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EXAMINATION OF A CRACKED MANGANESE STEEL JAW CRUSHER

by

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PHYSICAL METALLURGY DIVISION

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SUMMARY

Metallurgical examination of a cracked manganese steel Jaw Crusher showed that the major cause of failure was due to an inadequate heat treatment. A large amount of both film type grain boundary carbide and massive carbide was present in the casting. Some of the carbide was needle-shaped which indicated that this was a carbide phase which had not been dissolved during the heat treatment.

It is recommended that the heat treatment and composition of the alloy be modified to avoid further failures.

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INTRODUCTION

A request was received from Mr M.O. Dorio, Works Manager, Joliette Steel Division, Joliette, P.Q., on February 6, 1959, to carry out an examination of a section of a chromium-containing manganese steel jaw crusher which had failed in service. A previous casting, supplied by an American firm was reported to have also failed. Specifically, the request was to ... "have an investigation carried out to determine if the jaw supplied by us is metallurgically sound and the cause of failure."

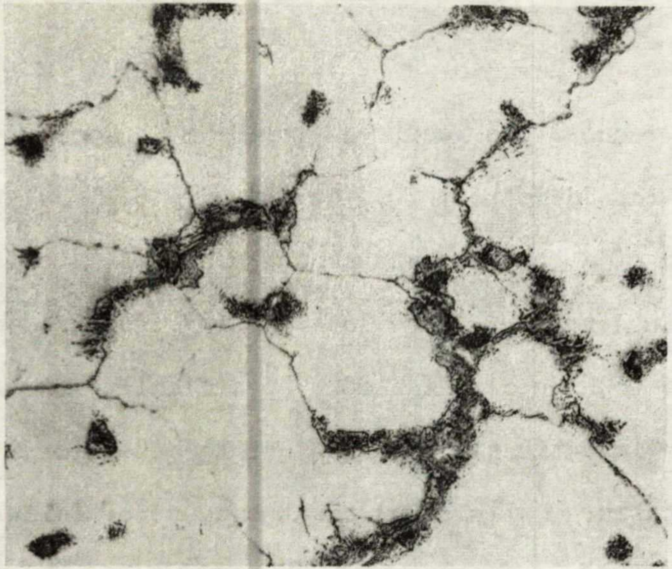
CHEMICAL COMPOSITION

Drillings were obtained from the samples supplied and were chemically analyzed. The results are given below:

Element	Percent
C	1.29
Mn	13.0
Si	1.11
S	0.011
P	0.055
Cr	1.77
Ni	0.01

METALLOGRAPHIC EXAMINATION

Sections were carefully cut from the samples and suitably prepared for examination under a microscope. The etched specimen showed the presence of large amounts of massive and film type grain boundary carbides. Some of the carbide was needle-shaped, which is typical of that found in the as cast steel. Figures 1 and 2 illustrate the above remarks.



Mag. X100 Etched in 6% Nital

Figure 1 - Typical microstructure of the section showing large amounts of carbides present in the steel.

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Mag. X500 Etched in 6% Nital

Figure 2 - Shows carbide at grain boundaries as well as the needle-shaped carbide typical of as-cast manganese steel.

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DISCUSSION

The cause of failure of the casting is undoubtably due to the large amount of carbide in the steel, especially the grain boundary carbide. The presence of the needle-shaped carbide indicates that this carbide is the original constituent, i.e. the heat treatment given the casting was not sufficient to bring about complete solution of the carbide. The needle-shaped carbide is also found in manganese steel after reheating the fully heat treated steel, but this is not suspected in the present case.

The solution to the problems is twofold. First, it is suggested that a lower carbon content be aimed for. A carbon content of 1.10% would be easier to heat treat correctly. The presence of chromium is, however, the primary cause of heat treatment difficulties. This element produces a complex carbide which is quite stable. The second change is a higher austenitizing temperature and a longer soak time in order to obtain a completely austenitic structure. This time and temperature may be best determined by tests under plant conditions. A temperature of 2050°F and a soak time of 1 hour per inch has been found satisfactory in some instances and may be a good starting point.

CONCLUSIONS

1. The cause of failure is due to the presence of large amounts of massive and grain boundary type carbides.

2. An increase in the austenitizing temperature is necessary in order to dissolve all the carbides. A revision in the composition of the steel may also prove helpful.

RKB:lh