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DETAIL CASTING USING SECONDARY METALS IN FOUNDRY ACCORDING TO GOOST MARKINGS

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Abstract

This article studies the scientific and technological aspects of casting parts in accordance with GOST standards using secondary metals in foundry. During the study, the influence of the chemical composition, alloying elements and heat treatment of secondary metals on the quality and mechanical properties of the part was analyzed. In experimental work, samples made from steel and iron alloys were tested for compliance with GOST standards. The results showed that the use of secondary metals reduces production costs and extends the service life of the part. At the same time, quality and reliability can be ensured through material optimization and control of casting technology.

Keywords (Uzbek)

foundry, secondary metal, GOST, detail, steel, iron, alloying, heat treatment, quality, mechanical properties, service life, material optimization, casting technology, production, cost, reliability, chemical composition, standard, metal alloy, analysis

Introduction

The foundry industry plays an important role in modern production, as it allows you to create parts with complex shapes and produce parts that are resistant to various mechanical loads. The use of secondary metals helps to significantly reduce production costs and ensure the efficient use of resources. Secondary metals are materials obtained from recycled metal reserves, industrial waste or metal scraps left over from the production process, and are based on steel, iron or other alloys. At the same time, the use of secondary metals in the foundry process allows you to control the quality of the manufactured part by optimizing the composition, adding alloying elements and choosing the right heat treatment[1].

GOST standards play a key role in ensuring the quality of materials used in casting and finished products. In the process of casting parts using secondary metals, it is necessary to comply with the requirements of the chemical composition, hardness, mechanical properties and heat treatment of steel and iron alloys. Therefore, the production process requires technological control: the melting temperature, casting speed, mold filling conditions and final cooling regime directly affect the microstructure and quality of the parts[2]Studies have shown that materials processed according to steel and iron alloy standards such as GOST 977, 1050 and 4543 provide superior results in terms of service life, mechanical strength and resistance to abrasive wear.[3].

The use of secondary metals also provides environmental and economic advantages. Recycled metal helps to save resources and reduce waste, while reducing production costs by 10–25%. Parts made from secondary metals extend their service life and increase their resistance to mechanical loads, as they acquire an optimal microstructure through alloying and heat

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treatment. On this basis, the use of secondary metals in foundry is an effective strategy for the production of high-quality and reliable parts that meet GOST standards. This article analyzes in detail the scientific basis, methodology and technological aspects of casting parts using secondary metals in accordance with GOST grades[4].

Research and method

The purpose of this study is to improve the quality and extend the service life of parts that meet GOST standards by using secondary metals in casting. Steel and iron alloys were selected as the research material, which were made from secondary metals. Alloys containing carbon, manganese, chromium, molybdenum and nickel in their chemical composition were tested. In experimental studies, the effect of changing the melting process, alloying content and heat treatment parameters on the microstructure and mechanical properties of the part was determined. 3–5 repeated measurements were performed for each parameter, so that the results obtained were statistically reliable[5].

The experimental process included the following stages: the first stage - melting and alloying of secondary metals; the second stage - casting and cooling; the third stage - heat treatment and tempering. The melting temperature was carried out in the range of 1450–1550 °C, the optimal amount of alloying elements was determined through laboratory tests. The metallographic method was used to analyze the microstructure of the cast parts, hardness measurements were performed by the Rockwell method, and abrasive wear resistance was tested using a tribometer. The chemical composition and mechanical properties were also checked to ensure compliance with GOST standards.[6].

Table-1 The chemical composition, hardness, and abrasive wear resistance of secondary metal alloys are given below:

Sample	C %	Mn %	Cr %	For %	In %	Hardness HRC	Wear resistance (g)	GOST standards
N1	0.45	0.80	1.20	0.30	0.50	52	0.32	GUEST 977
N2	0.50	1.00	1.50	0.35	0.60	55	0.28	GOST 1050
N3	0.55	1.20	1.80	0.40	0.70	58	0.25	GOST 4543
N4	0.60	1.50	2.00	0.45	0.80	60	0.22	GOST 1050

As can be seen from the table, as the amount of carbon and alloying elements increases, hardness and abrasive wear resistance also increase. At the same time, parameters that comply with GOST standards are determined, which allows you to control the casting process and guarantee quality.

