Technology for Obtaining High-Quality Castings from Resistance White Cast Iron

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ABSTRACT

This article calculated the ingots in order to obtain quality castings and liquefied them in an induction furnace. In addition, the scheme of placement of the supply disk in the casting mold, which provides a uniform distribution of bending on the surface to be strengthened during the cooling of castings, is based on the level of thermal conductivity of the mold walls. It is also designed to increase the hardness and ductility of the 280X29NL alloy based on the degree of dependence of the chromium element on its dispersion during liquefaction. This serves to ensure a uniform distribution of the elements in the alloy.

Keywords: Casting, 280X29NL, IST – 0.4 induction furnace, non – ferrous metal, sand – clay mold, supply disk, resistance, white cast iron, ferrochrome, ferromanganese, ferrosilicon, nickel

Introduction

One of the most important tasks in the world today is to cast cheap and brittle castings on the basis of increasing the strength, quality, mechanical and operational properties of machine parts obtained by casting. Research work in the field of foundry worldwide, including: development of high – quality and economically inexpensive alloys without changing the chemical composition of the alloy, depending on the operating conditions of the alloy, taking into account the working environment of ductile white cast iron; correct selection and improvement of the system of injection molding of ductile white cast iron in casting molds. It is important to study the effect of top – cast liquid alloy on the casting sand when pouring the alloy into the casting mold, thereby calculating the heat dissipation coefficient of the alloy in the mold when pouring the alloy into the mold, developing and using new optimal heat treatment standards for ductile alloys [1 – 3].

Scientific innovations are being made in a number of areas for the liquefaction of ferrous metals and the production of high – quality alloys from ductile white cast iron in foundries. In this regard, the United States, Spain, Egypt, Mexico, Russia,

Ukraine and other countries are the leaders in the production of white cast iron. Due to the increase in the production of castings in the foundry industry from year to year, increasing demand for quality of parts made of ductile iron castings, special attention is paid to the creation of technology for obtaining castings from quality, ductile cast iron on the basis of effective resource – saving methods [4 – 6].

After the independence of the Republic of Uzbekistan, with the development of metallurgy, mining and foundry, research work has been carried out on the production of cast products made of import – substitutable white cast iron, and a number of results are being achieved. In this regard, further improvement of the technology of casting of brittle white cast iron in clay – clay molds, improving the quality of castings, the development of the foundry industry on the basis of modern requirements for the production of castings, including the optimal composition and heat treatment of alloys to increase the ductility of castings standards need to be developed and put into practice [7 – 8].

Materials and Methods

For the production of economically inexpensive and ductile castings from 280X29NL ductile white cast iron, the ingot was developed as a sample for the NMP plant of Navoi MMC and liquefied in the non – ferrous metals liquefaction shop in the IST – 0.4 induction furnace, a disk detail providing a sand – clay mold was cast. The supply disk sketch can be seen in Figure 1.

