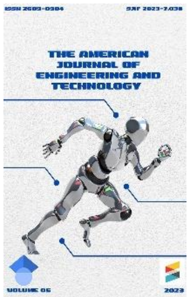
The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE12 Pages: 15-20
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Crossref doi Google Scholar WorldCat MENDELEY
Publisher: The USA Journals



Journal Website: https://theamericanjournals.com/index.php/tajet

Research Article

TECHNOLOGY OF OBTAINING THE WORKING WHEEL DETAIL WITHOUT IMPACT LOADS BY CASTING

Submission Date: December 08, 2023, Accepted Date: December 13, 2023,
Published Date: December 18, 2023
Crossrefdoi: https://doi.org/10.37547/tajet/Volume05Issue12-04

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ABSTRACT

This article provides information and descriptions of the new alloy fluidization technology for casting wheel parts without shock loads and the processes involved in casting the alloy into the mold.

KEYWORDS

Steel wheel, carbon steel, electric arc furnace, gas voids, microstructures, manganese, GENT WP-300.

INTRODUCTION

Casting of low-cost industrial products on the basis of increasing the strength of the machine-building parts obtained by the casting method, improving their mechanical and operational properties is becoming important. At the same time, one of the important issues of the foundry sector is the production of high-quality cast products using the internal capabilities of local production facilities, while reducing the import of machine-building parts due to localization.

In particular, it is possible to improve the internal transformation capabilities of metallurgical and machine-building plants by obtaining cast steel wheels that work without impact loads. In this case, steel wheels that work without impact loads and move on rails are the main detail that requires high quality when transporting large loads.

Typically, wheel parts are made of corrosion-resistant, high-carbon steels (C above 0.6%). Wheel parts working without shock loads are made of 65G steel (C 0.62-0.7%, Mn 0.9-1.2%) and its foreign analogues [1].

Research methods

The liquefaction process was carried out in a grounded electric arc furnace at the highest level of the secondary voltage of the transformer. The voltage of the secondary winding did not exceed 170 V, the current strength of the low voltage side did not exceed 1685 A, and the high voltage side did not exceed 60.5 A. Limestone was added in 1-2 parts up to 10-30 kg to form a thick slag. After 50-80% of the slag was melted in the furnace, 10-15 kg of limestone was added to cover the liquid metal with slag. After melting the alloy, the bath was mixed with a special spoon, a sample was taken and sent to the express laboratory through special tubes to determine the mass fraction of carbon and the chemical composition of the alloy. The chemical composition of samples 1-2-3 obtained from the mixture is shown in Table 1 [2].

Table 1

65G alloy	Chemical composition %:								
	C	Si	Mn	S	P	Cr	Ni	Cu	Al
Sample 1	0.58	0.20	0.95	0.03	0.030	0.20	0.22	0.2	0.1
Sample 2	0.60	0.25	1.10	0.035	0.035	0.25	0.25	0.2	0.3
Sample 3	0.65	0.30	1.20	0.035	0.035	0.25	0.25	0.2	0.3

Table 1: Determined chemical composition of samples 1-2-3 obtained during liquefaction of high-carbon low-alloy steel 65G alloy

The percentages of chemical components were controlled until the composition of the mixture was in accordance with SSO 14959-89. According to the composition, 10-15 kg of coke was added during the liquefaction period to increase the carbon content [3].

After the alloy is ready, it is removed from the furnace heated at 750-850°C and the temperature of 1580°C is removed from the furnace and poured into the mold prepared based on the relevant drawings for the wheel detail. (the prepared mold for the wheel detail is shown in Figure 1).

Figure 1

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Figure 1: Upper (a) and lower (b) parts of a sand-clay mold prepared for casting a wheel detail.

When pouring into the mold cavity, the liquid metal was poured through the casting system and then through the sprue until the cavity was filled.

The advantage of die casting is that it avoids the intrusion that can be encountered in casting.

The obtained samples were subjected to mechanical tests on several modern stands, at the same time, microstructures of the samples and distribution of components along the volume and nominal amounts were checked in graph form on the "SPECTORLAB M12" device (Figure 2 (a,b,c) [4].