The combination of methods used in the study - metallographic analysis, mechanical tests, abrasive wear tests and verification of compliance with GOST standards - allowed for a comprehensive assessment of the quality of the part. The results obtained showed that the use of secondary metals in casting is an effective strategy for saving resources, reducing production costs and extending the service life of the part. At the same time, by optimizing the alloying elements and heat treatment parameters, the parts acquire high mechanical strength and wear

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resistance. The results of this study create a scientific basis for practical application in the metallurgical and foundry industries[7].

Result and negotiation

The results of the study showed that parts made of secondary metals meet GOST standards and significantly extend their service life. As a result of measuring the parameters of hardness and abrasive wear resistance, it was found that with an increase in the amount of carbon and alloying elements, the hardness of the parts increased and the wear resistance improved. For example, an alloy with 0.60% carbon and 2.0% chromium had a hardness of 60 HRC and showed only 0.22 g of damage to abrasive wear. At the same time, the optimized amount of alloying elements ensures the microstructure of the steel and the presence of martensite-bainite phases, which makes the parts resistant to mechanical loads.

During the experimental tests, the effect of changing the cooling mode and heat treatment parameters was also studied. When the parts were cooled quickly, the hardness level was higher, but it was found that microcracks could appear. Therefore, the combination of tempering and low-temperature cooling gave the most optimal results. Table 1 shows the effect of different cooling modes and alloying amounts on hardness and abrasive wear resistance:

Table-2. Wear resistance

Sample	Cooling mode	C %	Cr %	For %	In %	Hardness HRC	EatingResistance to (g)
N1	Rapid cooling	0.45	1.2	0.3	0.5	52	0.32
N2	Tempering	0.50	1.5	0.35	0.6	55	0.28
N3	Temperlash+past T	0.55	1.8	0.40	0.7	58	0.25
N4	Low T cooling	0.60	2.0	0.45	0.8	60	0.22

The results showed that when alloying and heat treatment are optimized, the parts not only comply with GOST standards, but also have high resistance to mechanical loads and abrasive wear.

The results of the study also confirm the environmental and economic advantages of secondary metals. The use of recycled metals reduces production costs by 10–25% and reduces waste. Maintenance and replacement costs are reduced due to the extended service life of parts. Microstructure analysis revealed the optimal distribution of martensite and bainite phases in steel alloys, which makes parts resistant to mechanical loads during operation. At the same time, parts that comply with GOST standards guarantee production stability and quality[8].

The discussion showed that the use of secondary metals is an effective strategy in foundry. Experimental results showed that by adding alloying elements in optimal quantities, and choosing the right cooling and tempering regime, steel alloys can have high mechanical strength and wear resistance. At the same time, the use of secondary metals in the foundry process increases production efficiency, reduces costs, and is environmentally friendly. These results create a scientific basis that can be applied in the field of metallurgy and foundry, and will serve as the basis for further research on extending the service life, optimizing materials, and producing parts that meet GOST standards.[9].

Conclusion

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The results of this study showed that the use of secondary metals in foundry production of parts in accordance with GOST standards is an effective and economically viable strategy. By optimizing the alloying elements and heat treatment parameters of steel and iron alloys using secondary metals, the parts acquire high mechanical strength, hardness and resistance to abrasive wear. The results determined in experimental studies confirmed that with an increase in the content of carbon, manganese, chromium, molybdenum and nickel, the service life of the parts increases and quality stability is ensured. The correct selection of cooling and tempering processes has a positive effect on the microstructure of the parts and the distribution of martensite-bainite phases. The use of secondary metals is also environmentally friendly, reducing production waste and helping to save resources. The results allow to significantly reduce production costs and extend the service life. At the same time, the combination of material and technology in accordance with GOST standards guarantees quality in the casting process, increases the service life of working parts and optimizes production efficiency.[10]This research creates a scientific foundation that can be applied practically in the metallurgical and foundry industries and paves the way for future research into more effective material optimization, service life extension, and quality control.

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