

Q2: How to extend the life of die-casting molds? (1) Analysis from the perspective of mold materials.

A2: The die-casting mold life is an important index to consider mold quality, and it is also an important factor that affects the economic benefits of die-casting enterprises. For die-casting molds, especially aluminum alloy die-casting molds, because the melting point of aluminum alloy is high, and the injection pressure and speed are high during the die-casting process, its life is much lower than that of plastic injection mold, low-pressure casting, and other molds, generally only 40,000 Up to hundreds of thousands of times.

- **Factors affecting die casting mold**

From the perspective of the use property of die-casting molds, the main manifestations of mold damage and unusable include: (1) Mold ageing, cracks that affect the appearance, and at the same time, the cracks cause the surface damage of the part to be pulled out of the mold or the casting is deformed, making the mold unusable; (2) The mold is cracked and cannot be used; (3) Frequent mold failures, such as blockage of the slider, aluminum channeling of the mold, etc., cause the mold to be unusable, or the die casting efficiency is extremely low.

When the die-casting mold is in use, the mold is subjected to high-speed and high-pressure impact from the molten metal. The entire process is an injection process. Generally, the internal gate speed can reach 30-70 m/s, and the filling pressure is generally 400-900 kg/ Square centimeter, the impact pressure and speed are great; on the other hand, the temperature of the molten metal is higher, so that the temperature of the cavity part has been changing back and forth between 160-350 degrees, in a reciprocating fatigue state of thermal expansion and contraction. In short, due to the impact, compression, expansion and contraction of the molten metal, the mold is prone to fatigue, deformation, surface cracking or overall cracking, thereby shortening the die-casting mold life, which also means a loss of economic efficiency.

There are many ways to improve the life of die-casting molds, which can be summarized in four aspects: mold materials, mold design, mold manufacturing, mold use and maintenance. Among them, the mold material is the most intuitive and important factor that affects the life of the mold, which can be considered from the cavity material, the plate material, and the heat treatment of the material.

- **Control of cavity materials**

Choosing suitable mold steel and heat treatment according to different casting

requirements and die casting conditions is an important way to extend the life of the die. The choice of cavity material can be considered from three aspects: (1) The mold steel must have the ability to resist crack propagation and extension, to avoid the overall cracking of the mold, that is, "high toughness and ductility can improve the thermal fatigue resistance of steel. Therefore, the improved H11 and H13 steels from European and Japanese manufacturers put the toughness and ductility of die-casting die steel in the first place; (2) The metallographic analysis of the material and the microstructure determine to improve the performance of steel, when the metallographic structure is finer, the ability to resist impact load (impact energy) is higher. The metallographic structure depends on the property of the material itself or its heat treatment; (3) The internal quality of the material, the die-casting mold cavity material is generally forged steel billet, which is prone to micro-cracks inside, and timely detection and avoidance are extremely critical.

According to Chinese manufacturers, as the industry's emphasis on quality has gradually increased, die-casting factories have also begun to deploy related testing equipment such as impact testing machines, metallographic analyzers, and flaw detectors to control mold materials and heat treatment effects in the early stage. To ensure the quality control of the mold, thereby extending the mold life.

- **Heat treatment of mold cavity**

Heat treatment is an especially important factor affecting the life of the mold, especially the high temperature retention time during heat treatment, and should be carried out in an appropriate way according to the size and shape of the parts; however, some manufacturers have different property to save costs. Putting the parts together for heat treatment, or reducing the high temperature holding time to save costs, etc., will have an adverse effect on the life of the mold. For example, quenching is the operation of heating the material to an appropriate temperature and keeping it for an appropriate time to make it quenched. If the cooling rate is too slow, its hardenability is insufficient, which will also affect the life of the mold.

In addition, the heat treatment hardness of the mold cavity should also be comprehensively considered based on the alloy material of the casting, the requirements of the property and quality of the casting, and the die casting method. In general, when the hardness of the mold cavity is high, the mold is less likely to stick to the mold, but it is relatively easy to crack; when the hardness is low, it is easier to stick to aluminum, but the mold is not prone to cracking; on the other hand, For zinc alloy or magnesium alloy die-casting, it is usually recommended that the mold cavity heat treatment hardness be as high as possible to achieve the effect of prolonging the life of the mold.

- **Selection of plate material**

The material of the plate, including the slide, the material of the bead, etc., are also factors that affect the life of the mold. The impact force acting on the die-casting cavity during the die-casting process is very large, and the sleeve plate is very important as the fixing of the cavity and the sliding and locking of the slider. According to the Chinese industry, most of the die-casting die set plates of the factory used nodular cast iron or cast steel in the early days. Later, S50C forged steel was partially used, and the heat treatment of high temperature tempering after quenching (quenching and tempering) was carried out. The actual effect is indeed It is a great improvement over the previous one. At that time, foreign countries also used P20 quenched and tempered prestressed steel or 4140 quenching. Although the cost of the mold was increased, the stability of the plate was greatly improved, and the life of the mold was prolonged. This experience is worthy of reference by the industry.

- **Mold material and its heat treatment and mold life**

In summary, the selection of materials and the method of heat treatment will affect the property of the mold material, and these properties are important reference indicators for judging the quality and life of the mold. Mastering the properties of the material itself, the application, and properties of the heat treatment method, etc. are important knowledge that the first-line engineering and R&D personnel must possess in the face of increasingly severe market competition. Considering material cost, heat treatment time, mold quality and life, etc., choosing high-quality mold materials and appropriate heat treatment methods, a solid foundation will become one of the important key factors to stabilize the competitiveness of enterprises.

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