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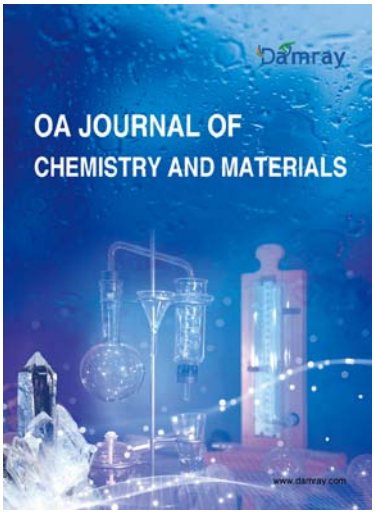
Research and Development Status of Wear-Resistant Materials and Technologies at Home and Abroad



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Abstract

By discussing the research and development status of wear-resistant materials and technologies at home and abroad, this article can clearly and intuitively understand that wear-resistant materials at home and abroad are specifically used in industrial fields, including thermal power generation, metallurgical mines, building materials, etc. In industrial use, some raw materials such as cement and coal slag will wear some parts or equipment of the machine to a certain degree during the use of the machine. In order to cope with this situation, the development of wear-resistant material technology is very It is necessary to effectively prevent this situation from occurring, increase the service life of the machine, and make the machine more durable and lasting. However, at present, the development of wear-resistant material technology is still at the basic stage, and it is still a long-term and arduous task to select a certain casting process to complete the reliability and engineering of the machine. Based on this, this paper focuses on making certain thinking and exploration from the research and development status of wear-resistant materials and technologies at home and abroad.

Keywords

Home and abroad, Wear-resistant materials, Technical research, Development status

1. Types of wear-resistant materials

Wear-resistant materials are mainly used for rolling mill bushings, separators, plates, balls, profiles, breakers, plate hammers, impact hammers, plates, vertical grinding rolls, plates, etc. From the material can be divided into the following three categories.

1.1 High manganese steel series

Back in the 1980s, this material has dominated wear-resistant materials for over 100 years. Advantages: good toughness, work hardening under strong impact conditions; Disadvantages: easy to plastic deformation, not wear-resistant. It

has been withdrawn from consumables (grinding linings) used in non-high-impact conditions, but it still has an irreplaceable advantage in consumables used in high-impact loads. Using ordinary high-manganese steel and alloyed high-manganese steel, adding various alloying elements to improve the yield strength, hammering strength and hammering strength of the large crusher.

The inner and outer cones of impact, plate, jaw and cone crushers dominate. Ultra-high manganese steel is limited to hammer head steel and large breaking hammer steel. Medium manganese steel also has certain application effects.

1.2 Alloy steel series

Domestic various alloy steels, such as carbon alloy steel in low carbon alloy steel, low carbon alloy steel, low carbon alloy steel, low carbon high alloy steel, etc., due to extensive changes in chemical composition and heat treatment process, the mechanical properties of the final products change greatly. Hardness hrC40-60, impact toughness 0 [K10-100J/cm2], the main wear mechanism can be analyzed according to the service conditions of consuming parts. Optimizing chemical composition and comprehensive mechanical properties of alloy steel to achieve the most economical and reasonable purpose. The advantages of medium carbon steel low alloy steel are: less alloy, low production cost, high hardness of water quenching or oil quenching, long wear life of vulnerable parts.

The advantages of the medium carbon alloy steel are that the medium alloy content strengthens the matrix structure by solution, and has dispersed carbides. The heat treatment process is simple and stable, and the comprehensive mechanical properties are good. Compared with medium carbon low alloy steel, the wear resistance is significantly improved even though the hardness is the same, but the production cost is high.

The advantages of low carbon high alloy steel are: low carbon, high alloy chemical composition combined with appropriate heat treatment process, can obtain high toughness and high hardness, absolutely suitable for large impact load, complex structure wearing parts. Its advantage is that it can be used as separator between drying chamber and ball cage, iron ore wet grinding bushing in dry mill, plate and so on. The disadvantage is high production cost.

1.3 Wear-resistant white cast iron series

The products include high chromium cast iron, medium chromium cast iron, low chromium cast iron, nickel hard cast iron and high chromium cast steel. Overall advantages: high hardness, good wear resistance. Disadvantages: Lack of toughness. High chromium cast iron (Crl 4.30%) has the best wear resistance and the widest application. Such as small and medium mill bushing, ball bearings and joints, small crushing hammer and hammer, vertical grinding roller and disc. After large rolling mill adopts roller press, high chromium cast iron can be used to stretch to avoid short plate and give full play to its excellent wear resistance. Casing life can be more than 8 years.

