSOCIATION,

2 Rue Henri Borbusse, Marseille, Cedex 01, 13241. France. Tel: +33-9108 6115. Telex: 441-247. Hydroplan, originally a trade association for agricultural and urban water supply and rural development, Hydroplan now comprises of 65 firms specialising in hydraulics which employ 100,000 people, with a turnover of 2.5 billion dollars - of which a third is on for foreign markets.

INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP,

Myson House, Railway Terrace, Rugby, Warks CV21 3HT. UK. Tel: +44-788 60631. Telex: +317466. ITDG is a British charity dedicated to increasing the income generating capabilities of poor people in rural areas of the developing world. The Group gives advice in the choice of appropriate technologies and provides technical assistance to local development projects aimed at improving the productivity of communities and small enterprises. Developed the IT wind-pump and publishes 'Waterlines' quarterly journal and several relevant books. IT Development Techniques Ltd is the Group's marketing channel.

INTERNATIONAL ASSOCIATION FOR GREAT LAKES RESEARCH,

Large Lakes Research Station 9311 Groh Rd, Grrosse Ile, Michigan 48138. USA. This Association is a multidisciplinary body whose objectives are to promote, publish and present results on the North American Great Lakes and other large lakes of the world.

INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS,

Arnhem, PO Box 9090, Marktstraat 1. The Netherlands. The aim of the IAH is to promote co-operation between geologists and specialists of other disciplines interested in hydrogeological problems. The Association participates in the International Hydrological Programme (IHP) of UNESCO and co-operates with many other associations.

INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES,

Institute of Hydrology, Wallingford, Oxon OX10 8BB. UK. Tel: +44-491 38800. Telex: 849365 HYDROL G. The aims of IAHS include the promotion of the study of hydrology, the provision of means for discussion, comparison and publication of results of research, and the initiation and co-ordination of research that requires international co-operation. To fulfil these aims, the Association organises general assemblies, symposia and workshops in various parts of the world, publishes the proceedings of these meetings and a quarterly scientific journal, and contributes to a wide range of international initiatives.

INTERNATIONAL ASSOCIATION OF LIMNOLOGY (SIL),

Althanstrasse 14, Vienna, A-1090. Austria.

OXFAM,

274 Banbury Rd, Oxford OX2 7DZ/ UK. An independent voluntary organisation campaigning to involve as many people as possible in the cause of world development and raising funds for the relief of poverty and suffering among under-privileged communities anywhere in the world.

SAPP,

PO Box 5513, Stockholm S-11485. Sweden. Tel: +46-8-783-85-00. Telex: 19620 EXPORT S. Fax: +46-8-662-90-93. SAPP is the semi-official organisation for collaborating Swedish companies specialising in the provision of services, technology, plants and equipment for agro-industry and agriculture, including water resources assessment and water supply.

SCOTTISH CATHOLIC INTERNATIONAL AID FUND (SCIAF),

43 Greenhill Rd, Rutherglen, Glasgow G73 2SW. UK. Assists and advises the Scottish hierarchy of the church in matters concerning the Third World, and provides grants for overseas projects concerned with overcoming poverty, hunger and ignorance, and concentrates most of its work in Africa, Latin America and India.

WATERAID,

1 Queen Anne's Gate, London SW1H 9BT. UK. Tel: +44-71-222 8111. Telex: 918518. Fax: +44-71-222 1811. Charity commission reg no 288701. Wateraid (a charity) assists local partners in Africa and Asia, with technical advice and materials, for domestic water supply and sanitation projects for poor communities. *Projects supported must involve self-help.*

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PROJECT APPRAISAL & EVALUATION PROCEDURES

by George Akosa and Peter Barker.

The earliest work in formal project appraisal in Ghana investigated sections of the Accra-Tema (ATMA) Water Supply and Sewerage Project. Components of this were first appraised by the World Bank in 1969 and in addition on subsequent stages, the African Development Bank.

Ex-post evaluation of the efficiency of projects has been limited and it is suggested that much can be learned by the application of appraisal and evaluation techniques to both water and sanitation projects.

ACCRA WATER AND SANITATION

Water supply to the ATMA area is obtained from two river sources. The Phase 1 project has an intake located at Kpong downstream of the Volta Dam which feeds a 14,500m³/d conventional water treatment plant operated without chemical pre-treatment due to good quality raw water resulting from the construction of the Volta Dam.

