O T T A W A November 6, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1959.

Investigation of Cause of Failure of Grate Bars in Dwight Lloyd Sintering Machine.

(Copy No. 6.)

Bureau of Mines
Division of Metallic
Minerals
Physical Metallurgy
Research Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

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Origin of Material and Object of Investigation:

Under date of September 25, 1945, Mr. C. M. Beck, Manager, Algoma Ore Properties, Limited, Helen Mine, via Sault Ste. Marie, Ontario, submitted for metallurgical examination two grate bars intended for use in a "Dwight Lloyd" sintering machine, and the broken pieces of one bar which had failed in service.

In the covering letter, attention was drawn to the fact that the bars did not burn out, but broke.

Chemical Analysis:

The chemical analyses of drillings taken from broken and unused grates are shown in Table I.

TABLE I.

	Unused Grate Bar	Broken Grate Bar
	- Per Cent -	
Total carbon -	3.47	3.50
Graphitic carbon -	2.75	3.39
Combined carbon -	0.72	0.11
Manganese -	0.50	0.49
Silicon -	1.88	1.78
Sulphur -	0.081	0.097
Phosphorus -	0.61	0.58
Chromium -	Nil.	Nil.

Microscopic Examination:

The microstructure of the unused bars is typical of pearlitic cast iron, consisting of flakes of graphite and areas of phosphide eutectic in a matrix of pearlite. In the microstructure of the broken bars, however, the combined carbon of the pearlite has been transformed to graphite and the three phases now present are graphite (with the flakes much larger than before), phosphide eutectic, and ferrite. These microstructures are shown in Figures 2 and 3, photomicrographs at 250 diameters.

Discussion of Results:

The chemical analysis and the microscopic examination have substantiated each other to show that the microstructure of the broken grate bars has undergone a change during the heating and cooling cycles in service. This change, whereby the combined carbon of the pearlite is transformed to graphite and ferrite, is known as graphitization and always results in serious loss of strength and ductility in the casting. This loss of mechanical strength is the most likely cause of failure.

(Discussion, cont'd) -

Graphitization is a common source of trouble in grey cast irons subject to repeated cycles of heating and cooling and is always associated with "growth," a term which applies to the accompanying permanent increase in volume of the metal, particularly at operating temperatures above 1000° F., although the presence of some corroding agents, e.g. sulphur dioxide, may cause growth at lower temperatures.

Many methods have been successfully adopted to obtain resistance to growth and graphitization in cast iron, but, generally speaking, any increase in resistance is accompanied by increase in cost. A closely specified chemical composition to give suitable carbon, manganese, silicon and chromium contents will yield, at moderate cost, increased resistance to graphitization. However, some service conditions may be so severe that failures persist, and it may be necessary to use high-alloy austenitic cast irons which, despite their greater cost, may be warranted because of their superior heat resistance.

It is suggested that grate bars of the following chemical composition would be superior to those examined, and should be tried to determine the amount of growth resistance necessary to promote economical operating conditions for this particular sintering process:

Pearlitic Cast Iron

		Per cent
Carbon	-	3.10 max.
Silicon	-	1.40-1.60
Manganese	-	0.70-0.90
Chromium	-	0.15-0.25

If possible, it would be advisable to lower the phosphorus content to 0.25 per cent maximum.

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(Figures 1 to 3 follow, on Page 4.)

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