Figure 2

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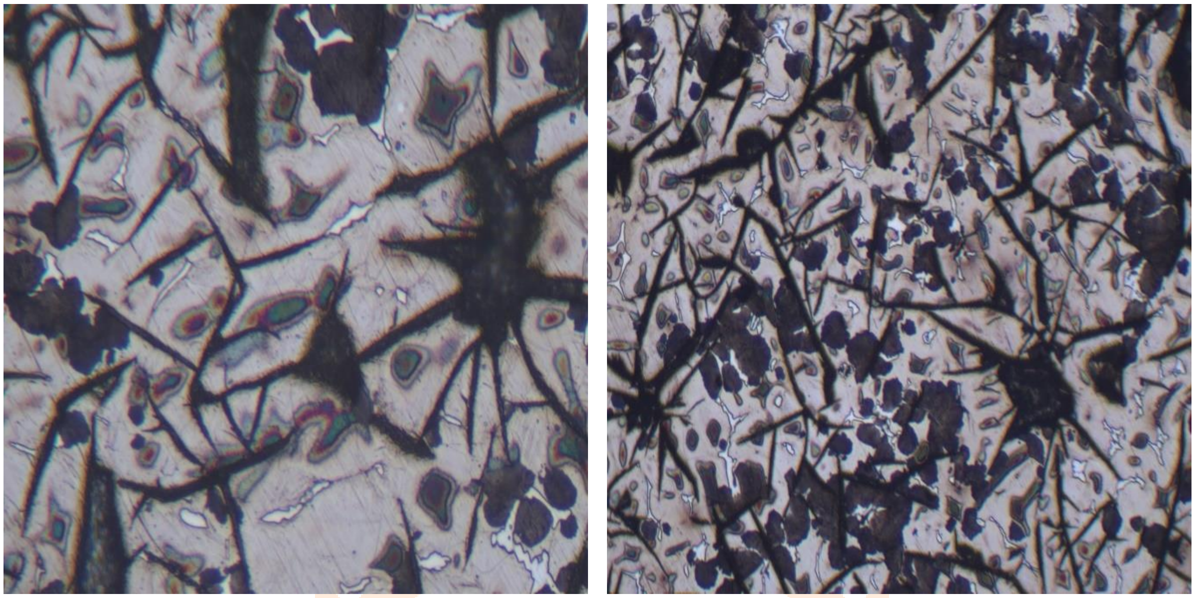

Figure 2: a) Microstructure analysis of a wheel detail sample without impact loads

