Q10: What is the impact of slag and melt loss caused by smelting on the quality of aluminum alloy die casting?

A10: Smelting technology is extremely important to ensure the quality of aluminum alloy die castings. The slag and melting loss generated during smelting not only directly affect the quality of the molten aluminum alloy, but also increase the cost of die casting.

- **Influence of furnace type**

At present, there are many types of smelting furnaces and holding furnaces used for die-casting aluminum alloys, which are mainly selected according to the requirements of the alloy composition, temperature, and capacity to be smelted. Large-scale die-casting factories generally adopt the process mode of centralized rapid melting furnace melting → refining and degassing outside the furnace → and then dividing the molten metal to the front holding furnace of the die-casting machine. Since each step has the opportunity of oxidation melting loss, the melting loss rate under normal feeding conditions is close to 4%.

If a centralized melting furnace with a certain reducing atmosphere is used, and the corresponding refining furnace is equipped (without refining outside the furnace), then the processed molten aluminum is supplied to the holding furnace in front of the die casting machine (it is best to use electric heating for heat preservation), It can fully guarantee the purification quality of molten aluminum and reduce the loss of aluminum. Its best performance can reach a melting loss rate of about 0.5%.

For small and medium-sized die-casting factories, most of them currently use molten pool or crucible-type fuel or gas melting and holding furnaces, and one die-casting machine is equipped with one furnace. Under normal circumstances, the melting loss rate is 2 to 4%, but the structure, quality and thermal efficiency of the furnace are quite different, resulting in a large difference in the melting loss rate.

When the furnace structure is unreasonable and the melting speed is slow, the temperature of the molten aluminum is not well controlled to cause over-burning, or the molten pool material is not enough to cause the refractory material to fall off, the melting loss rate can reach more than 5%; therefore, not only the investment of the furnace itself must be considered , The quality and benefit of smelting must be considered, with its continuous influence on casting quality and scrap rate.

- **The influence of furnace material**

If the same material is wet or stained with oil, the melting loss may increase

several times, and other environmental protection equipment must be added to solve the problem of air pollution. Generally, the melting loss of molten aluminum during the holding period is about 0.5 to 1.0%, the melting loss of aluminum alloy ingot melting is 1 to 2%, the aluminum remelting is 2 to 6%, and the unclean waste is 6 to 10%. The remelting of the recycled material is 10%-15%.

Therefore, it is generally not allowed to directly enter the furnace with waste or waste castings, trimmings, gates, etc., with unclean materials such as coatings, grease, etc., and must first be cleaned and dehumidified. Although the processing cost has risen, due to the reduction of melting loss, the quality of molten aluminum is improved, the investment in environmental protection is small, and the actual comprehensive economic benefits are improved.

- **Influence of smelting operation habits**

Most aluminum alloys are melted in a reverberatory combustion furnace, and a small change in its parameters may cause a large change in the melting loss. The first is the inappropriate adjustment of the fuel to air ratio at the burner. If the oxidizing atmosphere is too strong, when the surface of the molten aluminum is exposed to disturbances, the melting loss will increase significantly; secondly, the control of the heat preservation temperature is very important. Above the reasonable range, if the temperature is increased by 10-40°C, the number of oxides will increase by 2% to 3%, and if the temperature is increased by 80°C, the amount of oxides will increase by about 20%. In addition, the thickness of the slag layer has a direct relationship with the thermal insulation effect of molten aluminum and the consumption of fuel. When the temperature of the slag is increased, the oxidation rate of the molten aluminum increases, which will cause the melting loss to increase in a logarithmic curve.

In recent years, research on reducing oxides in molten slag and recycling useful metals has attracted much attention. Some equipment for separating metal from molten slag and recycling metal from molten slag has appeared in abroad, which deserve our attention. In the process of producing furnaces and follow-up services for the die-casting factory, many unreasonable operations have led to an increase in melting loss. For example, in order to increase the melting speed, unreasonably adjust the gas ratio, neglect the control of the furnace temperature and the temperature of the molten aluminum, make the molten aluminum overheat for a long time, do not slag in time, and not clean the furnace wall on schedule, etc., which has potential hazards. Potential and concealment are therefore the easiest to overlook.

In addition, the turbulent flow of the liquid surface will cause oxides to be

wrapped in the molten metal and form a thick layer of floats. In fact, this kind of slag contains about 95% of the metal, which not only causes melting loss, but also the smaller oxide particles enter the molten aluminum alloy to make the die-casting loose, reduce the mechanical properties and produce hard spots. Therefore, attention should also be paid to the fluctuation of the molten pool level, the flow of the molten aluminum and the flow when separating the molten aluminum, and the steps involving the conveyance of the molten aluminum, such as the scoop of the molten aluminum.

▲ This article is excerpted by Assistant Wu from the Alliance Office, from a discussion on slag and melt loss, Xiu Yuping, from Die Casting Magazine, 2018-03-22.