BELOW: Weija Dam - Accra water supply project.



Treated water is pumped 54km through steel mains to the Tema booster stations. Part of the water gravitates to Tema while the rest is pumped 22km to the Accra booster station from where water is delivered to the high, medium and low pressure zones of the Accra distribution system. The project constructed by a West German consortium and financed by supplier's credit guaranteed by the FRG government was commissioned in 1966 at a capital cost of 34.834 million dollars.

Phase 2 of the system is located at Weija on the Densu River 12km west of Accra and is composed of a dam and raw water pumping station, conventional water treatment plant, power supply and treated water transmission mains. In addition 177km of primary, secondary and tertiary distribution mains completed the project. The work was completed in 1984 at a total capital cost of \$51.727 million dollars but was reduced in scale from the original plan due to financial and contractual difficulties. Water demand in Accra-Tema outstrips installed capacity and the future development will depend on the supply economics of high treatment cost with low pumping cost at Weija as opposed to low treatment costs and high pumping costs at Kpong. The ATMA project is operated by the ATMA management of the Ghana Water and

Sewerage Corporation. The population in the supply area is 1.4 million with 80 per cent coverage, mainly through house connections and yard taps. Some metered public standpipes located in slums and squatter areas are community operated on a pay-as-you-draw basis.

The Central Accra Sewerage Project represents the only large sewerage system in Ghana. Substantial completion was achieved by August 1973 with the project involving 32km of reinforced concrete sewers manufactured locally to cover an area of 750 hectares. Provision was made for 500 junctions for house connections and for facilities for admitting dry weather flow from open sewers to augment the flow. Final disposal of sewage was through a temporary ocean outfall. Later coastal defence activity caused the outfall to be washed away with the result that sewage is pumped onto the beach at high tide. Plans are available to treat the sewage by waste stabilization ponds to be constructed when funds permit.

The main problem with the project was that by 1989 very few household connections had been made. The system therefore operates at about 20 per cent of design capacity with consequent implications for its efficiency.

