IMPROVING THE TECHNOLOGY OF LIQUIDATION OF WEAR – RESISTANT WHITE CAST IRON

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ANNOTATION

In this article, the optimal mode of liquefaction of wear – resistant white cast iron alloy in an induction furnace is developed. In addition, the chemical composition of the alloy for wear – resistant white cast iron without reducing the mechanical properties was developed, which is cheap and resource – saving from the economic point of view, and the microstructures of the alloy were examined using a scanning electron microscope.

Also, depending on the amount of carbon and chromium in the alloy, the fluidity of the alloy was determined, and quality cast products were obtained.

Keywords: casting, induction furnace, microstructure, scanning electron microscope, alloying, abrasive wear, chromium, manganese, silicon, carbon, corrosion resistance, reagent, alloy, cast iron, ductility.

INTRODUCTION

Today, one of the important tasks in the world is the casting of cheap and wear – resistant white cast iron alloy based on improving the strength, quality, mechanical and operational properties of cast products obtained by the casting method [1, 2]. The scientific and research works carried out in the field of foundry on a global scale, including: taking into account the working environment of wear – resistant white cast iron, developing a high – quality and economically inexpensive alloy without changing the mechanical properties of the alloy depending on the working conditions of the alloy exit; correct selection of the system for casting wear – resistant white cast iron in foundry molds and its improvement; It is important to study how the liquid alloy poured from above erodes the mold sand in the process of pouring the alloy into the casting molds and thereby affects the quality of the casting, to calculate the heat dissipation coefficient of the alloy in the mold when the alloy is poured into the casting mold, to develop and use the optimal mode of liquefaction of a wear – resistant alloy in an induction furnace is considered important [3, 4].

Scientific innovations are being made in a number of directions in order to liquefy ferrous metals and obtain high – quality ingots from wear – resistant white cast iron at foundries. In this regard, the USA, Spain, Egypt, Mexico, Russia, Ukraine and other countries are the leaders among the countries that wear – resistant white cast iron. From year to year, due to the increase in the amount of production of cast products in the field of foundry, the increase in the demand for the quality of the cast products obtained from wear – resistant white cast iron, based on an effective method that ensures resource saving, is a special reason for creating a technology for obtaining cast products from wear – resistant white cast iron. attention [5 – 8].

Wear – resistant white cast irons have high operational properties, and the production of high – quality cast products from them is of great importance. Due to alloying of wear – resistant white cast iron with various alloying elements, including chromium, its casting properties increase depending on the amount of chromium. In addition, the wear – resistant of alloyed cast iron depends on its microstructure, that is, in obtaining wear – resistant white cast iron castings, not only the quality of the casting, but also the formation of the microstructure that ensures the wear – resistance of cast iron is of great importance [9 – 12].

The wear – resistance of wear – resistant white cast iron is mainly provided by carbides with the structure $(Cr, Fe, Mn)_7C_3$. This is because this carbide is 1.5 – 2.0 times harder than cementite carbide. One of the complications related to this is that the amount of chromium in cast iron with 3% C for the formation of carbides in the system $(Cr, Fe, Mn)_7C_3$ is between 12 and 27% maximum [13 – 15].

MATERIALS AND METHODS

Despite the fact that world practice has accumulated a lot of experience in the use of low – alloyed high – chromium and chromium – manganese cast iron as an anti – friction material, it remains a problem to increase the defects, friction and mechanical properties of castings during heat treatment or crystallization [16, 17]. It is urgent and necessary to solve these problems with the help of additional studies of alloying, microalloying, modification and thermal treatment processes [18, 19].

One of the most common types of abrasive friction is hydroabrasive, which includes hydraulic ash cleaning of parts of thermal power plants. This process is carried out depending on the working conditions of the details.

The following chemical composition was recommended in this work.

Table 1 Chemical composition of recommended wear – resistant white cast iron

Elements, %					
C	**Si**	**Mn**	**Cr**	**P**	**S**
2,7 – 3,2	0,4 – 0,8	3,8 – 4,0	19 – 20	0,05 – 0,06	0,04 – 0,05

Studying the effect of chromium and manganese on the hardness and corrosion of wear – resistant white cast iron and it was found that they have high operational properties in different environments [20].

In the metal fabrication industry, mechanical properties play a major role in selecting the right alloy for each part. During the entire casting and processing process, as well as during the life of the products, the selected material is affected by many external forces. It's up to manufacturers to create products that work as they should at each stage.

By increasing the amount of manganese in the alloy, the impact viscosity and wear – resistance of the alloy have been improved. However, as the manganese content increased above 1%, the wear – resistance of the inner layer (lining) of the furnace crucible accelerated.

For this purpose, the inner layer (lining) of the induction furnace crucible was selected from the basic materials. The selected crucible material resulted in less wear – resistance of the inner layer of the furnace crucible in the fluidization of the high – manganese white cast iron alloy.

