Design of Low-Pressure Casting Process for Aluminum Alloy Reducer Housing

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Abstract: In recent years, with the changing environment and the demand for energy conservation, emission reduction, and environmental protection, the research and development focus of automobile manufacturing enterprises has shifted from traditional fuel vehicles to new energy vehicles. This article takes the middle shell of the HD reducer housing as the research object, explores the typical casting process scheme of the motor housing using low-pressure technology, and evaluates the feasibility of the process scheme using MAGMA simulation software. The results indicate that the produced motor casing fully meets the requirements of the relevant technical conditions.

Key words: reducer shell; low-pressure; casting process for middle shell; CAE

1 Introduction

By simulating and analyzing the casting process, casting defects can be predicted and the feasibility of the process can be evaluated. Using the casting simulation software to simulate and analyze the casting process, as well as validate the process.

1.Technical requirements for reducer housing - middle housing

1.1 Product overview

The product size is 982×545×370 mm, with a main wall thickness of 8mm and a rib plate wall thickness of 4 mm in the middle position. The casting weighs 74.3 kg. The material is ZL101A aluminum alloy.

1.2 Technical requirements

1) After T6 heat treatment, the specified position of the casting requires a tensile strength of ≥ 295MPa and a hardness of ≥90HB.

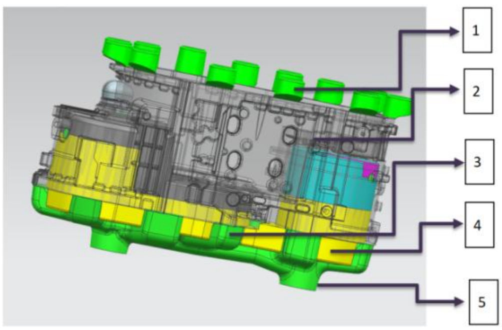
2 Design of casting process for 3 reducer shell middle shell

2.1 Casting scheme selection

Low pressure casting is used, and sand cores are used to form the sprue and non-moldable positions. The thick parts are cooled by a water circulation system.

2.2 Riser design

Multiple risers are installed at the top and thick parts: the riser function (1) is to supplement and shrink; (2) Beneficial for exhaust and slag removal; (3) Avoid shrinkage and looseness. The diameter and height should be selected between 60-100mm.



1. Riser; 2. Product; 3. Sprue; 4. Sand core; 5 water inlet

Fig.1 Process Diagram

2.3 Design of sprue

The pouring system adopts a vertical sprue to separate the internal sprue and feed the material, with a sprue diameter within the range of 80-100mm.

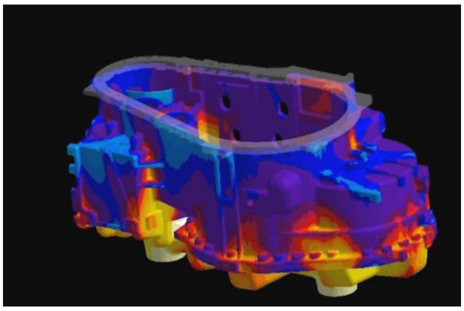
2.4 Water cooling design

The water-cooling effect (1) Adjusting the solidification time; (2) Shorten the molding cycle (3) to avoid blockage of the lifting pipe; use a water circulation system for cooling thick parts.

3 Simulation and Analysis of Casting Process

The analysis of the metal liquid flow state and temperature field during the filling process is shown in

Figure 2. The metal liquid flows smoothly and the cooling state is also ideal (Figure 5a-b). The temperature of the metal liquid is also above the liquidus temperature, and the risk of cold shut off or porosity is relatively low.



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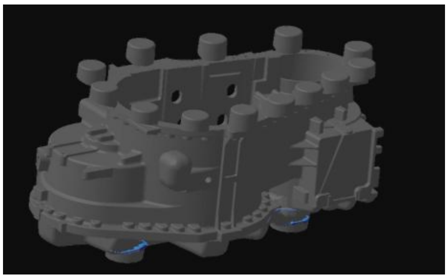

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Fig.2 Solidification Liquid Phase Ratio during Solidification Process

4 Production validation

The sand core adopts a core assembly method; 70-140 mesh coated sand, metal hot box core making. Rotary degassing method is used for pre furnace treatment.

Pouring parameters: pouring temperature of 700 ℃, liquid lifting time parameters are shown in Table 1, and filling time of 500s. The boosting pressure during the pressure holding process is 150mbar, Open the mold and take out the parts after 600 seconds.

Table 1 Shell filling parameters in

Filling stage	Filling time (s)	Filling pressure (Mbar)
first phase	12	160
phase 2	7	230
Third stage	13	390
Stage 4	3	460
Stage 5	3	550

The actual castings produced have passed the leak test after inspection and processing.

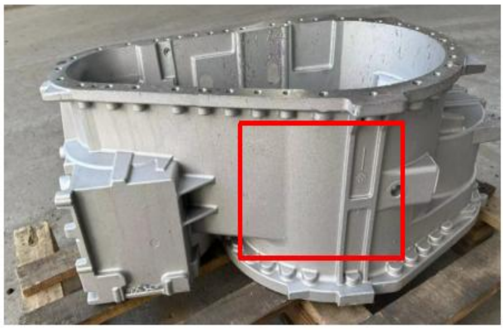

Fig.3 Pouring Products

5 Conclusion

(1) Low pressure process is a shell casting metho d for producing aluminum alloy water-cooled motor shells. If the riser, water-cooled position, and pourin g system are designed reasonably, qualified motor s hells can be produced.

(2) The casting simulation software provides conv enience for product process design, and through risk analysis, casting process design can be evaluated. S hortened the trial production time of the product

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