Low chromium cast iron (Crl. 5.3%) has much lower hardness and toughness than high chromium cast iron. Mainly used for ball, sheet and fine grinding lining. It has the advantages of low production cost, short application range and good comprehensive performance. And wear resistance index is general.

Nickel hard cast iron (Crl. 5.11%, Ni 3.3.7%) is mainly used for vertical grinding rolls and discs. As its hardness and toughness are not as good as high chromium cast iron, production costs are high, and wear-resistant materials are gradually withdrawn from the market.

Medium chromium cast iron (Cr8.14 %) is only used for casting balls. Reduce chromium content, reduce production costs, achieve ball loss index. It is still marketed as a high chrome ball.

High chromium cast steel (crL-13%, C). At present, it cannot be judged to belong to the category of cast steel or cast iron. It is widely used, mainly used for rolling mill lining, end lining, slab, and even warehouse. Other materials such as medium manganese nodular cast iron, wear and heat resistant steels, are not described here.

2. Other anti-wear technologies

For metal wear-resistant materials, hardness and toughness are contradictory. In order to improve wear resistance, it is impossible to increase the hardness without limit. Therefore, the researchers took measures such as composite materials, structural changes, and crystallographic changes. Maintain the toughness of metal wear-resistant materials under the premise of constant hardness, or increase the hardness under the premise of constant toughness to further improve wear resistance.

2.1 Composite materials

The casting method is to form materials with different properties as a whole, and combine the high toughness of the soft substrate with the high hardness of the wear-resistant layer material to give full play to their respective advantages.

2.1.1 Two-liquid bimetallic composites

Casting is achieved by continuously casting two liquid metals. A typical dual-liquid bimetallic composite material is: cast steel base + high-chromium cast iron wear-resistant layer. A typical product is a crusher compound hammer. Bimetal is a metallurgical combination that not only solves the problem of high impact and easy breakage, but also ensures the longevity of the hammer. Mago musclex launched the first bi-metal hammer head, the head is high chromium cast iron + treated low alloy steel (Head: 3.4% C, 16% Cr, HRC Blue 6l: Handle: 0.2% C, 1.9% Cr) Currently, there are many successful manufacturing and investment projects in China. It works well. Casting and forming methods have been widely used, namely cast steel hammer shank castings. After surface treatment, cast high chromium cast iron head. Due to the mechanical bonding of the bimetal, cracks are inevitably generated during use, and the reliability is not high. So it's basically eliminated and only works with hammers.

2.1.2 Insert cast alloy composite material

Wear-resistant materials are soft base materials used in casting and the casting process. There are two typical cast alloy composites: cemented carbide cast in high manganese steel or cast steel matrix, and high chromium cast iron blocks cast in cast steel matrix. The typical product is single - stage hammer large gold teeth. The tungsten titanium alloy with HRC 70 improves the wear resistance of the hammer.

2.1.3 cast-permeable alloy composite material

During the filtration process, the ceramic particles are evenly distributed on the working surface of the worn component. A typical product is Magotteaux X-WIN metal-base ceramic composite roller: ceramic particles are evenly distributed in a honeycomb structure of high chromium cast iron. Because the hardness of ceramic Hv2100 is much higher than that of other materials (quartz Hv~1800, Nihard IV and high chromium cast iron Hv[900, clinker Hv~550), its service life is more than twice that of Nihard IV and high chromium cast iron.

2. Change the structure of consumables

This is a simple and reliable way to improve wear resistance. Typical cases are as follows :3.2.1 The bimetal composite grinding roller is placed on the plastic cast iron (disk 320), and the high chromium cast iron block (Cr) 16%, HRC 64) is mechanically inserted into the dovetail groove. The same material high chromium cast iron blade has higher hardness and better wear resistance than the integral roll. Plastic cast iron has a good hindrance to the diffusion of various stresses in the process of mill production. Even if a metal foreign body causes a crack in the insert, it is difficult to expand inward. The equipment runs more reliably. The plastic cast iron between the jacket quickly wears away and forms small grooves, which increase the bite force on the material and improve grinding efficiency.

3. Conclusion

The development of wear-resistant materials at home and abroad is relatively rapid, materials also try a variety of. For the application and development of wear-resisting technology, there is a very broad market at home and abroad.

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