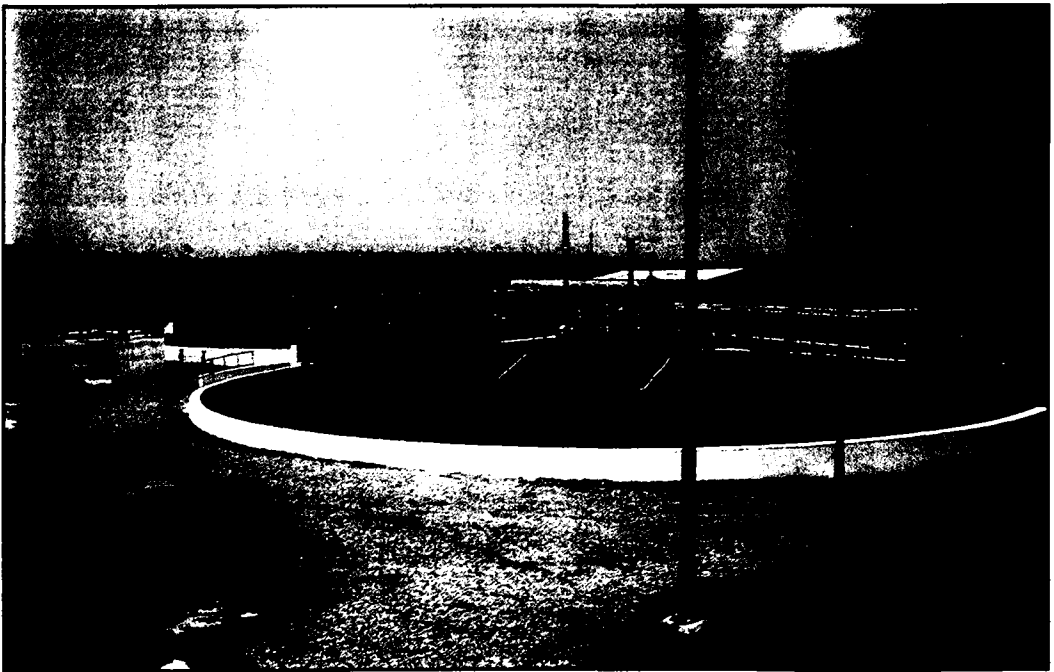
EVALUATION PROCEDURES

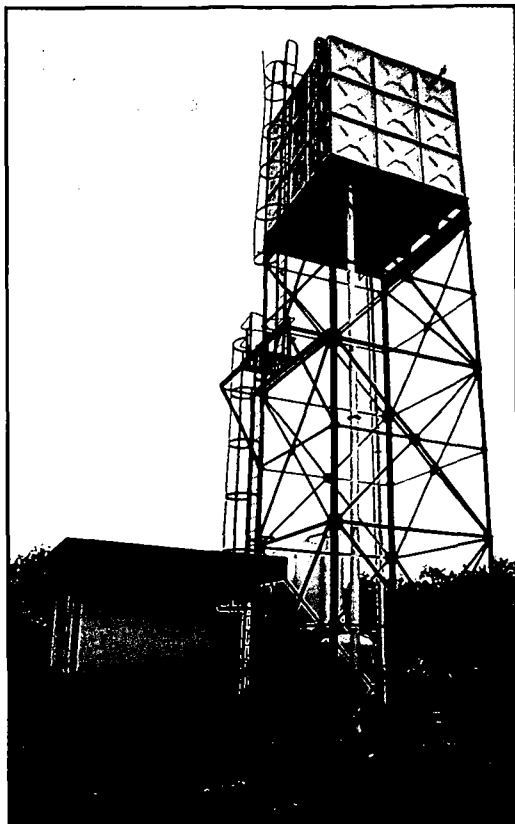
Frequently, economic appraisal of projects has taken the form of cost-effectiveness analysis or more ambitiously cost-benefit analysis. Lack of information relating to benefits often dictates that a cost-effectiveness study is made but these are not totally satisfactory. In particular, choosing the least cost project implicitly assumes that the benefits are greater than the costs and also assumes that the benefits of each alternative project are approximately equal. Only when both of these assumptions are correct will choosing the least cost project also select the most economic. For the economist the most economic is that which maximizes the discounted net benefits, that is the benefits minus the cost.

Employing cost-benefit analysis in project selection is more desirable but requires difficult monetary evaluation of intangible benefits such as health benefits, evaluation of life and time savings. The record of evaluating health benefits of water supply improvements has been problematic and it has been recommended that projects be justified on the basis of time savings alone (Churchill, 1987).

An alternative approach to project appraisal and evaluation is to use the less well-known

BELOW: Weija water treatment works.





ABOVE: Rural 'package' water treatment plant, Ghana.

technique of data envelopment analysis (DEA). A detailed exposition of the method and its basis in economic theory may be found in Akosa (1990). Computer programmes are now available which allow employment of the method without complex mathematics. Its objective is to determine the relative technical efficiency of a project (or bundle of projects) usually referred to as a decision-making unit or DMU.

This is calculated by forming the ratio of a

BELOW: Figure 1.

Input Factors		Output Factors
Technical	Project	Reliability
Financial	or	Utilisation
Economic	DMU	Convenience
Institutional		
Social		
Environmental		

weighted sum of outputs to a weighted sum of inputs. The technique selects weights so that the ratio of the weighted outputs to the weighted inputs for the DMU in question is maximized subject to the constraint that the ratios of weighted outputs to weighted inputs for each DMU is equal to or less than 1.0. The method ensures that efficiency scores lie between 0 and 1 with a fully efficient DMU having a score of 1. All DMUs receive scores relative to the most efficient, the latter being scored one.

Employing the method firstly requires identification of input factors which are the essential ingredients of the project or DMU in question. The second requirement is to identify the desirable output attributes of the project and these are referred to as output factors. The DEA technique then requires that the input and output factors are calculated by using a one dimension measure of each factor's significance to the project. Figure 1 presents the method schematically:

This method has been applied to assess the efficiencies of 10 Ghanaian projects, six water supply and four sanitation projects, including the Accra Tema Project. The projects were selected to give a representation of technologies currently employed to improve living standards for a range of communities of populations living in both urban and rural environments.