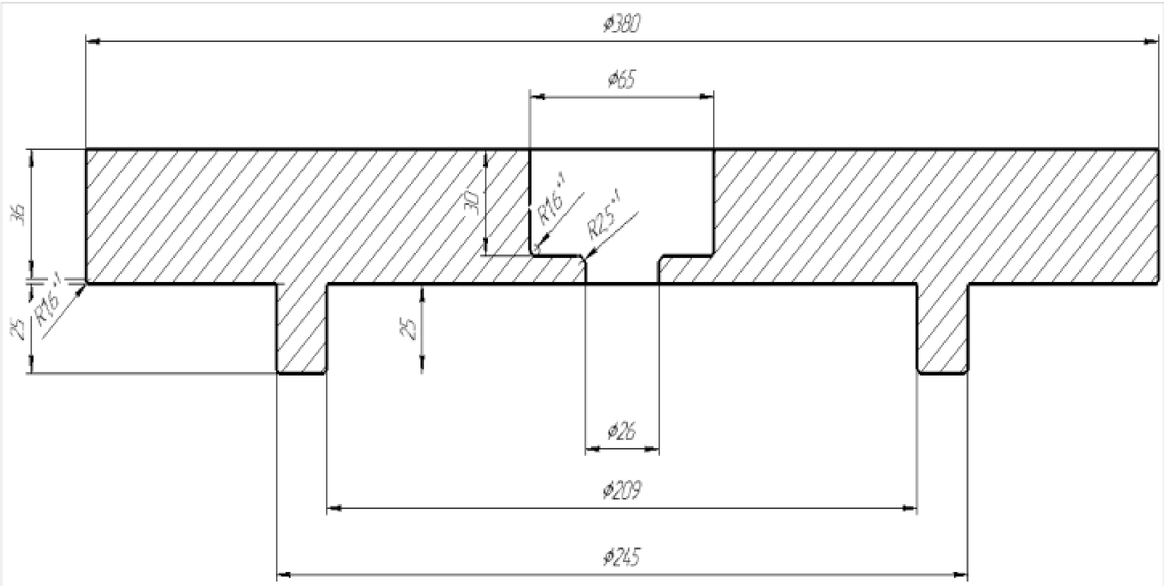


Figure 1. Supply disk drawing

In the shop “Liquefaction of non – ferrous metals” of the plant “NMP” was previously cast two alloy wheels 280X29NL in a sand – clay mold.

As can be seen from Figure 2, the sand – clay mold was filled with two supply disk parts and the top of the mold was filled with mold material (see Figure 3). It was found that a large amount of mold material was used to cast the two supply disk parts.

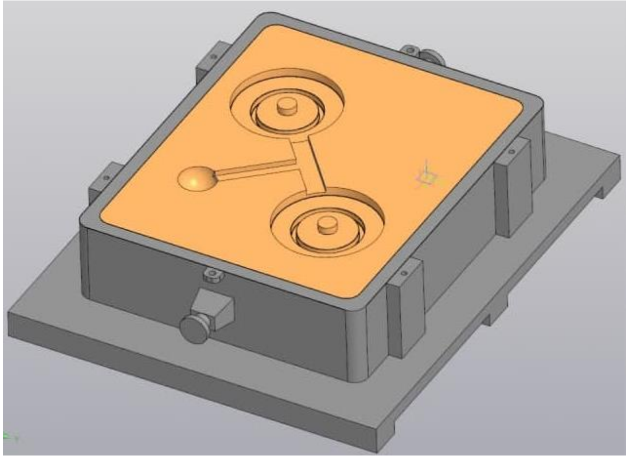


Figure 2. The sand prepared to accommodate the supply disk detail is the bottom of the clay mold

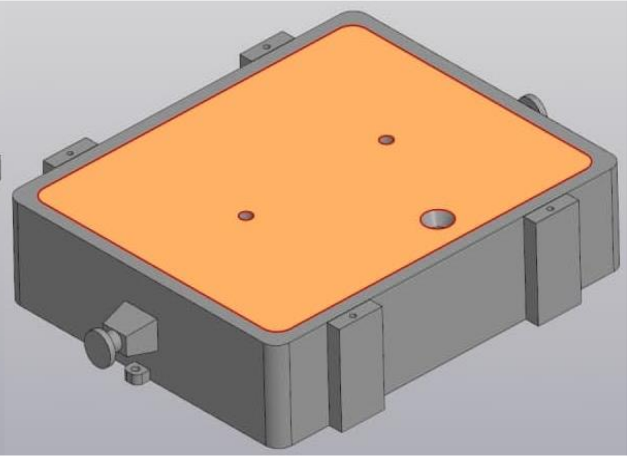


Figure 3. The sand prepared to accommodate the supply disk detail is the top of the clay mold