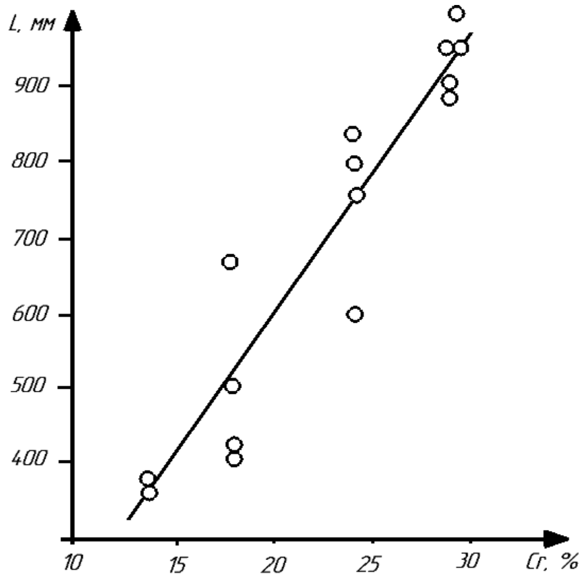
The inner layer of the induction furnace made of the base material and the condition of the inner layer of the furnace after liquidizing the alloy can be seen in pictures 1, 2. As can be seen from the picture 2, it was observed that the wear – resistant of the inner layer of the furnace is less after the melting of the wear – resistant white cast iron with a high content of manganese.

1 – picture. A view of the inner layer of the prepared induction furnace

2 – picture. The condition of the inner layer of the induction furnace after melting the wear – resistant white iron

The mechanical properties of a fluidized alloy describe how the material responds to applied loads or forces. These properties are not constant, they vary with temperature and other external factors, so manufacturers must have a complete understanding of the part's operating environment before recommending an appropriate material.

As can be seen in Picture 3, the ductility of cast iron improved with the increase of chromium content in wear – resistant white cast iron. When the amount of chromium is in the range of 18 – 30%, in practice, the effect on the penetration of cast iron is very small.



3 – picture. A graph showing the variation of the ductility of cast iron with a carbon content of 2.8 – 3.2% as a function of the amount of chromium

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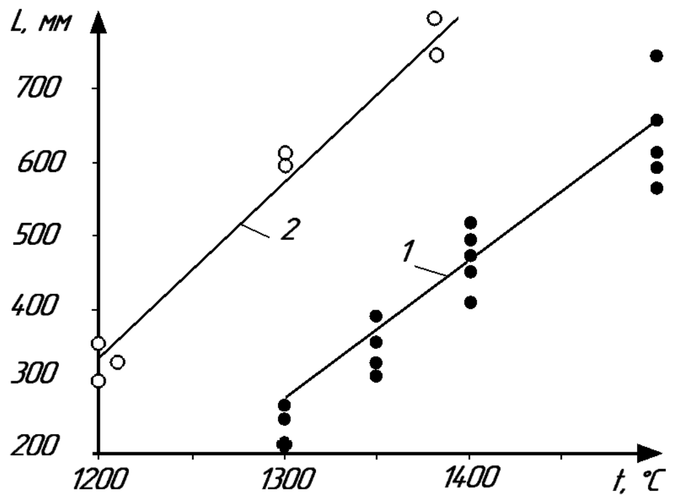
The average carbon content of the alloy is 3.0 percent, and with increasing chromium content, it was observed that the alloy's fluidity improves.

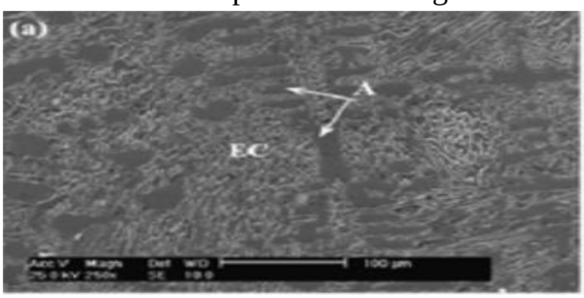


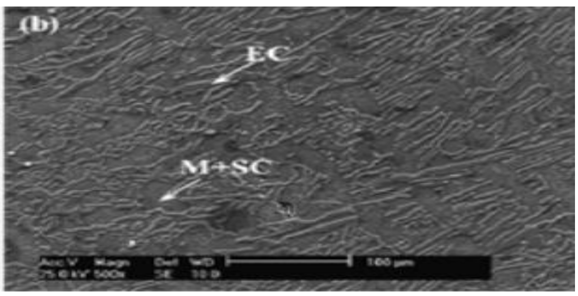
4 – picture. A graph showing the effect of molten iron temperature on alloy flowability during alloy casting. 1 – wear – resistant white cast iron; 2 – gray cast iron

Picture 4 shows that wear – resistant white cast iron and gray cast iron improve their fluidity depending on the temperature. As the casting temperature of cast irons increased, their ductility also increased linearly and reached 600 mm according to the Keri spiral at a temperature of 1500^0 C.

