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BIODETERIORATION OF RUBBER RINGS FROM GUJARAT, INDIA



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Biodeterioration of rubber rings from Gujarat, India.

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Summary.

Two rings of natural rubber were examined to identify the cause of deterioration. Microscopical and bacteriological investigations revealed that deterioration was due to bacteriological attack. Most likely all deterioration of all of the rings examined previously, and which were all made of polyisoprene, had been caused by bacteria.

Contents.

Summary

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Introduction.

In December 1983, 10 rubber rings were obtained from a water supply project in Gujarat, India for identifying the cause of deterioration. It was suggested that the deteriorated rings had been attacked by white termites. The 10 rings, 7 large ones and 3 smaller ones, which were obtained without specification were examined chemically for identifying the rubber type and visually for determining the cause and extend of deterioration. All rings consisted of poly-isoprene rubber, either natural or synthetic. The three small rings did not show signs of usage and/or attack and probably were new ones. Six of the larger rings obviously came from a water mains as could be concluded from the shape of the rings and the typical surface. These six rings all showed signs of deterioration. The typical character of this deterioration strongly suggested bacterial attack. Because of the dry state of these rings, bacteriological investigations could not be performed. One of the large rings was not attacked, and probably had not been used.

In November 1984, 4 rings of natural rubber were obtained from Santal pur, Gujarat, India, which had been digged in the ground for 33 and 45 days to test attack of thermites and/or bacteria. Three of the rings had a diameter of about 15 cm and one ring had a diameter of about 33 cm. The rubber polymer of these rings was identified as poly-isoprene. The rings showed very limited signs of a beginning deterioration as caused by bacteria. Bacteriological investigations were not possible because of the dry state of the rings.

In November 1987, two rubber rings were obtained for investigating the extend and cause of deterioration. These rings were obtained in wet state (in water).

Methods.

Rings were examined in the following ways:

- visually, with the naked eye,
- visually, with a stereo microscope (2-20x),
- bacteriologically for the presence of actinomycetes.

For this purpose, small pieces of the rings (about 3 cm) were placed in 100 ml. of autoclaved tap water. After ultrasonic treatment, portions of this water or one or more decimal dilutions, were streaked onto agar media suitable for the cultivation of actinomycetes

Results and discussion.

The results of the investigation are shown in Table 1. The rings were clearly and severely attacked. Ring nr. 2, which was less deteriorated than nr. 1 was strongly deformed most likely as a result of its application in the joint. Locally, this ring showed signs of mechanical damage. Moreover, on the cross sections, cracks were observed indicating a strong internal bruising. Possibly, this ring was not placed correctly in the joint and/or had a poor quality rapidly resulting in mechanical damage. The type of deterioration of both of the rings is typical for bacteriological attack of rubber. Moreover, a certain area of the ring was more strongly attacked. This is the side of the ring exposed to the water. The bacteriological examination revealed that large numbers of actinomycetes were present on the rubber rings. The structure of the colonies of these organisms on the agar medium was similar to those of actinomycetes observed on attacked rubbers in the Netherlands.

Conclusions and recommendations.

- The rubber rings most recently examined were degraded by the attack of actinomycetes. Most likely, deterioration of the rings examined previously had also been caused by the attack of bacteria.
- The rings examined most recently showed strong deformation and internal damage, suggesting a poor rubber quality.
- All rings obtained in the course of the investigations were made of poly-isoprene. This rubber polymer is easily biodegradable. Therefore it is recommended to replace the rings by rings made of synthetic rubber e.g. styrene butadiene rubber (SBR). This type of rubber was not attacked during prolonged exposure to actinomycetes under optimal conditions for these organisms (Leefflang, 1963)

Literature.

Leefflang, K.W.H. (1963). Microbiologic degradation of rubber. J. AM. Water Works Assoc. 55:1523-1535.

Table 1. Observations on rubber rings.

Phenomenon	Ring nr.	
	1*	2
Deformation	moderate	strong
Mechanical damage	none	cracks (internal)
Flexibility	moderate hard surface	as 1
Deterioration	strong to very strong (locally >50%)	clear to strong (usually <10%)
Actinomycetes (nr/cm ²)	2x10 ⁶ - 7x10 ⁶	10 ⁴ - 6x10 ⁶

* on surface of ring: "Lotus".