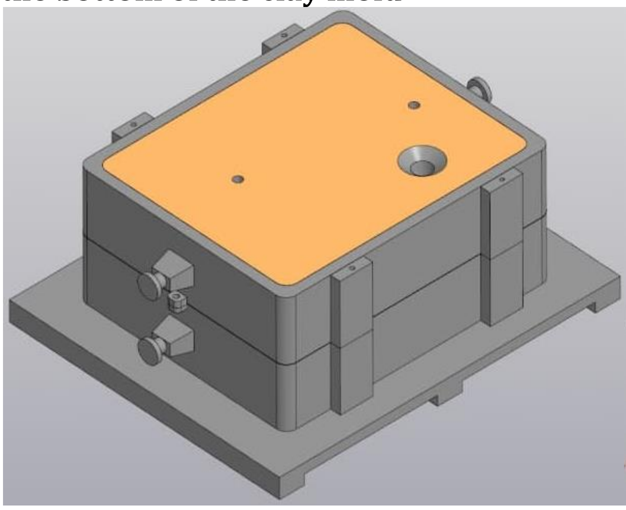


Figure 4. The sand prepared for the placement of the supply disk detail is the assembled state of the clay mold

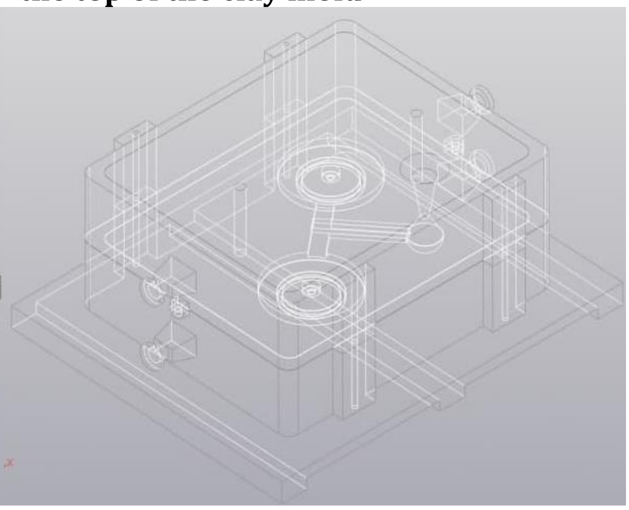
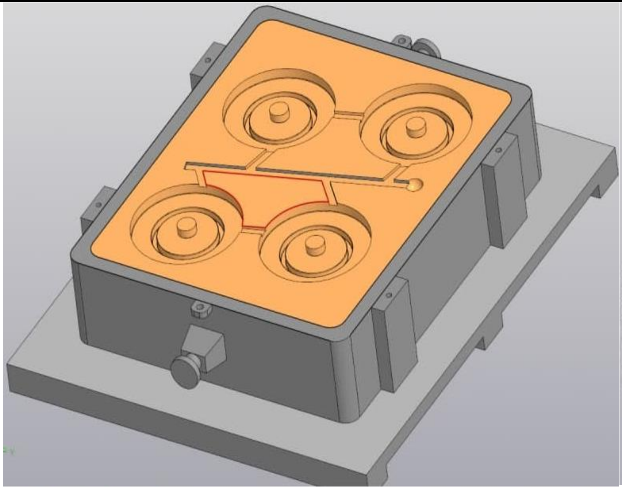


Figure 5 The sand prepared for the placement of the supply disk detail is a sketch of the assembled state of the clay mold

Figure 4 shows that the two mold's are ready. In this case, due to the fact that the mold mixture at the top is full, it affects the slow cooling of the casting and the slow release of gases from the mold to the external environment. Figure 5 shows a sketch of the mold made in a two – stage mold, which shows a diagram of the placement of the supporting disk detail inside the mold. The technology of casting the supply disk part in the production plant was analyzed, and the scheme of placement of the supply disk in the die casting mold was developed based on the thermal conductivity of the mold walls, which provides a uniform distribution of the surface elasticity of the casting during cooling. This reduced the consumption of mold material and allowed the casting of four supply disk parts in a single sand – clay mold.



