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O T T A W A

January 3, 1945.

## R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1770.

Evaluation of Corrosion Resistance of  
Selenium-Coated Steel Strip.

(Copy No. 10.)

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Origin of Material and Object of Investigation:

In connection with the investigation of selenium coatings being carried out for Canadian Copper Refiners Limited, Montreal, Quebec, a sample of selenium-coated steel strapping was submitted in December, 1944, for tests to determine the efficacy of the coating as a means of preventing rust.

Tests Performed:

A considerable part of the sample was cut into lengths of approximately 3 inches. These pieces were subjected to the salt spray, total immersion, intermittent immersion and porosity tests. In the first three tests, 5 per cent solutions of sodium chloride and a temperature of 93 to 95° F. (34-35° C.) were used. Filter paper saturated with a solution of sodium chloride (1 per cent) and potassium ferricyanide (0.1 per cent) was used in the porosity test. In addition, coating thickness tests were made by means of the Aminco-Brenner Magne-Gage.

Results of Tests:

Salt Spray Test -

Four samples of the selenium-coated steel were tested for 57 hours.

First rust was observed after 5 hours. At the end of the 57 hours the samples were badly rusted. They were removed from the test, dried, and both sides photographed (see Figures 1 and 2). In each photograph an uncorroded sample is included for comparison.

Total Immersion Test -

Three samples of the coated steel were tested for 89 hours.

Considerable rust was observed on the samples and on the bottom of the jars after 15 hours.

At the end of the 89 hours the samples were removed from the test, dried, and both sides photographed (Figures 3 and 4). In each photograph an uncorroded sample is included for comparison. It should be added that when Samples No. 2 and 3 were removed from their jars a considerable amount of rust dropped off from the concave side. Actually, Samples No. 2 and 3 were corroded to about the same extent as Sample No. 4.

Intermittent Immersion Test -

Three samples were tested for 89 hours.

Much rust was observed on the samples and at the bottom of the jar after 15 hours.

At the end of the 89 hours the samples were removed from the test, dried, and both sides photographed (Figures 5 and 6). In each photograph an uncorroded sample was included for comparison.

Porosity Test -

Strips of filter paper saturated with the above-mentioned solution were dried, laid upon eight samples of the coated

(Results of Tests, cont'd) -

steel, moistened with distilled water, and then allowed to dry. A blue spot appeared on the paper wherever a pore existed in the selenium coating. Four of these samples were tested on the concave side and four on the convex side. The papers were photographed (Figures 7 and 8). The results would indicate that considerable porosity existed in the selenium coating, particularly along the edges of the samples. The convex side appeared to be somewhat superior to the concave side.

Coating Thickness Measurements -

A two-foot strip of the selenium-coated steel was tested at intervals on both convex and concave sides, for thickness. The values obtained at the different points were as follows:

		<u>Inches</u>
<u>Convex side</u>	-	0.000025
		0.000025
		0.000030
		<u>0.000047</u>
Average	-	0.000032
<u>Concave side</u>	-	0.000040
		0.000030
		0.000050
		0.000025
		<u>0.000025</u>
Average	-	0.000034

There appears to be a considerable variation in thickness at different points on the surface of the coating (between 0.000025 and 0.000050 inch). The average thickness is about the same on concave and convex sides.

It may be of interest to compare the thickness of this selenium coating with that of other typical protective coatings.

(Continued on next page)

(Results of Tests, cont'd) -

	<u>Thickness, in inches</u>
Selenium coating on steel (average) -	0.00003
Hot dip zinc coating on steel -	0.002 to 0.05
Hot dip tin coating on steel -	0.00007 to 0.0002
Electroplated copper coating -	0.0001 to 0.0006
Electroplated silver coating (for frequent use) -	0.0008
Electroplated nickel coating: Useful for outdoor exposure -	0.0005
Almost perfect protection under any atmospheric conditions -	0.002
Electroplated zinc coatings -	0.0005 to 0.001
Anodized film on aluminium -	0.0008

The above data indicate that the selenium coating is much thinner than the protective coatings ordinarily used at the present time.

Recommendation:

On the basis of the above results the use of selenium-coated steel of the quality submitted for these tests, under the severely corrosive conditions encountered by the Armed Forces, is not recommended.

