WEAR RESISTANCE OF HIGH CHROMIUM CAST IRONS

[a]Abdullaev F.K., [a,b]Turakhodjaev N.D., [a]Yuldoshev O.Ch.
[a]Tashkent State Technical University, Uzbekistan
[b] Uzbek-Japan Innovation Center of Youth, Uzbekistan

White cast irons have long been used to provide wear resistance. The main requirement is good wear resistance with moderate resistance to brittle fracture. With the exception of low-alloy pearlitic cast iron, there are two main groups described as nickel-chromium and high-chromium cast iron.

White cast irons with a high chromium content can be welded onto a softer or stronger substrate or used as castings. Castings can be used either in finished form or subjected to heat treatment before use. The high chromium content of these alloys also provides a degree of corrosion resistance which, combined with their resistance to abrasion and erosive wear, makes them suitable for use in many industrial applications.

The main problem in the production of white cast iron alloys is to ensure proper impact strength, as well as high resistance to abrasive wear, characteristic of white cast iron.

Scientists from the Saarland University in Germany, Pranav Nayak, Valentin Pesnel, Frank Mücklich conducted scientific research on the microstructure and wear of high-chromium cast iron.

In the study, a high chromium cast iron alloy containing 26% Cr was subjected to a dry sliding linear wear test under various loads.

Loading during wear testing was examined in terms of the microstructural behavior of the matrix and its ability to support surrounding carbides. Morphological aspects of wear marks and deformed matrix microstructure adjacent to and underneath the track were analyzed using a confocal laser scanning microscope and a scanning electron microscope (SEM), respectively.

The calculated values were in good agreement with microstructural and morphological observations. Moreover, a clear shift in the dominant wear mechanism was identified from the behavior of the austenite matrix and carbide during wear. Therefore, this technique can be further extended to other alloys with high chromium content. Cast iron (HCCI) family to establish load limits and better understand the interactions between the various system components.

Scientists from the Slovak University of Technology in Bratislava, Pokusova Marcela, Berta Igor, Šoos Lyubomiri conducted a series of tests on cast irons containing (wt.%) 18–22 Cr and 2–5 C, as well as alloyed with 1.7 Mo + 5 Ni + 2 Mn for improve toughness.

High-chromium cast iron was prepared by melting a charge based on two moderately different raw materials in an induction furnace. For the first type of charge (A) cast iron with low Si content, ferroalloys were used, such as low-carbon and high-carbon FeCr, FeMo, FeMn, FeTi and FeV.

In the second charge (B), cast iron was replaced with steel scrap and the liquid metal was carburized using calcined petroleum coke and high-carbon FeCr. The Si content should be as low as possible. Silicon is a limited element because it increases the activity of carbon and promotes the formation of graphite and retards the formation of carbides. In addition, silicon reduces hardenability and promotes the formation of pearlite, which negatively affects wear resistance. Molten iron was cast at a pouring temperature of 1450°C into synthetic resin sand.

Table 1

Chemical composition of tested high-chromium cast irons

Charge	Chemical composition (wt.%)								
	C	Si	Cr	Mn	Mo	Ni	Cu	Ti	V
A	3.83	0.21	21.28	1.05	1.47	5.89	0.10	0.07	0.10
B	4.28	0.20	21.45	1.04	1.46	5.52	0.05	0.03	0.10

Tests showed that cast irons with a largely austenitic matrix achieved a hardness of 36-53 HRC, but their relative abrasion resistance was higher than STN 19436 tool steels heat treated to a hardness of 60 HRC.

Today, high-chromium cast irons are considered a promising category of metal materials. The main eutectic system Fe – C – Cr gives cast iron good casting properties and a liquid temperature of about 1200°C, which entails low energy costs for the preparation of liquid metal.

The cast irons described illustrate the beneficial properties carbide cast iron with a metastable austenitic matrix can achieve. The particularly high strength of austenite allows a significant increase in carbon content, up to the hypereutectic region, where a large volume of carbides provides high resistance to abrasion and at the same time iron has sufficient toughness and high fracture resistance.

References

1. The University of Queensland, Hamid Pourasiabi Lighvan, “Development and performance evaluation of abrasion-resistant white cast irons containing macro-additions of niobium carbide” 2020.
2. U. Pranav Nayak, Sebastian Suárez, Valentin Pesnel, Frank Mücklich & María Agustina Guitar. “Load dependent microstructural evolution in an as-cast 26% Cr high chromium cast iron during unlubricated sliding”. Research Article, Open access, Published: 07 December 2021 Volume 10, pages 1258–1275, (2022).
3. Pokusová Marcela, Berta Igor, Šooš Ľubomír. “Abrasion resistance of as-cast high-chromium cast iron”. Scientific proceedings 2014, Faculty of Mechanical Engineering, SUT in Bratislava Vol. 22, 2014, pp.74-79.
4. Nozimjon Kholmirzaev, Bakhtiyor Kasimov, Bahodirjon Abdullayev, Asatov Sunnatillo, & Abdullaev Farrux. (2021). INCREASING THE LIFETIME OF TILLAGE MACHINE OF PLOWSHARES MADE STELL

MADE BY FOUNDRY TECHNOLOGIES. *JournalNX - A Multidisciplinary Peer Reviewed Journal*, *7*(11), 55–59. https://doi.org/10.17605/OSF.IO/QB5TF

5. Turakhodjaev, N., Kholmirzaev, N., Saidkhodjaeva, S., & Kasimov, B. (2021). Quality improvement of the steel melting technology in an electric arc furnace. ACADEMICIA: An International Multidisciplinary Research Journal, 11(7), 48-54.
6. Nosir, S., Nodir, T., Kamol, A., Nozimjon, K., & Nuritdin, T. (2022). Development of quality steel alloy liquidation technology. American Journal of Interdisciplinary Research and Development, 7, 74-83.
7. Kholmirzaev, N., Turakhodjaev, N., & Sadikova, N. (2023). Improvement of the Melting Technology of 35ХГСЛ Brand Steel Alloy in An Electric ARC Furnace. Role of Exact and Natural Sciences During the Renaissance III, 60-64.
8. Turakhodjaev, N. (2022). Technology for cleaning non-metallic inclusions and gaseous pores in the process of liquefaction of steels in an electric arc furnace. European Multidisciplinary Journal of Modern Science, 4, 77-82.
9. Kholmirzaev, N., Abdullaev, F., Turakhodjaev, N., Akramov, M., & Makhamatmuratov, U. (2022). Development of Technology of Mading Shafts from 35XGCL Brand Steel Alloy.