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Kompozitsion Materiallar

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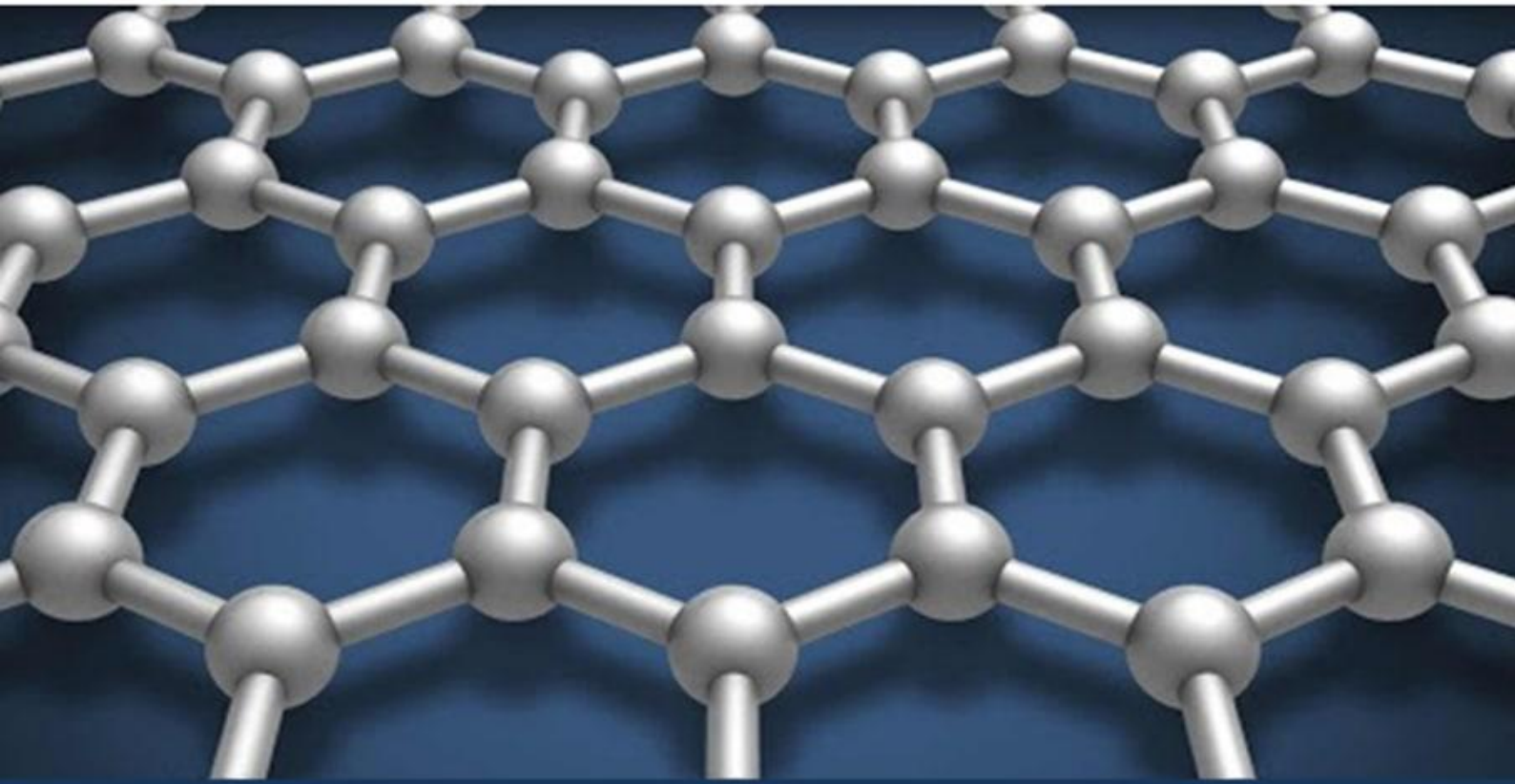

Узбекский научно-технический и производственный журнал

Композиционные материалы

Қотишмани суюқлантириш даврида электрод остига майдароқ бўлган кокс бўлагини киритиш орқали пўлат қотишмасини суюқлантириш жараёнини 15 – 20 % га тезлаштирилди.