Water supply and sanitation improvements in developing countries are valued for several reasons, the capturing of health benefits, the freeing of time for productive and leisure uses and generally reducing the drudgery of water collection which features so prominently, especially in the lives of women.

Three desirable output attributes were considered in this study; reliability of service, utilisation of the service and convenience to the consumer. Realisation of health benefits requires a high degree of reliability of service. Frequent outages and intermittent service reduce health benefits in two ways. Firstly, poor service deflects consumers back to traditional sources often with attendant health hazards. Alternatively, people may reduce water consumption and this is associated with increased disease incidence. Secondly, irregular service encourages avoidance of tariff payments and a consequent low level of

cost recovery. Frequently, this results in reduced maintenance, yet poorer service and sometimes abandonment and vandalism of the facility.

The second consideration relevant to capturing health benefits is a high degree of consumer utilisation. This depends upon coverage across the population but also the extent to which the communities can be persuaded to effectively use the improved provision. Successful utilisation of new provision is determined by many factors such as perceptions of the benefits, relative proximities of the new and traditional sources, water quality and a host of cultural factors. The important point is that provision as opposed to usage may have little or no beneficial health impact.

The final output attribute is the convenience afforded by the new service. This attribute is used in an effort to capture the reduced time and energy spent in haulage and collection of water and especially the well-established association between proximity to the point of supply, level of consumption and health benefits.

The method used in this study rests upon the assumption that if service is reliable, well-used and convenient then the health benefits will be realised. Direct evaluation of the health benefits is avoided.

The success of water supply and sanitation projects depends upon an amalgam of social, technical, economic, financial, institutional and environmental factors. Each of these factor's significance is captured by an appropriate measure. This study used the following indicators:

- Social – A measure of the degree of community participation in the planning, implementation and management of the projects; Scores of 0 and 1 are recorded for each component of participation according to whether participation is high or low. Summing the component scores for each project identifies the community participation achieved;
- Technical – The best single indicator of the technical complexity was the foreign exchange component expressed as a ratio of the total capital cost;
- Economic – The real cost of the resources used in the project – the opportunity cost – is measured by identifying the amounts of foreign exchange and skilled labour and multiplying these by appropriate shadow prices;
- Financial – This input factor attempts to measure the desirable cost recovery aspect of the project. Cost recovery is defined here as the ratio of the

Input Factors		
Social	6.00	8.00
Technical	0.60	0.46
Economic	2.43	77.60
Financial	0.73	0.88
Institutional	479.00	1150.00
Environmental	2.00	3.30
Output Factors		
	Accra-Tema	Sewerage
Reliability	0.97	0.90
Utilisation	0.80	0.10
Convenience	150.00	200.00

ABOVE Figure 2. BELOW: Figure 3.

Summary of the Efficiency Scores	
Accra-Tema Water	1.00
Borehole Water	0.90
Package Plant Water	0.98
2500 Drilled Wells	0.53
3000 Drilled Wells	0.63
Hand Dug Wells	1.00
Central Accra Sewerage	0.02
Urban K-Vip Latrine	0.11
Rural K-Vip Latrine	0.06
Traditional Pit Latrine	1.00

actual annual revenue collection to the annual cost of the service. The financial input factor is measured as the deficit on full cost;

- Institutional – This factor captures the back-up support needed as measured by the amount of skilled manpower required. The number obtained is scaled up to give an equivalent number per million population;
- Environmental – For water projects, acceptable disposal of sillage and for sanitation, disposal of sludge and sewage measured the environmental factor. The cost per person of effective disposal is the input factor.

The efficiency scores for the projects were determined from the input and output factors summarized above in Figure 2.

Application of the DEA technique to data for each of the output and inputs provided the efficiency scores shown in Figure 3 for the Accra Tema projects described above and eight other on-going projects in the Ghanaian water and sanitation sector.

