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PITTING CORROSION IN COPPER WATER SUPPLY LINE IN PRINCE GEORGE, B.C.

by

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PHYSICAL METALLURGY DIVISION

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SUMMARY OF RESULTS

A length of copper tubing which had pitted severely while in use as a cold water-supply line was examined. No abnormal features were detected. It was concluded that the tubing must have been exposed to a severely corrosive environment.

Water analyses, and perhaps an on-the-spot examination of the locality where the failure occurred, would be necessary for a complete explanation of the pitting attack.

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INTRODUCTION

Mr. D. K. Faurschou, Mines Branch Liaison Officer, Vancouver, B.C., forwarded a $\frac{1}{4}$ in. length of Type K copper tubing to the Corrosion Section, Physical Metallurgy Division, Mines Branch. This tubing had been part of a cold water supply line, conducting city water to a dwelling in Prince George, B. C. After $2\frac{1}{2}$ years burial in earth the pipe had failed by corrosion.

In his covering letter, Mr. Faurschou requested any discussion or suggestions which might explain this premature failure.

OBSERVATIONS

The small length of tubing had nine perforations, and a number of other near perforations. The pitting attack had originated on the inside of the tubing, which was coated with a spongy mass of greenish corrosion product. Microscopic examination showed that the corrosion product was not homogeneous. Some areas were shiny blue-green, whereas other areas were very light green or rust-red. A few small diameter fibers, possibly consisting of organic matter, were embedded in the corrosion product at a number of places. These were insufficient in number to isolate for identification.

Spectrographic analysis indicated that the copper tubing was the specified 99.9% purity.(1) The only trace elements reported were iron, nickel and titanium.

X-ray diffraction measurements on the corrosion product showed it to consist of the copper carbonates $2CuCO_3 \cdot \frac{1}{2}H_2O$ and $CuCO_3 \cdot Cu(OH)_2$, and of Cu_2O.

Metallographic cross sections showed no abnormalities in the structure, which appeared to be fully recrystallized. The pitting attack on the inner surface of the tubing was seen to be not intergranular, and was similar in appearance to attack reported by the British Columbia Research Council.(2)

The outside surface of the tubing was also noticeably corroded. In contrast to the inner surface, the corrosion penetration was quite uniform. As with the inner surface, the attack was not intergranular.

The figure shows typical metal corrosion product interfaces for the inner and outer surfaces on as-polished metallographic sections of the tubing.

CONCLUSIONS

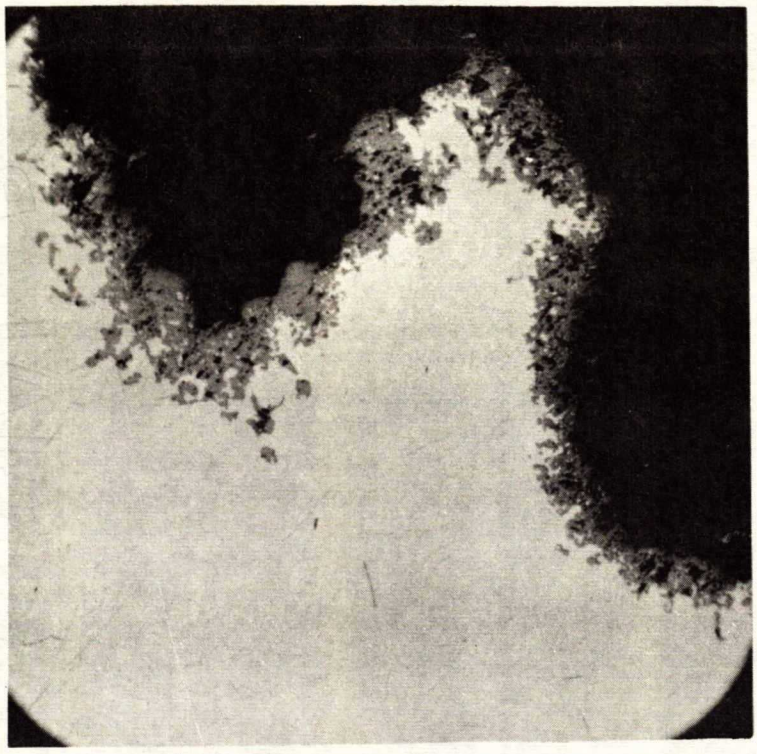
As far as the small piece of copper tubing could be characterized, it appeared completely normal. It therefore appears that the severe pitting attack must have resulted from the environment of the tubing during its $2\frac{1}{2}$ years of use. From the present examination, all that can be said is that carbonates must have been present. An analysis of Prince George water, being carried out by the Industrial Waters Section of the Mineral Processing Division, Mines Branch, may throw some light on the problem. However, a complete solution would require some knowledge of the usual behaviour of copper in Prince George water, and possibly an on-the-spot examination of the locality where the failure under discussion occurred.

REFERENCES

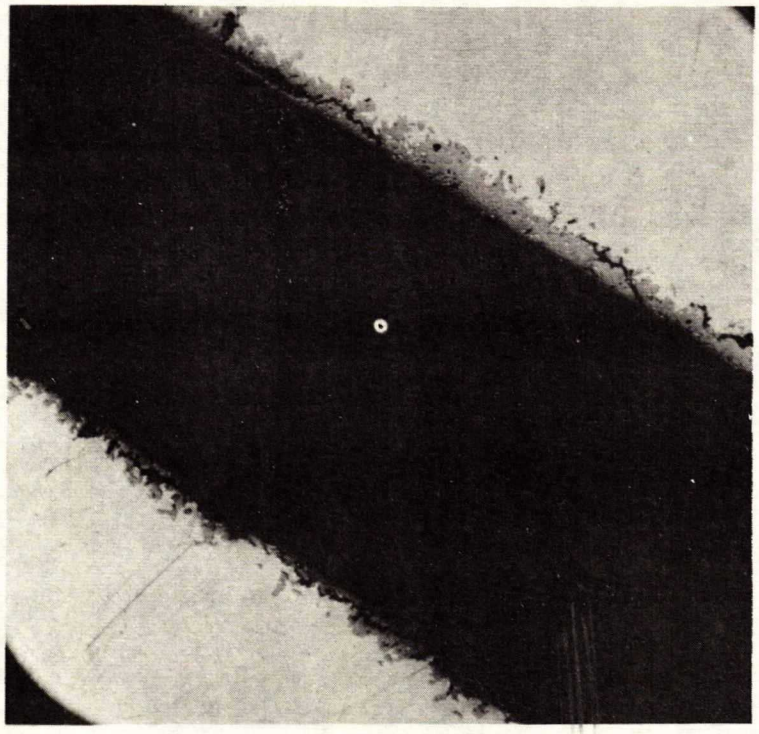
1. ASTM Standards B-88-58 (1955), page 138.

2. D. J. Rose, The Corrosion of Copper in Domestic Supply Waters, British Columbia Research Council Report No. 59-209 (Sept. 1959), page 70.

GJB/KW



(a) Plate 3287



(b) Plate 32819

Figure 1 - Polished cross-sections of the severely pitted copper tubing, showing (a) the severely pitted inner surface and (b) outer surfaces. X150.