Report No. 690/6
Watertown Arsenal

December 17, 1941

X-Metal Powder Spray on Low Carbon Steel Plate

OBJECT

To determine corrosion resistance in salt spray and microstructure of low carbon steel plate sprayed with X-Metal powder under the direct supervision of Mr. I. M. Hirshfeld.

CONCLUSIONS

1. The corrosion resistance of surfaces of low carbon steel coated with X-Metal was poor.

2. There is no apparent application of this process in ordnance.

INTRODUCTION

X-Metal is an ore concentrate obtained from a mine which is owned by Mr. Hirshfeld of Bakersfield, California, and associates, and which is located in California. The original ore assays 7% metallics, and by crushing, classifying, flotation, and concentration of 14 to 1, a product is obtained which is called X-Metal. This concentrate is ball-milled to about 100 mesh size for the spray material.

The mechanism of spraying consists of the introduction of the powder into a stream of air (50 pounds per square inch pressure) which propels the powdered concentrate into a reducing flame of propane (6 pounds per square inch). Here the small particles reach a high temperature (white heat) before impinging upon the samples which are at room temperature. After spraying, the material is given a short heat treatment.

EXPERIMENTAL

Four pieces 1-3/4" x 2-1/4" x .225" were obtained from an SAE 1020 sheet plate, and the surfaces of each were ground. Two pieces were sprayed thickly relatively to two other pieces, which were sprayed lightly. Only one side was sprayed, as the heated specimen oxidized readily on the side opposite to that being coated. This oxide would offer a poor surface to the spray coating. The thickness of the heavy coating was about 0.003", and of the thin about 0.001".

These specimens were heated in a furnace at 1650°F, being covered with hot "neutro-pack" in order to prevent undue oxidation. Ten minutes were allowed for the specimens to reach temperature, and they were held ten minutes at this temperature and then air cooled. The specimens, after heat treatment, did not have an oxide coating.

Salt spray specimens were lightly polished on 3 zero abrasive paper, and the cut ends and rear side were coated with Alox #L-1027A slushing compound. They were then subjected to 4% sodium chloride solution spray. Specimens for metallographic study were nickel plated in order to prevent too much rounding off of the edge during polishing.

RESULTS AND DISCUSSION

The salt spray caused localized rust areas on the thinly and heavily coated specimens after 35 hours of operation. At the end of 100 hours, the thickly sprayed specimen was severely rusted, and was rated #1. The thinly sprayed specimen was rated as #3 on a scale where #5 is perfect resistance to rusting and 0 is more than 50% of surface rusted. The photomicrographs, Figs. 1, 2 and 3, show the heavy coatings, and Fig. 4 the thin one. The absence of the coating at one area of the base metal is noticeable in Fig. 1. Fig. 3 shows the etched structure. There is little evidence of diffusion of the sprayed metal into the base. There is no sign of intergranular attack in these specimens. The coating is quite complex in structure.

There appears to be no place where this process has an application in ordnance. The coating is not rust resistant, does not cover the base metal perfectly, and forms a rough uneven

surface that could not be adequately honed and lapped.

No further study of the process is justified at the present time. For this reason, no study of the composition of the powder before and after spraying and of other properties was made.

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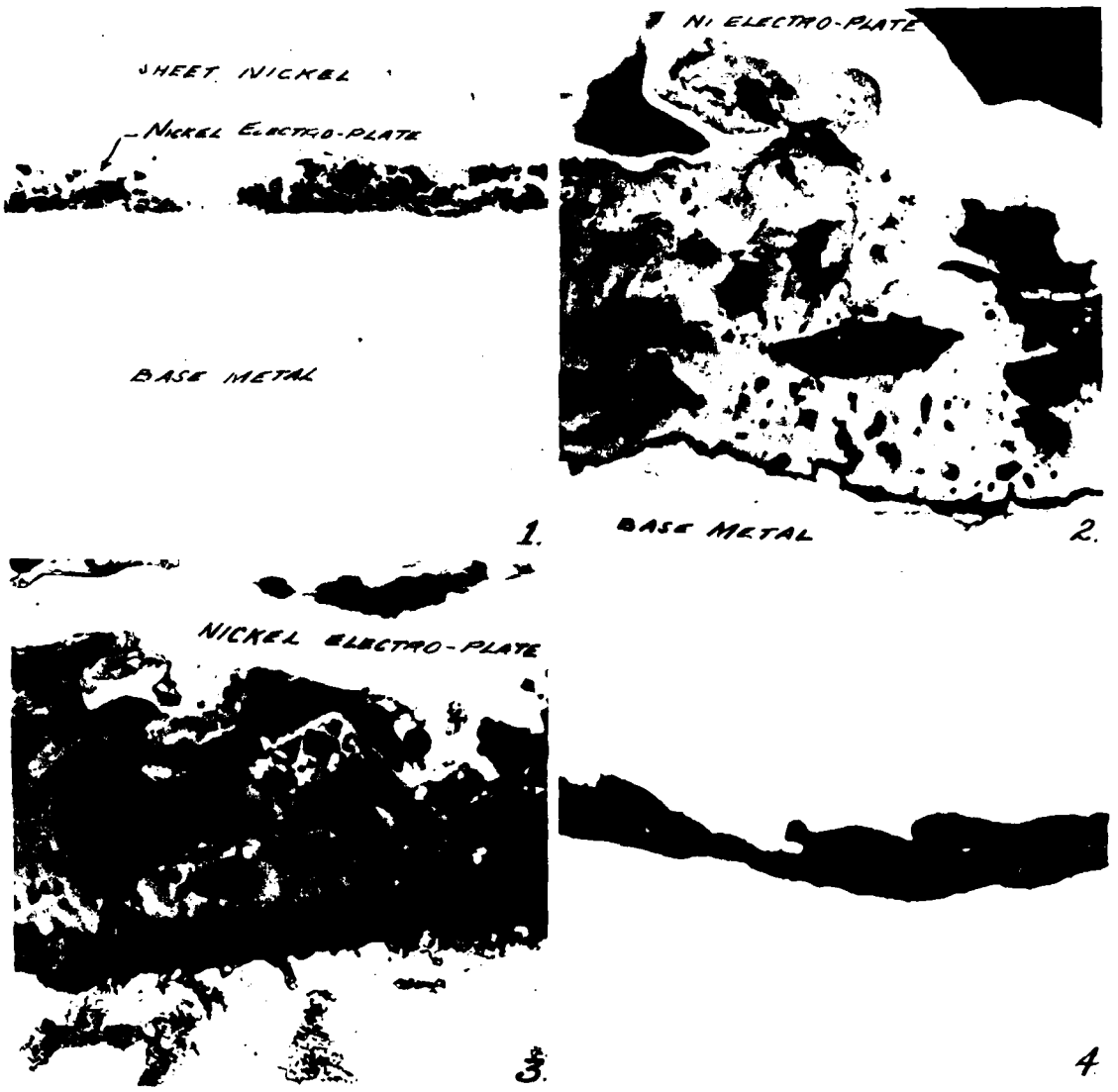

X-Metal Powder Sprayed on Low Carbon Steel.

Specimens Nickel-plated Prior to Polishing.

1. Thick, Uneven, Porous Coating and Bare Spot on Base Metal. X 100 Unetched.
2. Thick Coating X 1000 Unetched.
3. Thick Coating X 1000. Etched with 4% Picral.
4. Thin Coating X 1000. Unetched.

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