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OTTAWA July 17th, 1943.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1456.

Examination of a Broken Main Inlet Copper Pipe.

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Bureau of Mines Division of Metallic Minerals

Ore Dressing and Vetallurgical Laboratories

#### CANADA.

DEPARTMENT OP MINES AND RESCURCES

Mines and Geology Branch

OTTAWA July 17th, 1943.

# REPORT

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#### ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1456.

Examination of a Pitted Main Inlet Copper Pipe.

# Origin of Problem and Object of Investigation:

In a letter dated June 21st, 1943, (File No. N.S. 178-8-8 FD 7642), A/Lt. Cdr. (S.B.) J. R. Millard, R.C.N.V.R., Director of Technical Research, Department of National Defence (Naval Service), Ottawa, Ontario, requested the examination of three samples cut from a main inlet copper pipe.

It was stated that the ship in which this inlet pipe was installed had been commissioned in May of last year and that severe pitting of the main inlet copper called for patching during December of the same year. Patching consisted of

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(Origin of Problem and Object of Investigation, contid) -

coating inside with Apexior No. 3, and apparently also placing patches, probably with white lead, canvas or rubber and steel sheeting. Solder patches also were evident.

This pipe is now being replaced, and it is requested that microscopic and chemical analysis be made on the submitted samples, especially with regard to arsenic content. Observations were also required as to the reasons for cavitation being more prevalent in one ship than in another.

# Description of Samples Received:

Three samples were submitted and it was stated that they were cut from the following sections of the main inlet pipe:

> Sample No. 1 - adjacent to shipside. Sample No. 2 - cut from elbow. Sample No. 3 - cut from pipe near main circulating pump.

Figures 1 to 3 show the samples "as received", revealing the cavitation caused by erosion and corrosion of the copper tube.



SAMPLE NO. 1. (Approximately 2 size).



Figure 2.

(Origen of Problem and Object of Investigation, contid) -

SAMPLE NO. 3. (Approximately ± size).

Chemical Analysis: Copper - 99.85 per cent. Arsenic - None detected.

# Microscopic Examination:

Figures 4 to 6 show different stages of surface pitting.

Figure 4.

Figure 5.





X100, unetched.

X100, unetched.

Figure 6.



X100, unetched.

Figure 7 shows the copper oxide content, and Figure 8 the grain size, of a "sound" part of the copper tube.

The grain size shown in Figure 8, at X250 magnification, conforms to an average grain size equal to 0.045 mm. grain diameter at X75 magnification.

(Continued on next page)

(Microscopic Examination, cont'd) -





Figure 8.

X250, unetched.

X250, FeCl Etch.

### Conclusion:

The investigation shows no apparent metallurgical causes for the failure.

A comprehensive outline on the causes of corrosion of copper and copper alloys in sea water, together with some methods for its prevention, is given in our previous (Dec. 1941) Report of Investigation No. 1131, "Examination of Copper Draft Tube, Failed by Pitting."

JWM:LB.

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