RESULT

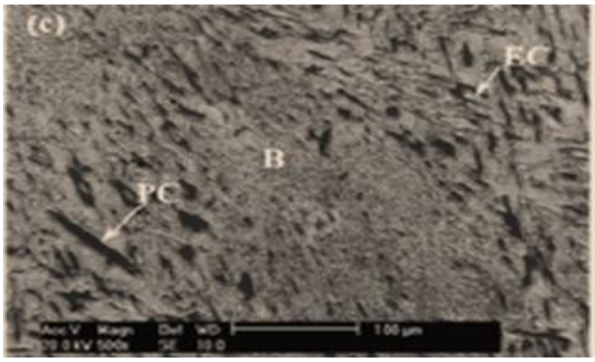
Wear – resistant white cast iron was liquefied in an induction furnace with a 2.5 – ton base crucible, poured into a sand – clay mold and cooled, then the surface of the cast products was cleaned of sand stuck to it by burning. Then, samples with a diameter of 8 mm and a length of 20 mm were cut from the sample, and the samples were processed step by step using SiC abrasive papers with 500, 1000 and 2000 μm. The surface of the samples was polished using WC (tungsten carbide) paste. After the polishing process, the samples were treated with reagents according to GOST 5639 – 82. Hydrochloric (HCl) and picric ($C_6H_2(NO_2)_3OH$) acids were used as reagents. The main purpose of reacting the structure of the samples with a reagent is to divide the structure of the samples into phases and study them under a microscope. As a result, it became possible to divide the structure of wear – resistant white cast iron into clear boundaries. The samples were subjected to metallographic and elemental research at the "Center of Advanced Technologies under the Ministry of Innovative Development" at the magnification of x500, x2000 to x5000 on a SEM Zeiss EVO MA 10 scanning electron microscope. The resulting microstructures are shown in Pictures 5 – 12.



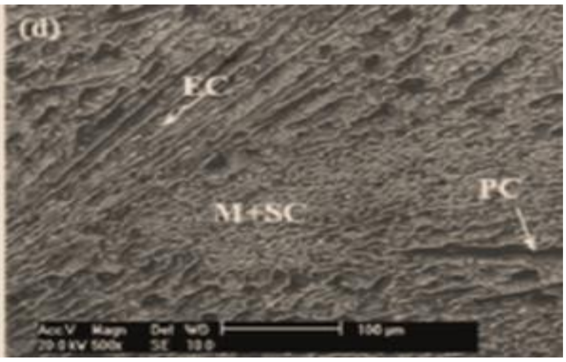


5 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x500 magnification

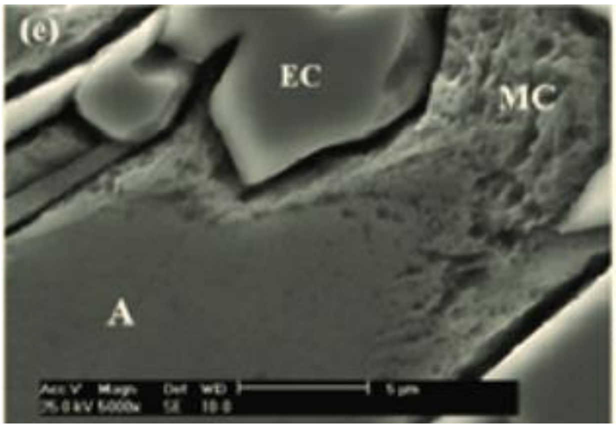
6 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x1000 magnification



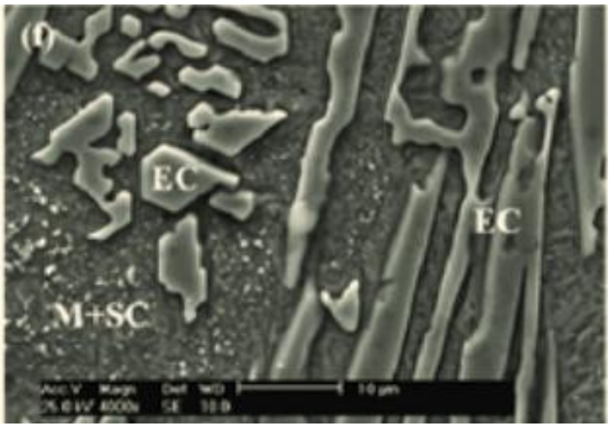
7 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x1500 magnification



