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Comparative Study of the Structure of Castings from White Wear Resistant Cast Iron

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ABSTRACT: In this article, white wear-resistant 280Cr29NL and 300Cr32N2M2TL brands of cast irons are investigated, chemical compositions and their structures are compared. A study was conducted to study the direction of carbides in the 280Cr29NL and 300Cr32N2M2TL grades of cast iron.

KEY WORDS: wear-resistant cast iron, carbide phase, abrasive wear, high-chromium white cast iron, carbide, iron sulfide.

I.INTRODUCTION

Modern white wear-resistant cast irons are complex alloyed multicomponent alloys of various structure and properties. They represent a separate group of industrial alloys, during solidification of which the carbide phase is formed. It determines the specific properties of white wear-resistant cast irons. Often, only white wear-resistant cast irons are able to ensure reliable operation of the most diverse equipment operating in the harsh conditions of intense abrasive wear [1].

II. EXPERIMENTAL RESULTS

The objects of research are samples of white wear-resistant cast irons of the grades 280Cr29NL (Sample No. 1) and 300Cr32N2M2TL (Sample No. 2), which has developed its service life. The chemical composition of the samples was determined by the emission spectral method on a Sptectro - Lab – M instrument (made in Germany).

III. THE RESULTS AND DISCUSSION

The results of the analysis are shown in table 1.

Table 1. The chemical composition of the investigated alloys.

	Elements, %									
	C	Si	Mn	P	S	Cr	Ni	Mo	Ti	Cu
Sample number 1 (280Cr29NL)	2,92	0,51	0,57	0,067	0,032	28,86	1,54	0,057	-	0,2
Sample No.2 (300H32N2M2TJI)	2,67	1,13	0,57	0,043	0,018	31,58	1,93	0,37	0,2	0,07

The main feature of high-chromium white cast irons is the presence in the microstructure of alloyed iron carbides and carbides of alloying elements, which provide high wear resistance under abrasive wear [2]. The amount of carbides in

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the iron structure is the greater, the higher the carbon content. The type of carbides formed is determined by the ratio of the contents of chromium and carbon in the iron. At the same time, cast iron, in which the carbon content corresponds to eutectic and the ratio of chromium to carbon, ensures the formation of carbides of the type $(Cr, Fe)_7 C_3$ and the absence of carbides of the type $(Cr, Fe)_3C$, have the maximum wear resistance. The total amount of carbides (Total) in the samples: $K_1 = 34.61\%$, $K_2 = 32.56\%$ [3].

Increasing the size of carbide inclusions reduces the wear resistance of cast iron. The degree of influence of carbide sizes depends on the wear conditions and abrasive characteristics, which is associated with the influence of these factors on the formation of stresses in the carbides and on the distribution of stresses between the carbide and the metal base. Large carbide inclusions (especially in a soft matrix) crack and crumble under the action of stresses created by the abrasive particle and deformations of the base [5, 6]. Small - transfer part of the stresses to the metal base and do not collapse. In relatively "soft" conditions in the iron, larger carbides are permissible, in more "hard" in speed, hardness, sharpness, abrasive mass, the allowable size of carbides decreases [4].

The electron microscope SEM EVO Carl Zeiss NA 10 was used to study the microstructure of the samples.

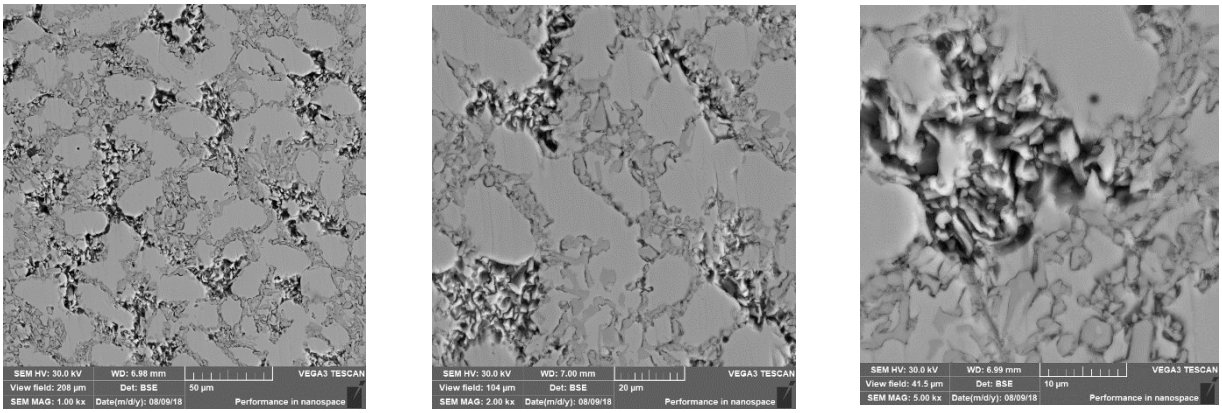

Fig.1. The structure of cast iron 280Cr29NL: × 1000, × 2000, × 5000.