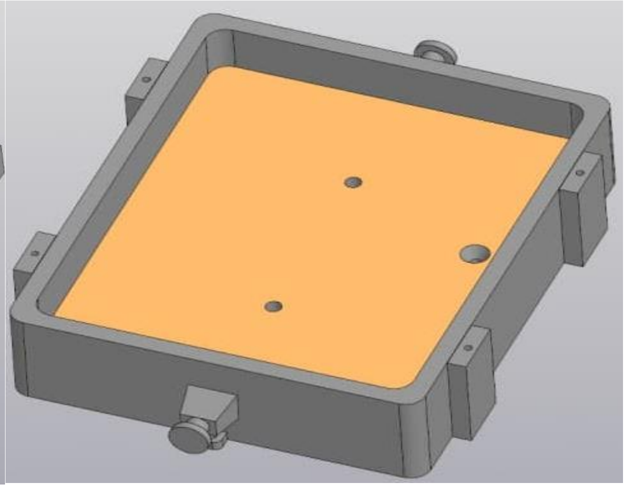
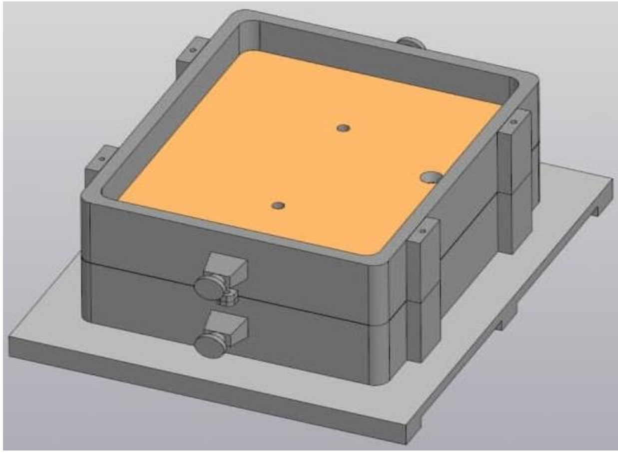


Figure 6. The sand prepared for the placement of the newly developed supply disk detail is the bottom of the clay mold

Figure 7. The sand, which is prepared to accommodate the newly developed supply disk detail, is the top of the clay mold



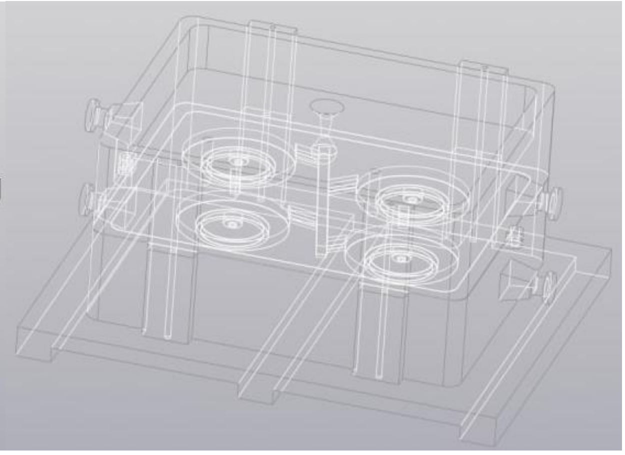


Figure 8. The sand prepared for the placement of the newly developed supply disk detail is the assembled state of the clay mold

Figure 9. The newly developed supply disk is a sketch of the assembled state of the sand – clay mold prepared for placement