АДАБИЁТЛАР:

1. Nosir S. et al. Study of the Effect of Copper Addition on Secondary Carbides with High Chromium Wear – Resistant White Cast Iron //International Journal of Innovative Analyses and Emerging Technology. – 2022. Т. 2. 37 – 43.
2. Valida B. et al. Development of Technology of Liquefaction of Steel Alloys in Electric Furnaces //Spanish Journal of Innovation and Integrity. – 2022. Т. 8. 65 – 69.

Калит сўзлар: нометалл, пўлат, мартен печи, электр печ

Ушбу мақолада 35ГС маркали кам легирланган конструкцион пўлат қотишмасини суюқлантириб олиш учун қотишмани оптимал кимёвий таркиби ишлаб чиқилди. Пўлат қотишмасини кимёвий таркиби ишлаб чиқилгандан сўнг лаборатория шароитида суюқлантириб олиш мақсадида 10 кгли электр ёй печи танлаб олинди. 35ГС маркали кам легирланган конструкцион пўлат қотишмани суюқлантиришда шихтани юклаш тартиби ишлаб чиқилиб, бу орқали шихтани куйиш миқдорини камайтиришга эришилди.

Ключевые слова: неметалл, сталь, мартеновская печь, электропечь

В данной статье разработан оптимальный химический состав сплава для плавления сплава конструкционной низколегированной стали марки 35ГС. После отработки химического состава стального сплава была выбрана электродуговая печь на 10 кг для плавления в лабораторных условиях. При плавлении сплава конструкционной низколегированная стали 35ГС разработана технология загрузки шихты, что позволило снизить количество розлива шихты.

Key words: non – metallic, steel, marten furnace, electric furnace

In this article, the optimal chemical composition of the alloy for liquefaction of low-alloy structural steel alloy 35GS was developed. After working out the chemical composition of the steel alloy, a 10 kg electric arc furnace was selected for liquefaction in laboratory conditions. A slag loading method was developed in liquefaction of 35GS low – alloy structural steel alloy, thereby reducing the amount of slag burn.

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DEVELOPMENT OF STEEL ALLOY LIQUIDATION TECHNOLOGY

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Introduction. Today, it is an alloy of iron with carbon (from 0.02 to 2.14 %) and other elements. Typical technical steel contains 0.05 – 1.5 % carbon, up to 0.4% silicon, 0.1 – 1 % manganese, up to 0.08 % sulfur, up to 0.1 % phosphorus and 96.92 – 99.27 % consists of iron. Industrially produced steels contain permanent inclusions: silicon (Si), manganese (Mn), sulfur (S) and phosphorus (P). The difference between steel and cast iron is that cast iron contains carbon from 2.14 to 6.67 % and has more permanent inclusions. When steel is hardened, its physical and mechanical properties change dramatically, its hardness and strength increase, and it becomes malleable. Depending on the amount of carbon and alloying elements in the chemical composition, Steel is divided into carbon and alloyed types. Carbon steel (in addition to carbon, it contains up to 0.7 % manganese, up to 0.37 % silicon, up to 0.04 % sulfur and up to 0.035 % phosphorus)[1].

Materials and methods. Shafts made of 35XGCL and 35XGCA steels are used for ball rolling machines in the “1st grade rolling” shop of “UzMetkombinat” JSC. This 35XGCL brand steel alloy is cast in the “Casting Mechanics” workshop of the combine.

Alloy steels are of great importance in reducing their mass, while improving the quality of machines and structures, ensuring long–term accurate operation. Alloying elements increase the fineness, viscosity, corrosion resistance and other mechanical properties of steel, as well as the malleability property, the depth of corrosion and other technological properties, change the physical (magnetic and electrical) properties, improve the corrosion resistance properties at high temperatures and under normal conditions [2–3] .