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Figure 1.



Concave side.

Figure 2.

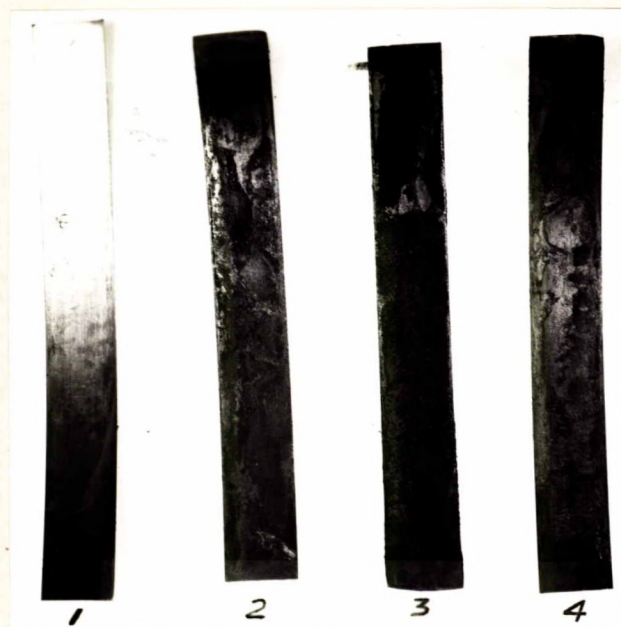


Convex side.

SELENIUM-COATED STEEL STRAPPING AFTER  
57 HOURS IN THE SALT SPRAY TEST.

5% sodium chloride was used as the corroding liquid,  
at a temperature of 95° F. (35° C.).

Figure 3.



Concave side.

Figure 4.



Convex side.

SELENIUM-COATED STEEL STRAPPING AFTER  
89 HOURS IN THE TOTAL IMMERSION TEST.

5% sodium chloride was used as the corroding liquid,  
at a temperature of 93° F. (34° C.).

Figure 5.



Figure 6.



Concave side.

Convex side.

SELENIUM-COATED STEEL STRAPPING AFTER 89 HOURS  
IN THE INTERMITTENT CORROSION TEST.

5% sodium chloride was used as the corroding liquid  
at a temperature of 93° F. (34° C.).

Figure 7.

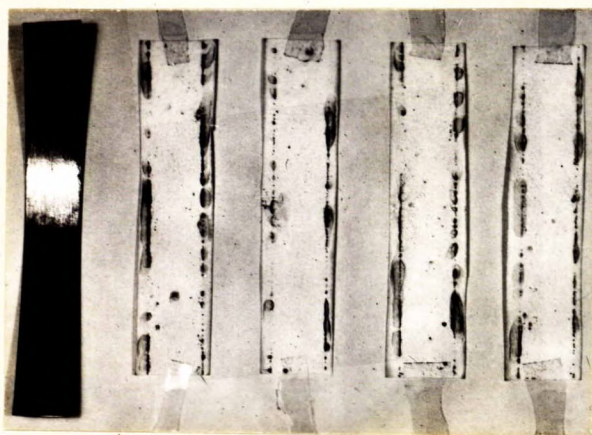
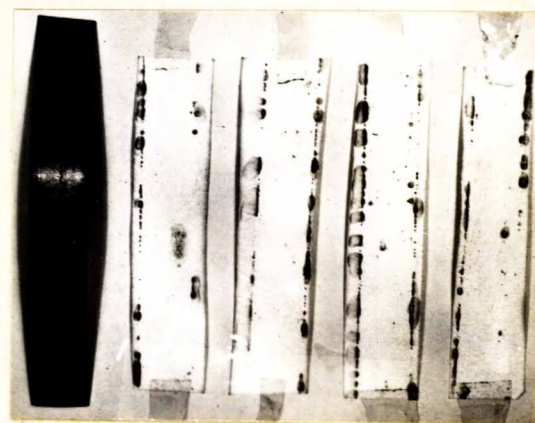


Figure 8.



Concave side of samples.

Convex side of samples.

PAPERS SHOWING THE NATURE AND LOCATION OF PORES  
IN THE SELENIUM-COATED STEEL STRAPPING.