International Engineering Research Journal

Casting of Power Unit Bracket

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Abstract

To achieve a required product quality during Casting of power Unit Bracket D (LPDC) process, it is necessary to identify and also control the main input parameters affecting the casting defects to arrive at the desired output quality. In industrial scale LPDC, where the issues of part quality, cost, and cast speed are the main driving forces for the industries, the cast process optimization to have minimum defects is quite essential. The LPDC process of light weight metals is defined as a casting process where the die is filled relatively slowly at low pressure. The melt flow regime has low turbulence, and filling process can be defined as relatively smooth filling of casting.
In recent years, in order to limit the component defects, the through process simulation has widely been used. In an interactive simulation environment, a full multi-phase casting process simulation (thermal-fluid simulation using multi-physical domain) along with its material and mechanical simulations are carried out in a single environment. One of the main contributions of this paper is to show the advantages of using full through process simulation of LPDC to limit the defect in the component. An experimental program along with a comprehensive process simulation has been setup to optimize the casting process and the results were presented for real world case studies. In this project casting process for power unit bracket is discussed from Design stage (i.e. CATIA for part modeling and MAGMA for simulation) to manufacturing Stage.

1. Introduction

The die-casting process (Brown, 1999) is one of the widespread casting techniques in the modern casting industry. In die casting, permanent moulds (dies) are usually made of hard materials such as tool steels and should endure several hundreds of thousands of casting cycles. Due to the harsh conditions during the casting operation (high temperatures, chemical attack by molten alloys, and high stresses) die-casting dies are prone to surface damage. Prediction of the lifetime of a die in service becomes a necessary and challenging task. Most common types of damage of die-casting dies include: thermal fatigue, e.g. “heat checks” (Person et al., 2005) and “corner cracking” (Srivastava et al., 2004); erosion and corrosion wear by molten cast alloy (Venkatesan and Shivpuri, 1995); die soldering, i.e. sticking of the cast alloy to the die (Gopal et al., 2000).Because of the complexity and multiphysical nature of the entire process the die geometry and process conditions are often designed with the help of simulation software. Specialized casting simulation software MAGMA soft (www.magmasoft.com, 2008) is used in the present work. The software is capable of 3D modelling of all stages of the casting process such as filling and solidification (Sequeira and Proske, 2005). It is beneficial to use the results of such simulations in the prediction of the lifetime of the die.

Sand Casting- In sand casting Rp generated parts can be used as patterns for fabricating a sand mould. RP processes that use the materials similar to wood are common. The moulds are created in a fraction of time and then affixed to the pattern board before sand is packed around to create half a mould cavity.

To save more time RP processes can be used to directly fabricate moulds and cores. These processes build the cores and mould layer by layer by fusing either polymer boned sand together or using a wide area inkjet to bond the sand the moulds and cores also may be created by forming a block of sand and machining out the cavity.

Investment Casting- RP models for investment casting are created by converting a 3D CAD model into an STL file. The file is then “printed” three dimensionally using either photopolymer, thermo polymer, polystyrene or other materials depending on RP method. The proto type models then can be attached to gating system and processed through typical investment casting to reduce cast prototype parts.

Plastic Molding-RP often is used with plaster molding process to circumvent or transist to the production of hard tooling. This is accomplished by creating a rubber mould from an RP-generated pattern (similar to sand casting). The rubber mould then is used to create plaster molds for casting production. Plaster casting often serves as a precursor to die-casting production while the hard tool is being made. A final form of RP worth mentioning is the use of CNC machining to create individual parts, tooling or dies, or to take blocks of sand and machine them to create prototype sand molds.

MAGAMA software guides us for proper gating system, risers, venting etc. it gives guideline to get casting free from defects. Various analysis done on power unit bracket Thermal analysis, solidification pattern, temperature distribution.

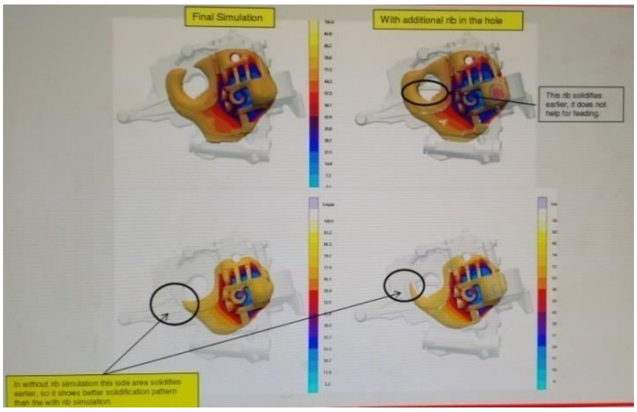

Fig 1.1 Solidification Pattern

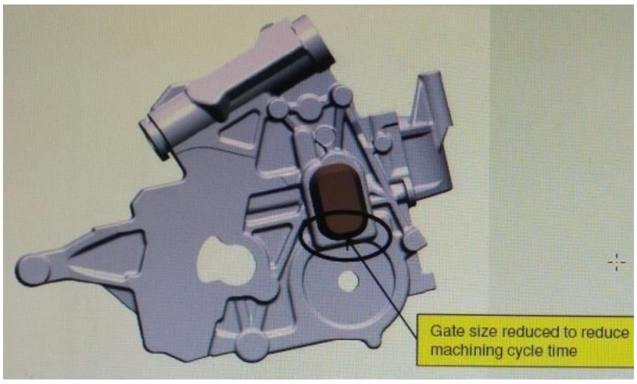

Fig 1.2 gate finalized

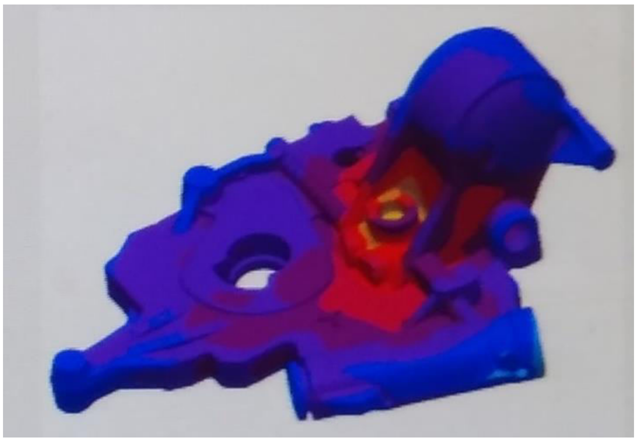

Fig 1.3 Temperature pattern

After three iterations of Thermal analysis the gate position finalized with minimum material to be removed in machining, with the customer.
Solidification pattern gave us idea of air cooling positions in the tool. Temperature analysis give the hollow out, cooling positions.

Trial Requirements:
1) Material test reports, vacuum testing of material.
2) Machine matching to the structure against CFT.
3) Temperature, flow sensing equipments.
4) Heating arrangement.
5) CFT members.
6) NPD members

Trials conducted with various inputs steel core, side inserts, sequencing the inserts. Machining the component on VMC with 50 tools for finishing the casting with an minimal cycle time of 10 minutes. And dispatch to customer after leak testing.

Conclusion

Component is evaluated by the simulation study
In initial case study, casting is simulated in order to check the filling of casting at preliminary stage. Secondly the material deformation is evaluated by Actual trial in the plant.

In actual case the casting is modeled and compared with results obtained by simulation. By using solid pin in port variation observed in casting is with tolerance, sequencing the inserts helped in proper venting of component without unfilling of horn section. Nose bend found and removed by bend checking fixture online with casting production.

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