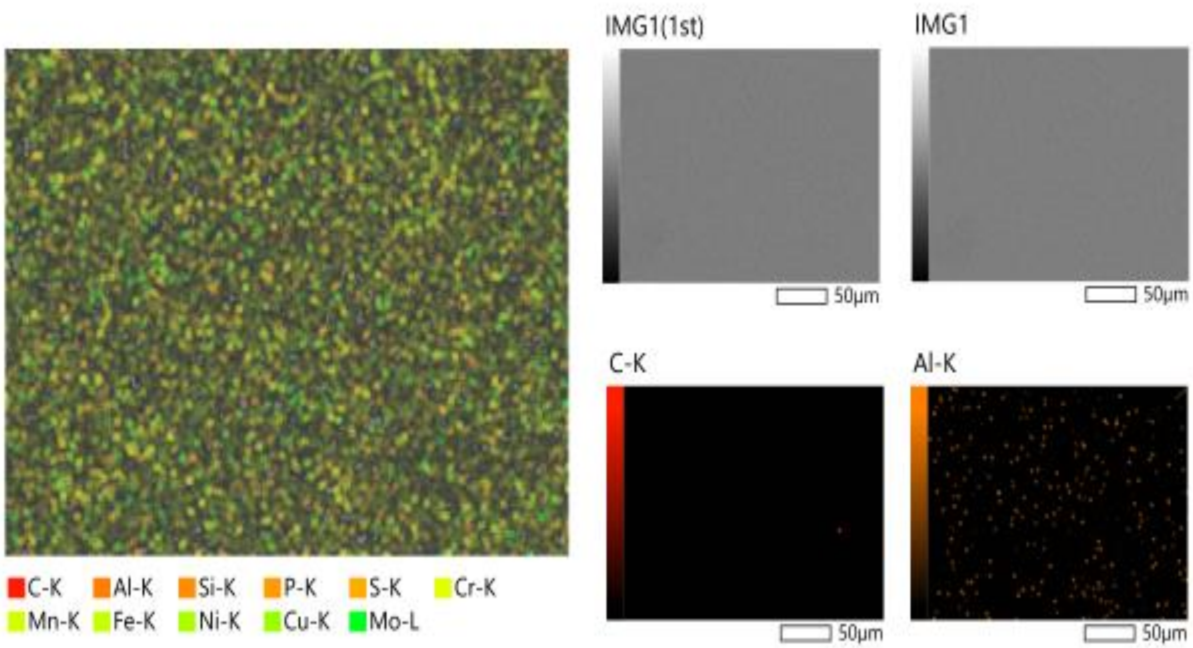

Figure 2: b) Dispersion of the components in the alloy along the volume

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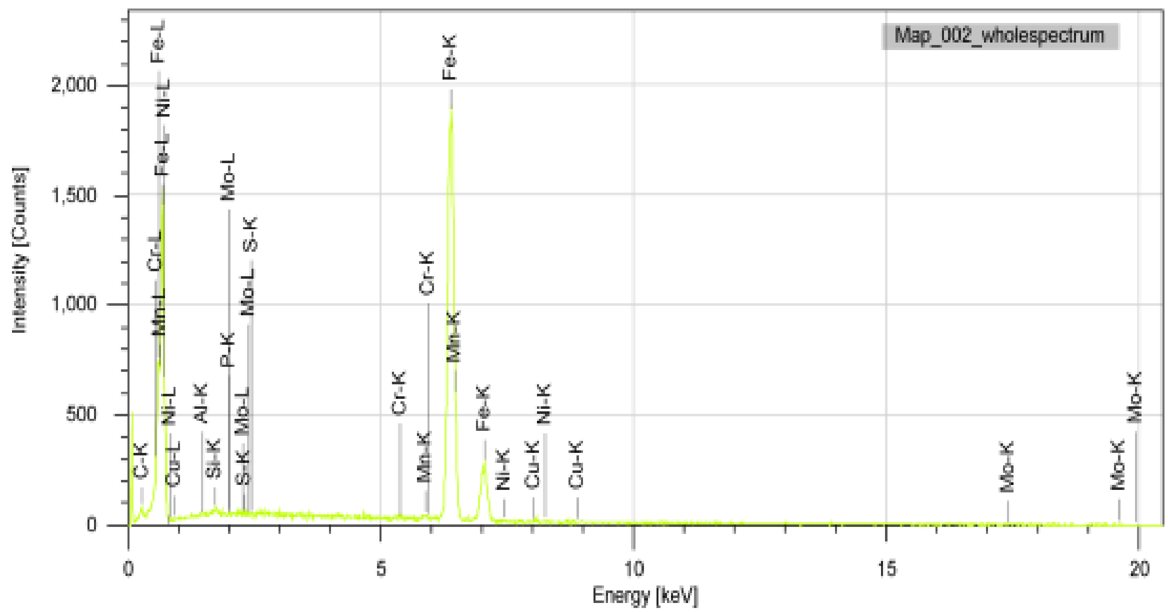

Figure 2: c) Nominal quantitative indicators of the components of the mixture

In the process of liquefaction, as a scientific innovation, the chemical composition was slightly changed. In particular, the shares of nickel (Ni) and aluminum (Al) in the concentrate were re-adjusted. In the processes of liquefaction and casting, the proportion of aluminum in the concentrate was divided into three parts and added outside the furnace. 40% of the aluminum content was added during annealing, 30% after annealing, and 30% when the alloy was inserted into the mold cavity [5]. In this case, the burning of aluminum was prevented, and the fluidity of the alloy was improved, and the cavity of the mold was well filled [4]. When testing the samples, while the alloy was still in the furnace, the sample was sent to the express laboratory through the transfer pipes. A modern "SPECTROLAB - M11" device was used for microstructure testing of the samples. Inspections were carried out at temperature t-20°C and humidity W-54%.

CONCLUSION

Hardness testing of alloy samples used for steel wheels working without shock loads was carried out on modern GUNT WP-300 equipment at room temperature t-27 °C and humidity W-54%. In this case, the samples were cut with a diameter of 30 mm and a height of 20 mm. As a result of the test, it was determined that the hardness of the samples was 240 MPa, 241 MPa, and 242 MPa, respectively. This is a mechanical property sufficient for the production of steel wheels without shock loads from this alloy.

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