Figure 6 shows the placement of four supply disks in a sand – clay mold, while Figure 6 shows the reduction of the mold material at the top of the mold. The advantage of this technology over the previous technology is that it is possible to cast not two, but four supply disk parts in the mold, which led to a reduction in additional metal consumption in the casting, an increase in work efficiency. Figure 8 shows a view of the two opal molds prepared for the supply disk detail, and Figure 9 shows a schematic of the placement of the four supply disk details inside the mold. In addition, after the liquid metal was poured into the mold, a hole was drilled from the top of the mold of the first sample to the casting, from where cold air was sent under a certain pressure. Carbon dioxide gas was sprayed on the mold material of the second sample and the cast was cooled rapidly. Through the proposed technology, the mold mixture at the top of the mold was reduced and the gas achieved faster cooling of the casting by air spraying, accelerating the crystallization process of the casting and increasing the number of crystallization centers. It was also found to save mold material by consuming less mold mixture and to supply four disk parts per mold [11 – 12].

Then, instead of ductile white cast iron of brand 280X29NL, an economically inexpensive chemical composition was developed without compromising the mechanical properties of the alloy.

Table 1
Chemical composition of resistance 280X29NL brand white cast iron

Brand	Элементлар, %								
	C	Si	Mn	Cr	Ni	Mo	Cu	P	S
280X29NL	2,92	0,51	0,57	28,86	1,54	0,057	0,2	0,067	0,032

Table 2
The recommended composition of alloys of 280X29NL

Cast iron	Л2	GOST 4832 – 95
Cast iron (return)	Б 65	GOST 2787 – 75
Steel	Nickel N12	GOST 1969 – 2009
Ferrochrome	FX-100	GOST 4757 – 91
Ferromanganese	FMn-88	GOST 4755 – 91
Ferrosilicon	FS-45	GOST 1415 – 9 3

Based on the developed chemical composition, the charge was calculated and the IST – 0.4 induction furnace was first tested with 250 kg of B65 (return), 135 kg of cast iron (pig iron) and 30 kg of steel (Nickel N12), 2 kg of FeSi 75, 1,250 kg. FeMn 90 ferroalloys were isolated. After the first start-up of the furnace, 125 kg of B65, 75 kg of cast iron and after 1:30 hours, the remaining B65, cast iron and 2 kg of FeSi 75, 1,250 kg of FeMn 90 ferroalloys and the weight of the liquid metal in the furnace, 0, At 4 – 0.6%, the modifiers were loaded in the furnace and bucket. Al, Mg, and Ti were used as modifiers. The process of liquefaction of the sample took 2:50 hours and the slag separated from the liquid alloy was removed from the furnace (slag mass was 10.6 kg, metal burning in the furnace was 2 – 3 %, ie 8 – 12 kg) and poured into a sand-clay mold.

The total weight of the liquid alloy was 400 kg, of which an average of 8 – 10%, ie 7.9 to 11.0 kg of slag (slag density 2.5 g / cm^3, the composition of the slag from MnO, FeO, SiO_2, CaO, P_2O_5 mirror additives)) and the burning of the metal averaged 2 to 3 percent, ranging from 7 to 12 kg.

Results And Discussion

A sample of 280X29NL brittle white cast iron was prepared and its microstructure was observed and analyzed in the laboratory of TDTU.

In order to analyze the existing defects in the structure of the sample made of ductile white cast iron brand 280X29NL, cuttings were prepared (Fig. 10) and magnified in MBS – 9 at a magnification of x5, x10 and MIM – 7 at a magnification of x200 to x1000 under a metallographic microscope.