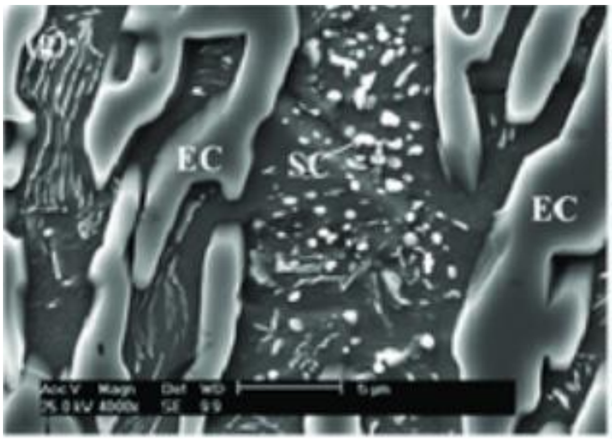
8 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x2000 magnification



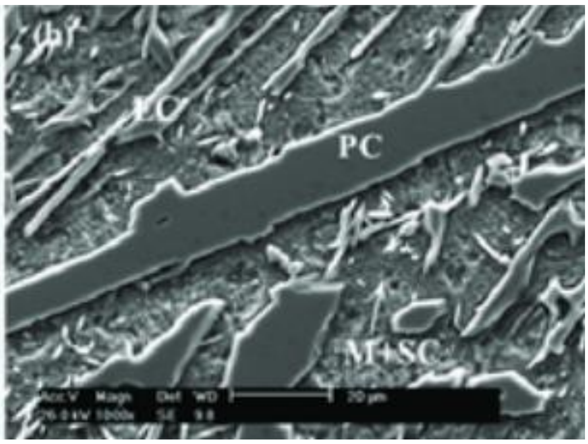
9 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x3000 magnification



10 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x4000 magnification



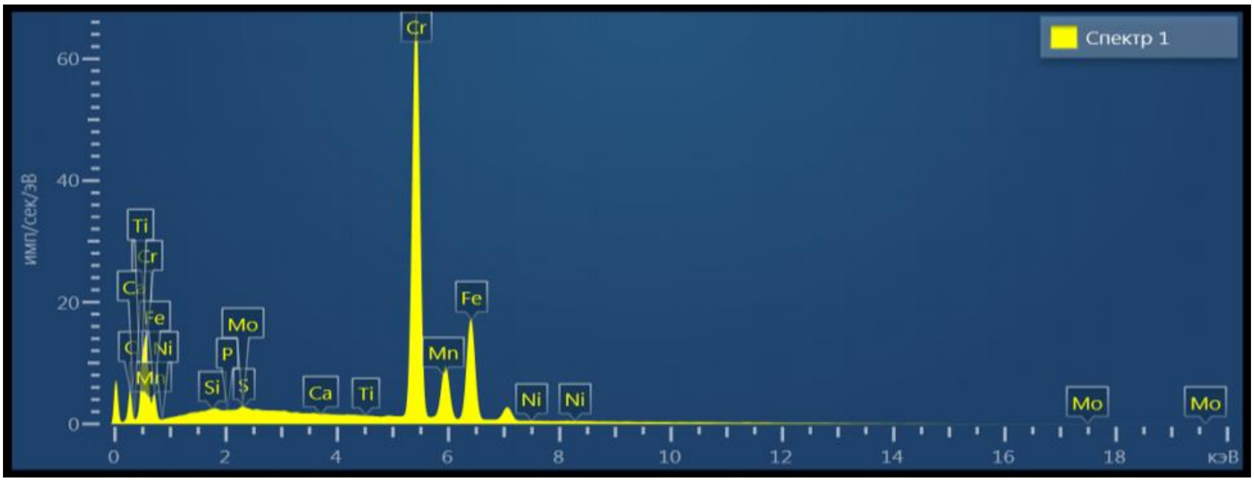
11 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x4500 magnification



12 – picture. SEM Image taken with a Zeiss EVO MA 10 scanning electron microscope at x5000 magnification

From the microstructures in pictures 5 – 12, it can be seen that the elements are evenly distributed in the microstructure of the alloy. The microstructure mainly includes austenite, eutectic carbide, martensite, secondary carbide, bainite and primary carbides.

Also, the chemical composition of the alloy was checked using a scanning electron microscope, and the obtained results are presented in Picture 13.



13 – picture. SEM Zeiss EVO MA 10 scanning electron microscope was used to determine the chemical composition of wear – resistant white cast iron

CONCLUSION

In summary, for the liquefaction of wear – resistant white cast iron, an economically inexpensive chemical composition was developed without reducing the mechanical properties of the alloy. Also, in order to improve the fluidity of the alloy, the optimal temperature of the alloy was selected depending on the amount of carbon and chromium.

In addition, in order to improve the quality of cast products obtained from wear – resistant white alloy, the composition of the solids was summarized, and the procedure for loading the solids into the furnace was developed.

As a result, it was possible to obtain high – quality cast products from wear – resistant white cast iron.

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