EFFICIENCY EVALUATION

The DEA scores indicate that in the water sector the most efficient projects were at the opposite extremes of water supply technology. The technical complexity of the ATMA system absorbs large amounts of foreign exchange, skilled labour and institutional support. At present sullage disposal is inadequate and providing a satisfactory solution would impose a considerable environmental cost. Some 60 per cent of the total cost of this project was in foreign exchange. Large urban supply in Ghana necessarily requires a surface water source. The project has required large capacity pumps, large diameter steel pipes plus other imported inputs. Moreover, the initial quality of raw water dictated that a full conventional treatment plant with consequent high foreign exchange requirements had to be provided. However, the very high degree of reliability (97 per cent) and utilisation (80 per cent of the 1.4 million inhabitants of the supply area) accorded the project top efficiency rating. The high utilisation is attributable to the concentration of standpipes and the lack of alternatives, most traditional sources now being polluted or unavailable.

In contrast the Accra Sewerage Scheme with an efficiency score of 0.02 relative to the most efficient sanitation technology is deemed highly inefficient. Development of local capacity to supply inputs to extensions of the system would lower the technical and economic input factors. Customers were expected to provide their own internal plumbing and to pay the connection cost. For the poor this has proved too much of a burden. Also amongst these people the perception of benefits of improved sanitation is minimal. Improvement of the connection rate would improve the poor utilisation rate (20 per cent) and with an adequate revenue collection system would improve the financial recovery which currently is only 12 per cent.

The economic input factor is high, in part reflecting the use of imported inputs and skills but also attributable to the poor connection record. For example, the latter increases the operation and maintenance cost per person significantly above anticipated levels.

The project requires major institutional support and the social input factor signifies that this was an imposed technology with no community participation. No attention was paid to what the community either wanted or could afford.

At the present time no waste water treatment plant exists, the outfall into the ocean is broken and the sewage is ejected onto the beach for dispersal by tidal action. The environmental score reflects the cost of providing a more satisfactory solution.

Though the project scores well on reliability and convenience the poor connection record means utilisation is very low. As a sanitation solution for a developing country under existing arrangements this sewered system represents a high cost, inefficient solution.

These objective results appear to confirm what might have been anticipated from a subjective view point. It is therefore believed that data envelopment analysis has potential as a significant tool both for evaluation of existing projects and more importantly for the appraisal of proposed projects. The particular value for appraisal lies in the possibility of investigating the sensitivity of any proposed project by altering certain variables and thus determining the result on overall project efficiency. This is similar to the 'what-if' use of a spreadsheet for financial appraisal but in the case of DEA includes many other non-financial factors as well.

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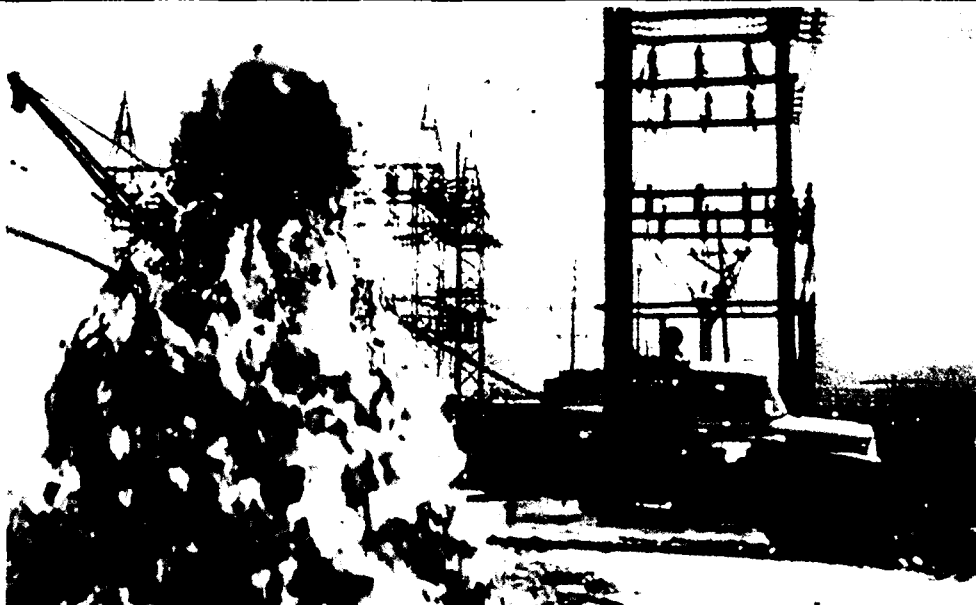
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Hawthorne & Co	89	Sutcliffe Speakman Plc	158
Hercules Environment Products Inc	274	Tamrock Driltech	59
Hercules Couplings BV	108	Tarmac Building Materials Ltd	16+ 130
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Hughes Humphreys & Partners Ltd	455	Tecator AB	405
Imperial Trading Export Co./Aluker	224	TFI International Inc	273
Indrotech Enterprises Inc	218	Tubafor International (WLL)	56
Indrope Analysis Ltd	463	Vammalan Konepaja Inc	49
Hyper Industries Inc	247	Verbund-Plan Gmbh	455
IMI Bailey Bissett Ltd	124	Water Engineering	254
International Drilling Services Ltd	45	Water Line Italia S.P.A	217
Intersigma Co Ltd	60	Weber Sensortechnik Gmbh	415
Kascad Engineering Ltd	302	Wessex Water International	434
Kotady Products Inc	209	Wildon Engineering Ltd	46
Konrad Treatment, Inc	248	Willamette Valve Co, Inc	124
Krapp Poly Pig Inc	IBC	Wirth Maschinen Und Bohrgerate-	
Konrad Sauerjurgens KG	41	Fabrik Gmbh	72
Krayan	329		