Figure 10. Samples made of cast iron brand 280X29NL

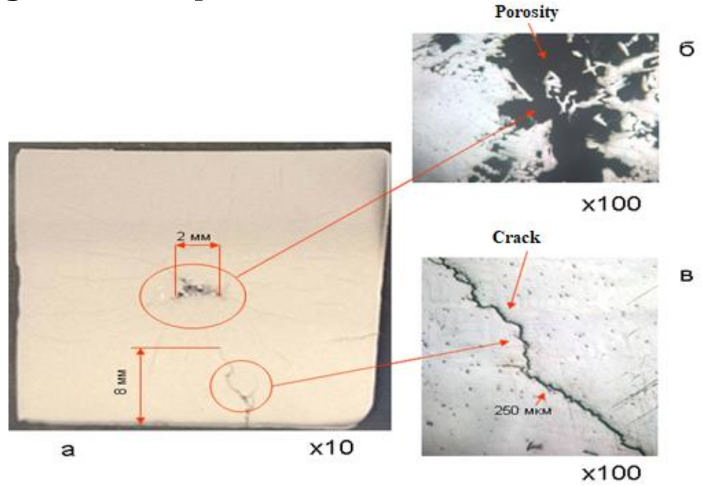
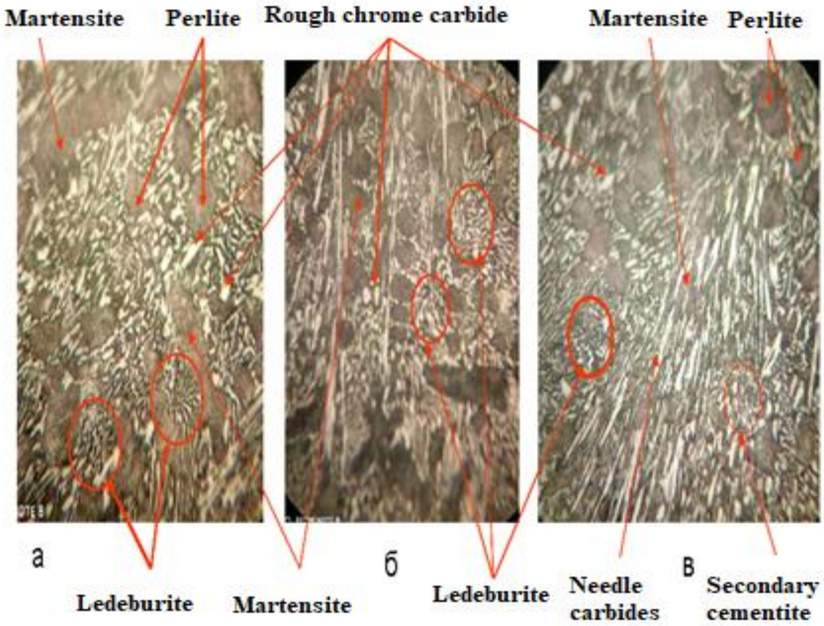


Figure 11. Defects on the unobtrusive surface of the macro-graft of the fragile white cast iron sample brand 280X29NL: a – defects on the surface of the macro-graft; b is a large porosity located in the center of the cut; v is a large crack at the edge of the cut

The sample is a technological process defect due to the origin of the large pores located in the center of the macro structure and the large cracks that tend from the edge of the cuticle to the center, which may be related to the technological process of casting.

According to the structural analysis of acid – immersed cuttings, the structure of the ductile white cast iron brand 280X29NL consisted mainly of martensitic + perlite and ledeburite distributed in it in the form of a grid. The structure and distribution of chromium carbides and cementite in the structure are different, some have a rough structure and some have a needle – like structure (Figure 11).



12 – picture. Microstructural image of a fragile white cast iron sample brand 280X29NL, (immersed in a mixture of picric and nitric acid for 10… 15 seconds) x200: a - sample center; b – is the middle of the sample: c – is the edge of the sample

12 – picture. Microstructural image of a fragile white cast iron sample sample brand 280X29NL, (immersed in a mixture of picric and nitric acid for 10… 15 seconds) x200: a – sample center; b is the middle of the sample: c is the edge of the sample.

In the sample of ductile white cast iron brand 280X29NL, the micro hardness of the martensitic + perlite and ledeburite base was carried out under the loading effect of 200 g using PMT – 3 on HV. Figure 13 shows a trace of a diamond pyramid in perlite and ledeburite in the sample structure using the PMT – 3 device..

