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May 19th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1647.

Examination of Manganese Steel from a
Symons Cone Crusher Bowl Liner.

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Origin of Sample:

A sample of manganese steel was received on May 9th, 1944, from the Sorel Steel Foundries Limited, Sorel, Quebec. In a covering letter, dated May 8th, 1944 (File No. 32120), Mr. J. A. Critchley, Plant Manager, stated that the sample was taken from a Symons cone crusher bowl liner which had failed prematurely at Wartime Metals Corporation, La Corne Molybdenum Project, Val d'Or, Quebec.

Object of Investigation:

Chemical analysis and microscopic examination were requested, to determine the reason for premature failure of the crusher liner.

Macroscopic Examination:

The sample submitted measured approximately $5\frac{1}{2} \times 4 \times 1\frac{1}{2}$ inches. Figure 1 shows the sample in the "as received" condition.

Chemical Analysis:

The chemical analysis of the sample is shown below. For comparison, A.S.T.M. Specification A-128-33, for austenitic manganese steel, is also shown.

	Crusher Liner	A.S.T.M. Spec. A-128-33
	- Per Cent -	
Carbon -	1.16	1.0-1.4
Manganese -	6.40	10.0-14.0
Silicon -	0.07	--
Sulphur -	0.007	0.05 max.
Phosphorus -	0.08	0.10 max.
Chromium -	0.18	--

Hardness Tests:

The hardness of the sample submitted was 229 Brinell (average of 3 readings).

Microscopic Examination:

One specimen was cut from the sample, hand polished, and etched for 20 seconds in 4 per cent picral. The structure revealed was austenitic, with free carbides on the grain boundaries. Needles of martensite were noted in the vicinity of the grain boundaries. Figure 3, at a magnification of 100 diameters, shows a representative field from this specimen.

Discussion of Results:

The chemical analysis, with the exception of the manganese content, agrees with A.S.T.M. Specification A-128-33 for austenitic manganese steel.

The hardness was normal for manganese steel.

The microscopic examination showed an austenitic

(Discussion of Results, cont'd) -

structure with some needles of martensite. Steel having a carbon content of 1.16 per cent and a manganese content of 6.4 per cent should be considered a border line steel; that is, under perfect conditions of quenching the structure would be austenitic, but if the quenching were not sufficiently drastic the result would be a martensitic structure. In the section of steel under examination, the structure is mainly austenitic with some martensite. The free carbides on the grain boundaries would indicate too slow a quench, which indication is further proved by the presence of the martensite. If the quenching had been exceptionally fast, the structure would probably have been austenitic with no martensite but, because of the low manganese, there would have been a few carbides on the grain boundaries.

CONCLUSIONS:

The premature failure of the crusher liner was due to the low manganese content of the steel, giving rise, under normal heat treating conditions, to free carbides on the grain boundaries and also some martensite, rather than to a completely austenitic steel.

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ELC:GHB.

Figure 1.



SAMPLE "AS RECEIVED".
(Approximately 7/10 actual size).

Figure 2.



X100, picral etch.
AUSTENITIC STRUCTURE WITH FREE
CARBIDES ON GRAIN BOUNDARIES
AND NEEDLES OF MARTENSITE.