
ABSTRACT

In the present world with the increasing use of Aluminum alloy wheels in automotive industry the Aluminum foundry industry had to focus on the quality of the products. The quality of a foundry industry can be increased by minimizing the casting defects during production. Shrinkage cavity may be detrimental to mechanical performances of casting parts. As a consequence, design engineers often use overly large safety factors in many designs due to insufficient understanding of quantitative effects of shrinkage cavity defects. Now a day casting simulation has become a powerful tool to understand mould filling, solidification and cooling to predict the location of internal defects such as shrinkage porosity, sand inclusions and cold shuts. It can be used for developing new casting without shop-floor trials. This dissertation describes the benefits of casting simulation and how to reduce shrinkage defect in casting part with Simulation process and theoretical background. Aim of the current study is to study the production line of an aluminum alloy wheel manufacturing industry and to improve the quality of production using quality control tools.

KEYWORDS: Casting, Shrinkage Defects, Simulation, Pro-Cast.

INTRODUCTION

Recently, due to the development of computer technology, an effort is done to predict casting defects directly as a consequence of the physical phenomena that are involved. A modeling approach based on an improved description of the physical processes has become a more realistic practical and straightforward option. Shrinkage related defects result from the interplay of phenomena such as fluid flow, heat transfer with solidification, feeding flow and its free surfaces, deformation of the solidified layers and so on. Casting, one of the economical manufacturing processes used in industries, is a complicated process, which involves considerable metallurgical and mechanical aspects. The rate of solidification governs the microstructure largely, which in turn controls the mechanical properties like strength, hardness, machinability, etc. The location, size and shape of riser in a casting depend on the geometry of the casting, mould design and thermal properties of metal, old and other process parameters. Wrong designed riser results either defective casting with shrinkage cavity or lower yield, as directional solidification has not achieved.

There are number of casting simulation software are developed and are used in foundry worldwide. The application of casting simulation software's are also increasing day to day in Indian foundry as it essentially replaces or minimizes the shop floor trials to achieve the desired internal quality at the highest possible time. The Pro-Cast (Thermal Analysis) allows the computation of heat flow by taking into account conduction, convection and radiation. The heat release associated with phase changes such as solidification and solid phase transformations is described by an enthalpy formulation. Casting issues addressed by the Pro-Cast include: Hot spots and Thermal Modulus, Macro and micro shrinkage, Die cooling and heating optimization. Runner and riser design.

The Pro-Cast (Flow Analysis) provided by Finite Element models allows ProCAST to predict the metal flow inside the mold and allows for the accurate understanding of: Sand erosion and turbulences. Oxide, Air Entrainments, Material Age, Misruns and cold shuts Flow Length, Air Pressure, Core Gases, Overflow positioning Colored Flow

Fluid flow calculations are described by the full Navier Stokes equation and can be coupled with thermal and stress analysis. Specific models have been added to the flow solver for the analysis of turbulent flows, thixotropic or semi-solid materials, centrifugal castings, lost foam and core blowing.

LITERATURE REVIEW

Following are some of the important reviews of different researchers and scientists in the Casting field.

Feng Liu [1] in this paper, with the aid of parametric modeling technology of runner and riser are modeled parametrically. By varying each parameter, it is easy to get different casting CAD models. These models output data populate the orthogonal matrix, which is used in the orthogonal array testing strategy to define the most suitable combinations of runners and risers parameters. After inputting the completed orthogonal matrix data and all CAD models into the simulation software the simulation result can be obtained.

Mohammad Sadeghi [2] observed that Pro-CAST software used to simulate the fluid flow and solidification step of the part, and the results were verified by experimental measurements. By this Paper he concludes that 1) Comparison of the experimental and simulation results indicates that defects in the pieces are placed at the predicted places by simulation. 2) If the die temperature is reduced from the optimum temperature range, probability of cold flow defects and air porosities increase. 3) Determination of optimized places of overflows by simulation led to decrease of some casting defects such as cold shots and air porosities.

Dr. B. Ravi [3] observed that in gravity die casting of Aluminum parts, computer simulation can be a useful tool for rapid process development. Limitation of the conventional die design and gating design has been elaborated. Advantages of computer simulation based design enumerated. The procedures thus described have been demonstrated with two case studies of application of Pro-CAST simulation at Ennore Foundries. It is demonstrated that the foundries can derive mileage by resorting to FEM simulations of the casting process for process development and optimization.

Sushil Patel [4] He focused on finding process-related causes for individual defects by using simulation of casting and its validation by experiments, and optimizing the parameter values to reduce the defects by optimizing the riser design, in gate runner design. This is not sufficient for completely eliminating the defects, since parameters related to part, tooling and methods design also affect casting quality, and these are not considered in conventional defect analysis approaches.

Vipul Vasava [5] He observed that by shrinkage defect simulation on software one can conclude from where the defect may develop, means by which stage the shrinkage defect can be reduced, he mainly studied on the 3d analysis on software and by making the same trials on the shop floor, due to this type of study he reduced the defects causing mainly on the casting.

Swapnil A. Ambekar [6] observed that gating some also termed the gating systems as risers or runners systems, overflows, venting channels can be optimized using numerical simulation. Solidification related defects can also be predicted taking into account cooling channels and die cycling so as to accurately reproduce production conditions. Pro E readily addresses all these issues but also includes advanced features to better assess the casting quality.

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