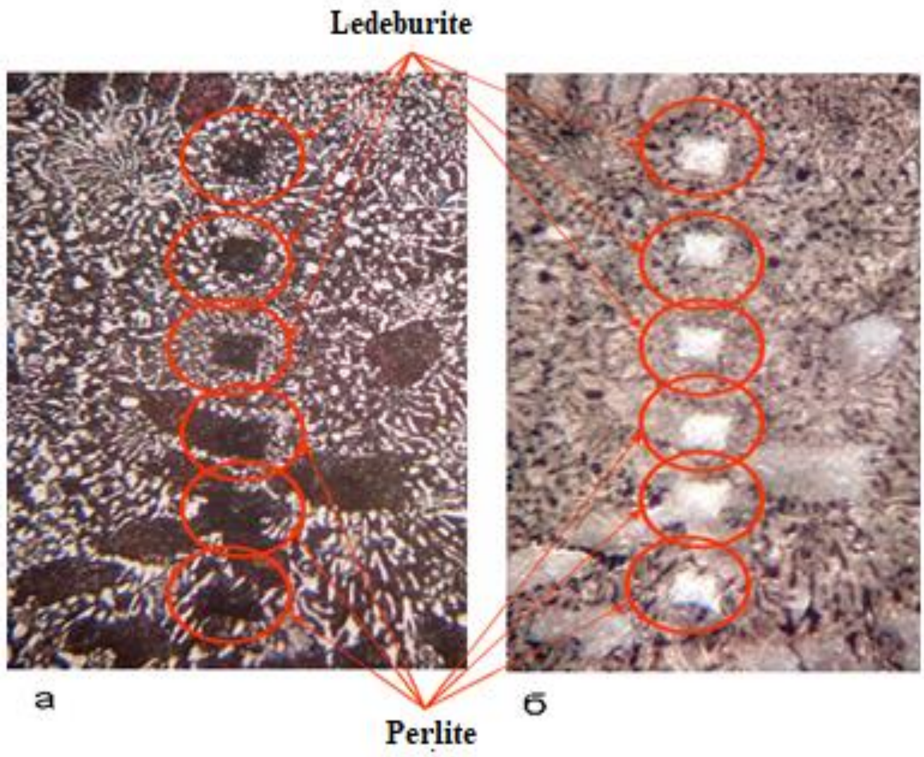


Figure 13 280X29NL brand edible white cast iron pattern with a diamond pyramid on the base, x600: a - on an open background; b - in the closed background