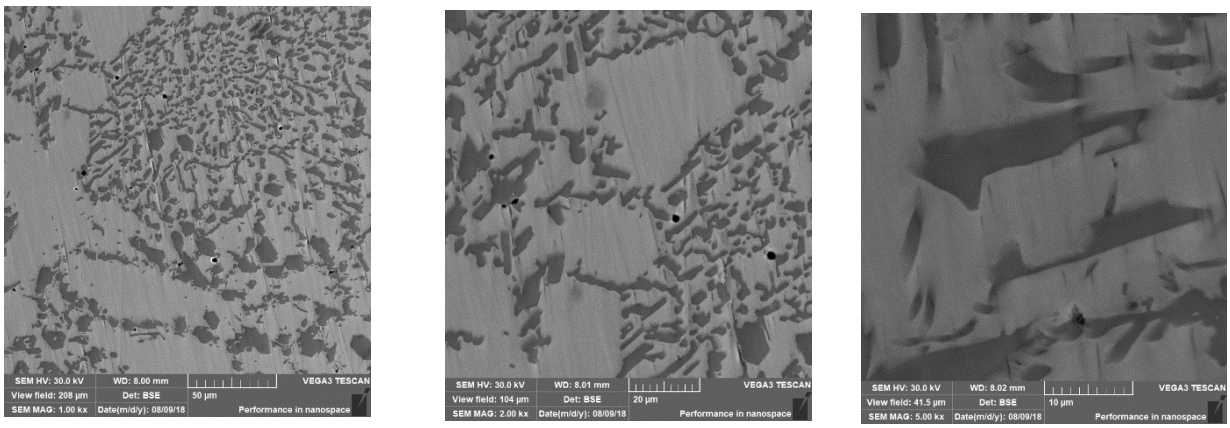

Fig.2. The structure of cast iron 300Cr32N2M2TL: × 1000, × 2000, × 5000.

In particular, samples of cast iron brand 280H29NL, are composed of a high content of sulfur. Iron sulphides, which are formed at an elevated sulfur content, embrittles the alloy, and wear takes place with chipping of carbides.

The influence of the size, number and orientation of carbides in the structure of cast iron is particularly significant in terms of impact-abrasive wear. Under these conditions, the bonding strength of carbides with the matrix and their ability to evenly distribute the impact energy of an abrasive particle are of great importance.

The dependence of wear resistance of high-chromium cast irons was found not only on hardness, but also on the orientation of carbides of the type $(Cr, Fe)_7 C_3$ with respect to the wear surface of the part [5].

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IV. CONCLUSION

Thus, according to the results of the research performed, the following conclusions can be drawn:

1. White high-chromium cast iron of the brand 280Cr29NL and 300Cr32N2M2TL molded in the foundry Navoi Machine-Building Plant has a composition close to eutectic, but is prone to brittle chipping. At high magnifications in the metal base, places of chipping are found, and where the chipping has not yet passed, gray sulphides are clearly visible;
2. The sizes of carbides of the studied cast iron vary widely from 8,6 μm to 31 μm;
3. The presence in the composition of the alloy modifier - Ce has a significant impact on structural stratum;
4. The dependence of the wear resistance and hardness of high-chromium cast irons was found not only on the hardness, but also on the orientation of carbides of the type $(Cr, Fe)_7 C_3$ with respect to the wear surface of the "Bottom incline" part. This result is a consequence of the anisotropy of the hardness of $(Cr, Fe)_7 C_3$. Maximum wear resistance is achieved for such an orientation, when the carbides are located by its axis (in which the hardness is maximum) perpendicular to the working surface.

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AUTHOR'S BIOGRAPHY

I **Jumaev Akhmadjon Abduvokhidovich** was born on May 24, 1989 in the Navoicity.In 1996 I went to the first class of school No. 10.Successfully graduated from school with honors in 2006. Participated in the Mathematics Olympiad among the participants of seventh grades in the Republic and took the third level. 2008, admission to the Navoi State Mining Institute Department of Mechanical Engineering. Graduated with honors in 2012. During the time 8 theses and 4 scientific articles were published.2012 Master's degree in Navoi State Mining Institute specialty Engineering technology and equipment. Graduated from the 2014 learning process. During the course, 18 theses and 12 scientific articles were published.In 2018, admission to PhD in Academy of Sciences Republic of Uzbekistan Navoi Branch. Theme PhD - "Optimization of the composition and structure of the alloy 300Cr32N2M2TL in order to obtain the required performance properties". Until today, having investigated white wear-resistant cast iron, publishing 4 theses and 2 scientific articles.