File

FILE COPY

O T T A W A

March 19, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2012.

"Metcolizing" of Cast Iron Stove Parts.

(Copy No. 9.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

O T T A W A

March 19, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2012.

"Metcolizing" of Cast Iron Stove Parts.

==========

Introduction:

On February 11, 1946, Mr. W. F. Findlay, Findlays Limited, Carleton Place, Ontario, requested the assistance of these Laboratories to investigate a method of improving certain stove castings. It was stated that changes in stove design had increased the operating temperatures of the castings and under these new service conditions the castings were failing by growth and consequent buckling.

The property of greatest importance in counteracting growth is resistance to oxidation at high temperatures. An investigation was undertaken to explore various methods of

(Introduction, cont'd) -

improving resistance to oxidation. Two general methods are presently under investigation: (1) addition of chromium to the cast iron, and (2) Metcolizing castings. The latter method consists of spraying a thin coating of pure aluminium on the surface of a properly cleaned and blasted casting. The casting is subsequently coated with fine aluminium suspended in oil, and heat treated at 1450° F. The heat treatment melts the aluminium and permits the formation of an aluminium-iron metallic alloy on the surface of the casting which is very resistant to oxidation.

A more detailed report on the first of these methods will be issued by these Laboratories. The purpose of the present report is to present the information already obtained, together with cost data, relative to the Metcolizing process.

Object of Investigation:

(1) To investigate the effectiveness of Metcolizing Process No. 11 in protecting cast iron at elevated temperatures.

(2) To obtain cost data of Metcolizing the actual castings.

PROCEDURE:

(1) Samples of the castings submitted were machined to 2" x ½" x ½". Samples were blasted with No. 30 angular steel grit and sprayed immediately with aluminium. These samples were subsequently painted with Metcoseal and heated to 1450° F. for 20 minutes.

(2) Two samples of unprotected grey cast iron and one Metcolized sample were held at 1600° F. for 100 hours. After this treatment all samples were measured and their permanent expansion recorded.

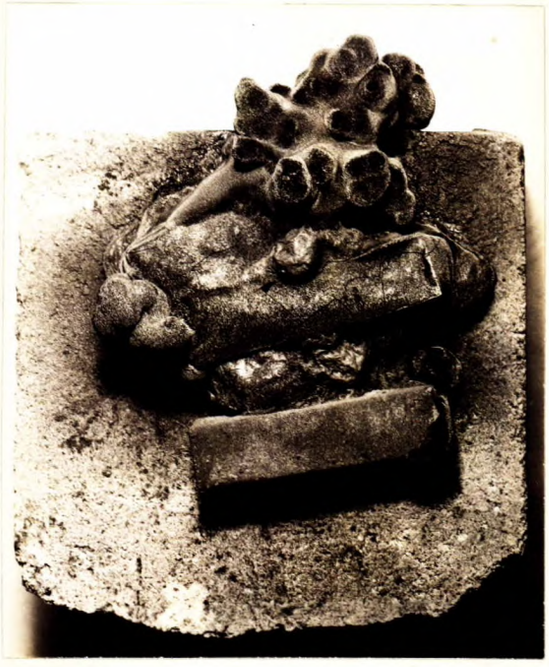
Sample Type	Permanent Expansion, per cent
Grey cast iron, unprotected	7.5
" " ", Metcolized	2.5

(3) A repetition of the above test produced some interesting results. The furnace temperature control failed to operate, with the result that the temperature increased to some degree of heat known to be in excess of 1800° F. and was

(Procedure, cont'd) -

there for approximately 20 hours. The unprotected sample of grey cast iron completely decomposed, whereas the Metcolized sample retained its shape perfectly. The condition of the test pieces after this treatment is shown in Figure 1.

Figure 1.



CONDITION OF ONE METCOLIZED (BOTTOM) AND ONE UNPROTECTED (TOP) SAMPLES OF STOVE CASTINGS AFTER EXPOSURE TO TEMPERATURE ABOVE 1800° F. FOR APPROXIMATELY 20 HOURS.

Note complete decomposition of unprotected sample and unaffected condition of Metcolized sample.

(4) Twelve castings were submitted for Metcolizing which were to be subsequently subjected to service tests. The castings in the 'as received' condition were found to be sandblasted, which was of considerable benefit in accelerating the additional cleaning and roughening necessary for metal spraying. The following is a step-by-step description of the Metcolizing No. 11 process:

(a) The castings were blasted with No. 20 angular steel grit in a Pangborn Junior sandblasting machine. This step is necessary to remove all iron oxide from the surface of the castings and to roughen the surface to ensure a good bond of the sprayed metal. The average cleaning time per casting

(Procedure, cont'd) -

was 15 minutes. It was estimated that a cleaning time of 20 minutes would have been necessary if the castings had not been previously sandblasted. Costs of the operation will depend on labour costs and equipment available at the plant, so no figure can be offered.

(b) The castings were immediately sprayed with Metco aluminium. A Type 2-E gun was used operating on 11-gauge wire, 15 pounds acetylene, 18 pounds oxygen and 60 pounds air. The coating was 0.005-inch in thickness and the spraying time ranged from 2½ to 3 minutes. Assuming labour to cost $0.75 per hour, labour, gases, air and aluminium costs would average 7 cents per casting.

(c) While still warm the castings were painted with Metcoseal (finely divided aluminium suspended in oil), using a ½-inch paint brush. The coating time was approximately 3 minutes but this could be reduced considerably if a larger paint brush were used, or, better still, by dipping the castings rather than painting them. The cost per casting of coating material, exclusive of labour, would average 5. cents.

(d) After spraying and coating, the castings were heated at 1450° F. for 20 minutes at temperature. No cost figures can be given for this operation, since they will depend upon the heat-treating equipment available, its capacity and continuity of use. Labour handling charges will also vary locally, so no costs can be given.

DISCUSSION:

It has been shown experimentally that the Metcolizing Process No. 11 will considerably reduce growth resulting from oxidation of this cast iron when exposed to a temperature of 1600° F. for 100 hours. Incidentally, it has also been shown

(Discussion, cont'd) -

that this same process will provide similar protection against accidental exposure of the cast iron to much higher temperatures for 20 hours. Unprotected cast iron under similar conditions completely decomposes.

It is difficult to properly assess the degree of protection provided by the Metcolizing Process No. 11 to castings in service, since the maximum temperatures attained are not known. For this reason, service trials of Metcolized castings were recommended and will be undertaken by the manufacturer with castings Metcolized in these Laboratories. Should service tests be satisfactory, the cost figures herein included will be of interest. Obviously, with mass production and suitable equipment, costs would probably be lower than those shown. The protection provided by the addition of chromium to the cast iron will be the subject of another report. Presumably the economics of both factors will determine the choice of method to be used.

Conclusions:

(1) Metcolizing Process No. 11 will considerably reduce growth due to oxidation of the cast iron when exposed to a temperature of 1600° F. for 100 hours.

(2) The same process provides a margin of safety of protection against accidental exposure to temperatures over 1800° F. for 20 hours.

(3) The estimated (partial) cost for spraying and coating is 12 cents per casting.

oooooooooooo
oooooooo
oo

HJN:LB.