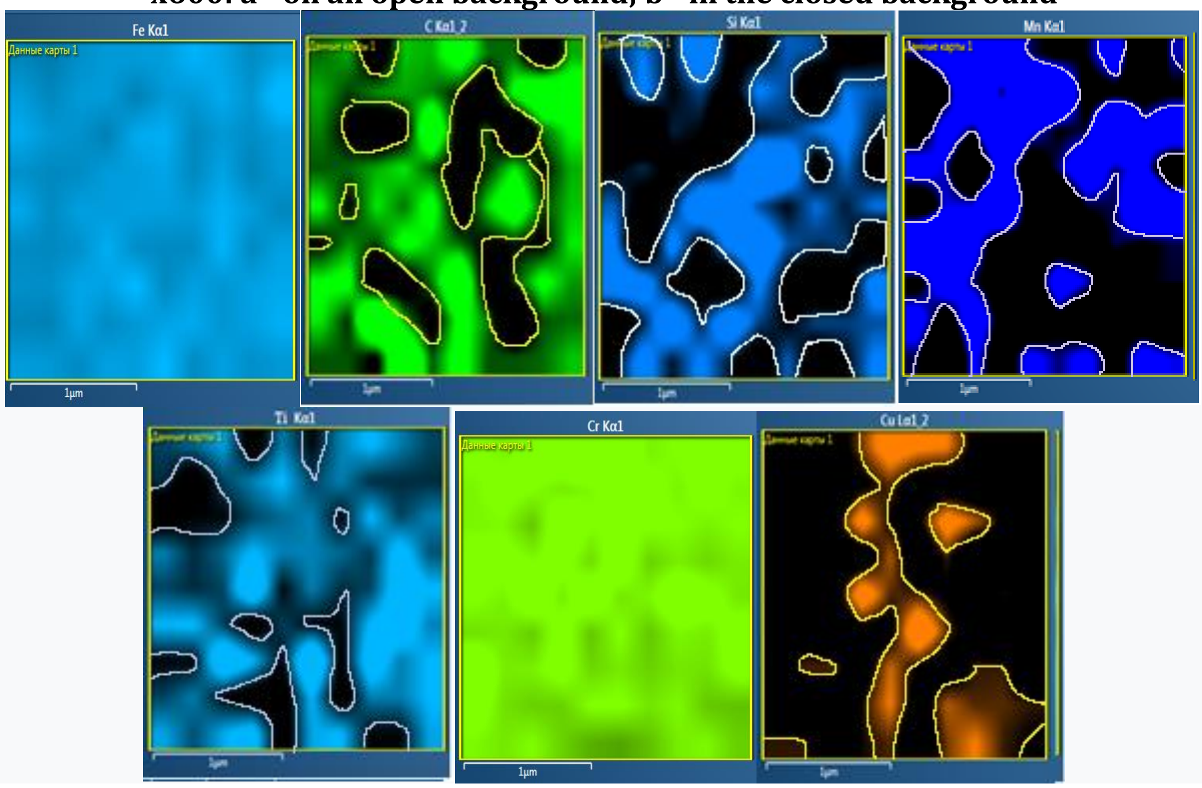


Figure 14. 280X29NL permeable distribution of resistance white cast iron elements SEM Zeiss EVO MA 10 scanned electron microscope x500 magnification image

When inspecting the 1 μм area of the alloy of elements in the composition of ductile white cast iron brand 280X29NL, it can be seen in Figure 14 that the elements of carbon, silicon, manganese, titanium and copper are not evenly distributed in the unit of volume except iron and chromium. This is a liquidation process, and such alloys cause various defects during corrosion and friction.

According to the results of the study, the microhardness of the perlite base was 2065 N/mm², the microhardness of ledeburite was 6893 – 7400 N/mm², the microhardness of martensite was 5065 N/mm², and the hardness in volume was 410 – 470 N mm².

Conclusion of the analysis. As a result of the uneven distribution of cooling temperature and uneven distribution of the alloying element in the structure during the transition from the liquid to the solidification (crystallization) process, sharp differences in volume separation phases formed large cracks in the material body on the one hand, and various gas bubbles in the material body in time. prevented him from leaving.

According to the structure, the casting and physico-mechanical properties of the material must be satisfactory, but the incorrect choice of technological modes has led to technological defects in the material.

Conclusion

Based on the results of the above experiment, a technology has been developed to increase the service life of the disks of CEMCO and BARMAK crushers, which operate under the influence of centrifugal force, obtained by casting from high-ductility chromium cast iron:

1. A liquefaction technology has been developed based on the introduction of additional chemical elements into the furnace to ensure the brittleness of the 280X29NL alloy. This alloy serves to develop the technology of loading the chemical elements into the furnace.

2. To increase the hardness and ductility, the 280X29NL alloy was developed based on the degree of dependence of the chromium element on its dispersion during liquefaction. This serves to ensure a uniform distribution of the elements in the alloy.

3. The newly developed brittle white cast iron casting technology is based on the regulation of the crystallization intensity of the alloy inside the mold. This allows the hardness distribution on the friction surface to be normalized.

4. The scheme of placement of the supply disk in the casting mold, which provides for a uniform distribution of bending on the surface to be strengthened during the cooling process of the casting, was developed based on the thermal conductivity of the mold walls. This serves to select the mold item.

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