Today, in the "Casting–mechanics" workshop of "UzMetkombinat" JSC, shafts made of 35XGCL brand steel, which are cast for ball rolling machines, are cast into sand–clay molds.

Iron ore, low–manganese steel, secondary metal, ferroalloys, ferrosilicon (FeSi 65), ferromanganese (FeMn 95), calcium carbonate ($CaCO_3$) and others were prepared as raw materials for slag. A basic 2.0 ton electric arc furnace was initially selected to liquefy the alloy. After checking that the inner lining of the furnace was in good condition, first small and then large solid materials were loaded into the furnace. As soon as the alloy begins to liquefy, 3 percent of limestone ($CaCO_3$) and sand (SiO_2) are introduced into the furnace as a flux based on the weight of the alloy. According to the established standards, the temperature of the chemical composition was liquefied at 1560 ^{0}C. After that, ferroalloys with high melting point were put into the furnace at 1565 ^{0}C. Iron oxide (FeO) was added through the window to reduce the carbon content of the alloy. As a result, the carbon content of the alloy decreased. After the alloy was completely liquefied, samples were taken from three places by mixing the liquid alloy, and the chemical composition of the alloy was checked on the "SPECTROLAB–10 L" equipment. When the liquid alloy reached a temperature of 1560–1570 ^{0}C, it was poured into a special ladle preheated to a temperature of 800–850 ^{0}C [4–6].

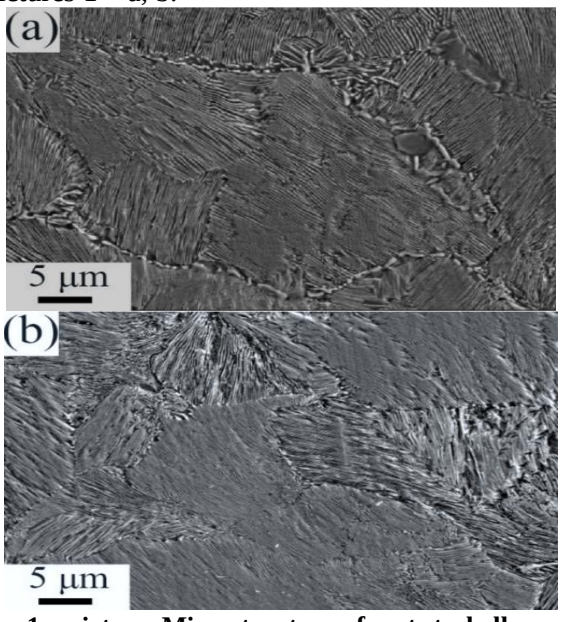
Result. Production of high–quality cast products from 35XGCL steel alloys and reduction of gas pores and mirror inclusions in its content, liquefaction mode of alloys and their processing technology were developed, and high–quality cast products were cast. After removing the alloy from the casting mold, a special sample was prepared, and the chemical composition of the alloy was determined using the "SPEKTROLAB–10M" device (Table 1).

Table 1

Chemical composition of 35XGCL steel obtained based on the results of the research

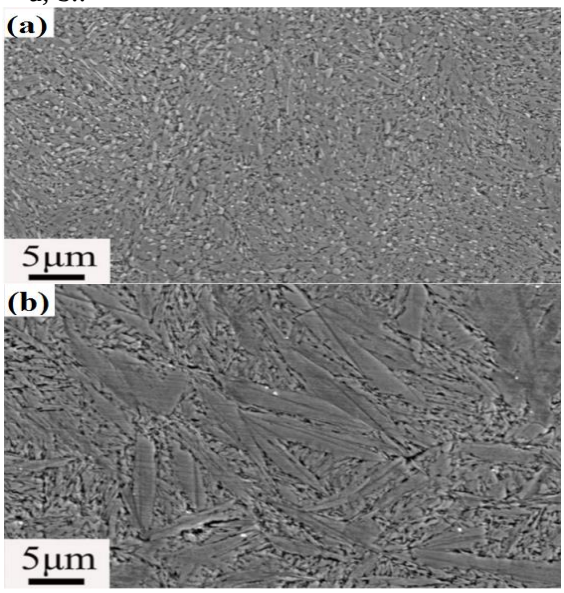
Brand		Elementlar, %								
	C	Si	Mn	Ni	P	S	Cr	Al	Cu	Ti
35XGCL	0.21	0.71	0.70	0.10	0.021	0.026	0.79	0.35	0.16	0.039

