File

DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

Ottawa, January 31, 1947.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2171.

Cause of Defects in "Hot Dip" Galvanized Parts.

(Copy No. 4.)

CANADA

Bureau of Mines

Mineral Dressing and
Metallurgy Division

DEPARTMENT
OF
MINES AND RESOURCES

Physical Metallurgy
Research Laboratories

Mines and Geology Branch

O T T A W A January 31, 1947.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2171.

Cause of Defects in "Hot Dip" Galvanized Parts.

==========

Background:

An enquiry on the above subject (Enquiry #2320), dated November 16, 1946, was received through the Technical Information Service, Research and Development Branch, Department of Reconstruction and Supply, National Research Building, Ottawa, Ontario, from Mr. E. P. Harrison, Metallurgist and Development Engineer, N. Slater Company Limited, Hamilton, Ontario. The enquiry stated in part:

> "You will find enclosed a sample taken from a malleable iron casting which has been sandblasted to get a smooth clean surface and then galvanized. Eruption on the surface, as may be seen on the sample, formed on nearly 50 out of 1,000 castings. It was found that after filing down the lumps, stripping of zinc and re-galvanizing, the imperfections appeared again. Any information as to the cause and correction of this trouble would be much appreciated."

A letter dated December 5, 1946, was sent to Mr. Harrison, asking for further details of the process and requesting

(Background, cont'd) -

more samples. A letter dated December 12 was received from Mr. Harrison, giving the information requested. The additional samples were received.

A letter dated December 5, 1946, was received from Mr. Harrison, asking that the composition of the coatings on a batch of small galvanized parts which he was submitting be compared with the composition of the coatings on a batch of galvanized nails which had been submitted in connection with earlier work done for the N. Slater Co. Ltd. (Technical Information Service enquiry #1542).

EXPERIMENTAL:

I. Coatings on Nails and the Other Small Parts.

As requested, the compositions of the coatings on the two different batches were determined. The spectrographic method was used. It was found that the metals present in the two types of coatings were almost identical chemically, as shown in Table I.

TABLE I. - Constituents of Coatings on Nails and Other Parts.

NAILS		Comparison	OTHER PARTS	
Metal	Importance		Metal	Importance
Zinc	Major.	=	Zinc	Major.
Iron)	Strong	=	Iron)	Strong
Lead)	trace.	=	Lead)	trace.
Manganese)		>	Manganese)	
Magnesium)		>	Magnesium)	
Aluminium)	Trace.	>	Aluminium)	Trace.
Copper)		=	Copper)	
Silicon)		<	Silicon)	
Calcium)		<	Calcium)	
Cadmium)	Faint	<	Cadmium)	Faint
Tin)	trace.		Bismuth)	trace.
Nickel)				

(Experimental, cont'd) -

A number of the other small parts submitted were quite rough. In an attempt to determine the reason for this roughness, typical samples were made anode in a caustic soda solution and all of the zinc was removed leaving a rough, almost black surface. This surface was found to consist largely of iron oxide (Fe_3O_4) when examined by the X-ray diffraction method.

-

II. Coatings on Malleable Iron Castings.

A good-looking coating and two coatings with "eruptions" are shown in Figure 1. Blisters occurring on the under side of a typical part having eruptions are shown in Figure 2. Good and erupted surfaces were examined under the microscope. While the good surfaces showed typical diffusion between iron and zinc, the diffusion seemed to have been interfered with in the neighbourhood of the eruptions. Iron rust appeared under the blisters.

A piece of coated iron with eruptions similar to those shown in Figure 1(b) was made anode in caustic soda solution. After the zinc was removed the area surrounded by the eruptions was almost black in colour. This black material proved to be iron oxide (Fe_3O_4) when inspected by the X-ray diffraction method.

-

Conclusions:

On the basis of the above experimental results, it is concluded that:

1. The compositions of the coatings on the nails and other small parts are almost identical.

2. The basis metal was not responsible for the eruptions.

(Continued on next page)

(Conclusions, cont'd) -

3. The roughness of the other small parts and the eruptions on the castings are due to the presence of iron oxide on the iron.

Recommendations:

In order to eliminate the roughness and eruptions in coatings of the types examined, it is suggested that:

1. Great care should be taken to ensure that iron oxide scale is completely removed from all surfaces before the parts are moved on to the next step of the galvanizing process.

2. After the pickling operation the parts should be thoroughly rinsed in cold water to remove all trace of acid and iron compounds.

Note: An excellent series of 14 articles on hot galvanizing has been published in "Steel," beginning with the August 12, 1946 issue, and ending with the December 2 issue.

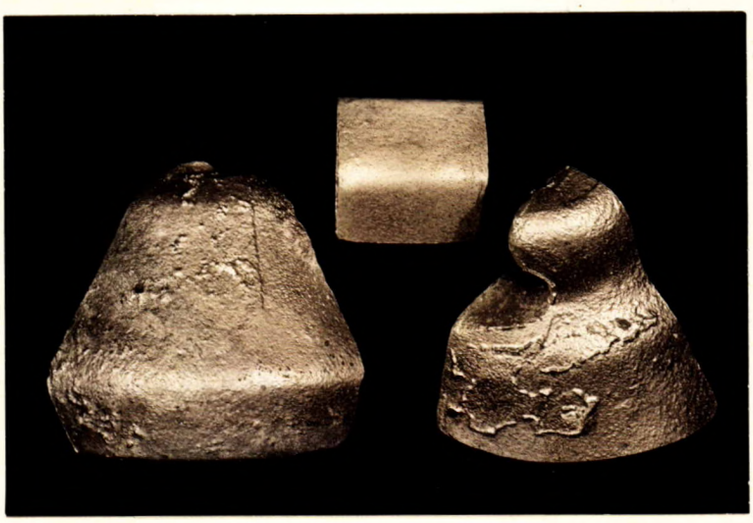
oooooooooooo
oooooooo
oo

RRR:LB.

(Figures 1 and 2 follow, on Page 5.)

Figure 1.

(c)



(a) (b)

SAMPLES OF HOT GALVANIZED MALLEABLE IRON CASTINGS.

(a) and (b) with eruptions.
(c) without eruptions.

(Approximately natural size.)

Figure 2.

SAMPLE OF HOT GALVANIZED MALLEABLE IRON CASTING SHOWING BLISTERS.

(Approximately natural size.)

RRR:LB.