DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

Ottawa, January 2, 1947.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2159.

Deterioration of Aluminium Tubing.

(Copy No. 5.)

CANADA

Bureau of Mines

Mineral Dressing and
Metallurgy Division

Physical Metallurgy
Research Laboratories

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Background:

A letter dated November 19, 1946, was received from Mr. C. A. Hill, Manager, Electrical Dept., Charles Ogilvy Limited, Ottawa, Ontario, requesting that an investigation be made of the causes of deterioration (believed to be corrosion) which had taken place in aluminium tubing used for fuel oil. A sample of deteriorated tubing and one of "unused" tubing were submitted for examination.

According to the letter, samples of deteriorated

(Background, cont'd) -

tubing had been

> "buried in a trough in cement or in earth or cinders or, in some cases, suspended, not covered. Cement mixture from 50-50 to 1-4 Canada cement and sand. Length of time buried or layed, from three weeks to two months. Oil conducted, Cities Service fuel oil #2. Sample of corroded tubing sent for analysis, three weeks buried beneath cement in earth and sand mixture combined with clay. Tubing, Satin Finish, Aluminum Co. of Canada."

No samples of cement or oil used with the deteriorated tube were submitted by Charles Ogilvy Limited.

Investigation:

The investigation was performed as follows:

1. Visual examination of the deteriorated and the "unused" tubing.
2. Microscopic examination of deteriorated tubing.
3. Study of behaviour of "unused" tubing when filled with water under pressure.
4. Spectrographic and chemical analysis of tubing.

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1. Visual Examination.

Typical pieces of deteriorated tubing were cut down one side and flattened in order to compare inner and outer surfaces. In a number of cases holes passing completely through the tube wall were observed (see Figures 1a and b and 2a and b). In some cases they were larger on the inner surface than on the outer surface. In other cases they were smaller on the inner surface than on the outer surface.

Typical pieces of "unused" tubing were examined by the same method. A number of areas with comparatively shallow pits were observed on the outside surfaces. No pits were observed on the inside surfaces.

(Investigation, cont'd) -

2. Microscopic Examination.

A typical piece of deteriorated tubing was examined under the microscope. Nothing was observed which would indicate that the tubing would be unusually susceptible to corrosion.

3. Behaviour of "Unused" Tubing When Filled With Water Under Pressure.

The piece of "unused" tubing which was submitted was connected to an ordinary water line. A jet of water came from a hole in the tube. This hole is shown in Figure 3.

4. Spectrographic and Chemical Analysis of Tubing.

By spectrographic means, it was determined that the tubing contained fairly small amounts of silicon, iron and manganese, as well as very small amounts of several other elements.

Chemical analysis of the material gave the following results:

Silicon	-	0.22 per cent
Iron	-	0.46 "
Manganese	-	0.10 "
Copper	-	)
Magnesium	-	) None detected.

Conclusions:

On the basis of inspection and the various tests listed above, it has been concluded that:

1. The "unused" tube that was submitted was not in good condition, due to pits on the outer surface and at least one hole completely through the tube wall. This poor condition may have been due to undesirable conditions during the production of the tube or to corrosion which took place after the tube was produced, possibly during storage or

(Conclusions, cont'd) -

shipment.

2. The materials which were in contact with the tubing in service may or may not have had a further deteriorating effect on the tubing. It was impossible to investigate this possibility, as samples of the materials were not submitted.

Note:

The use of aluminium in contact with cinders or a fairly highly alkaline medium cannot be recommended.

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(Figures 1 to 3 follow,
on Pages 5 and 6.)

Figure 1.

(a) Outer Surface.

(b) Inner Surface.

FLATTENED DETERIORATED ALUMINIUM TUBE, SHOWING HOLES WHICH EXTENDED ENTIRELY THROUGH THE WALL.

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Figure 2.

(a) Outer Surface.

(b) Inner Surface.

UNFLATTENED DETERIORATED ALUMINIUM TUBE, SHOWING HOLES WHICH EXTENDED ENTIRELY THROUGH THE WALL.

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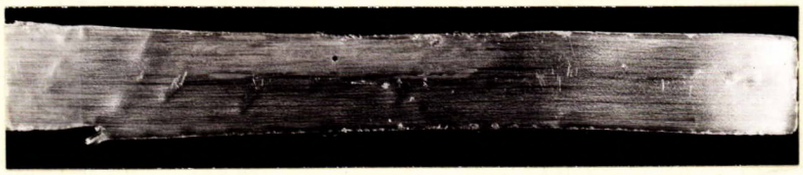
Figure 3.



FLATTENED PIECE OF "UNUSED" ALUMINIUM TUBE, SHOWING HOLE THROUGH WHICH WATER PASSED WHEN THE TUBE WAS CONNECTED TO THE WATER LINE.

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