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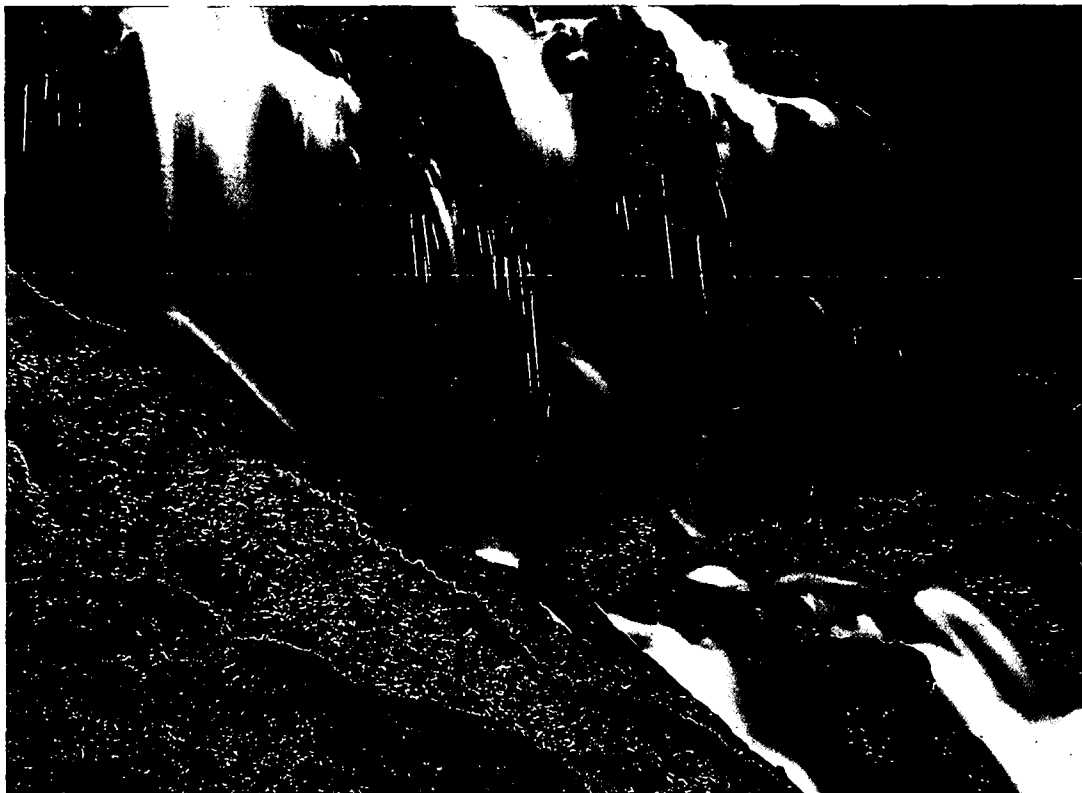
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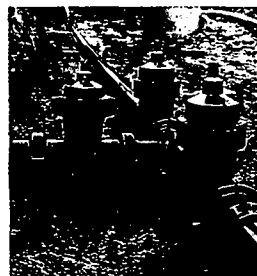


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