Samples were metallographically examined at the "Innovation Development Center" using a SEM Zeiss EVO MA 10 scanning electron microscope at a magnification of x500 to 1000 times, and the obtained results are shown in pictures 1 – a, b.



1 – picture. Microstructure of cast steel alloy

Layered pearlite can be observed when viewed using a scanning electron microscope at x500 to x1000 scanning microstructures in pictures 2 – a, b..



2 – picture. The microstructure of the alloy after it was fired in oil

In picture 2 – a, b, the alloy was heated to a temperature of 860 – 880 ^{0}C for 4 hours and kept at this temperature for 1 hour. Then it was fired at 250 – 300 ^{0}C for 2 hours and cooled in the open air. Pearlite and more austenite can be seen in heat treated microstructures.

Conslusion. Based on the implementation of liquefaction regimes of 35XGCL alloy at different temperatures in electric arc furnaces, the technology of obtaining cast products with surface cleanliness and high mechanical properties has been improved, and the technology of liquefaction of the alloy in an optimal way and pouring into casting molds has been developed. The alloy was treated with inert gases outside the furnace. Processing mode and casting technology were developed based on the dynamics of gas and mirror inclusions in the obtained alloy.

Based on the results of the research, the following conclusions were reached, which were taken as the main reasons for the flux, furnace lining, quality of refractory materials, the preheating process of the slag, and other similar factors. Based on the stated reasons, the quality of the furnace lining and lining material were considered to be the most important factors that led to a decrease in the quality of the final casting.

The approach used in this work made it possible to achieve a complex and reliable result. In addition, as a remedial process, the furnace lining, furnace top, and furnace lining were replaced with high – quality refractory material. The results of the re – survey were discussed and the rate of substandard castings was reduced as only 1 in 10 shafts were found to be substandard in the current study. In addition, it has been proven that by controlling the percentage of additives at each stage, the level of poor quality bulk product can also be reduced.

Also, in order to smooth the structure of the cast part and improve its mechanical properties, a thermal treatment regime was developed.

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Kalit so‘zlar: xrom, marganes, qotishma, val, qum – gil qolip, qattiqlik, yopishqoqlik, gaz g'ovaklari, metall bo‘lmagan qo‘shimchalar, flyuslar.

Ushbu maqolada 35XGCL markali po‘lat qotishmasini suyuqlantirish rejimidan foydalanildi. Olingan suyuq metallga pechdan tashqari ishlov berish orqali tarkibidagi metall bo‘lmagan qo‘shimchalar hamda gazli g’ovaklardan tozalash, bundan tashqari energiya va resurstejamkor innovatsion texnologiyalar asosida quyish texnologiyasi ishlab chiqildi.

Ключевые слова: хром, марганец, сплав, вал, песчано – глинистая форма, твердость, вязкость, газовые поры, неметаллические включения, флюсы.

В данной статье использован режим ожижения сплава стали марки 35ХГСЛ. Полученный жидкий металл очищается от неметаллических включений и газовых пор путем внепечной обработки, а технология литья разработана на основе энерго- и ресурсосберегающих инновационных технологий.

Key words: chrome, manganese, alloyed, shaft, sand–clay mold, hardness, viscosity, gas pores, nonmetallic inclusions, fluxes.

This article used the mode of liquefaction of 35XGCL brand steel alloy. The obtained liquid metal is cleaned from non-metallic inclusions and gas pores by non-furnace processing, and casting technology was developed on the basis of energy and resource efficient innovative technologies.

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