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REVIEW OF CASTING DESIGN AND SIMULATION

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ABSTRACT

In casting process before starting the actual process the simulation of design is necessary to avoid the different defects. To carry the simulation of casting process many techniques are used. In this paper the review is carried on different techniques of simulation. Many simulation techniques like numerical, modeling and software are used for simulation of casting.

Keywords: Computational Fluid Dynamics, Finite Element, Auto-CAST, Wide die Heavy blow Forging.

I. INTRODUCTION

Casting process is very old process and it is the basic of all the mechanical process. However, there are many problems, such as difficulty in quality control, low production, energy efficiency, material consumption reduction, and environmental protection. The defects can be predicted by casting solidification simulation, and corrected by suitable modification to part design. Hence casting solidification simulation enables predicting and preventing potential problems before freezing the product design, to achieve high yield at the desired quality level, and evolving optimal process plans compatible with both product requirements and foundry capability [1]. With the rapid development of computer science and technology, many kinds of finite element software are used all over the world, including both casting p software and finite element analysis software [2]. Simulation methods have contributed since their origins to reach a better knowledge about the materials and the manufacturing processes, and as consequence to improve the manufacturing methods. Today, a big number of commercial codes are available to simulate a wide range of metal casting[3].

II. NUMERICAL SIMULATION OF DC CASTING OF AZ31 MAGNESIUM SLAB AT DIFFERENT CASTING SPEEDS

Wenyi Hu et. Al. [4] has prepared mathematical model of direct chill casting process for AZ31magnesium slab. The temperature fields at different casting speeds were compared and optimum casting speed was obtained. For casting of 300 mm× 800 mm magnesium slab the temperature gradient is larger in the length direction than that in the width direction. The maximum value of temperature gradient appears when slab is in contact of cooling water. The optimum velocity of slab is 30-35 mm/min.

III. EFFECT OF CASTING PARAMETERS ON ROLL SEPARATION FORCE DURING TWIN ROLL CASTING

Yun-Soo Lee et. al. [5] has adopted a two-dimensional finite analysis to predict temperature distribution and roll separation force during twin casting of A7075 aluminum alloy strip. Effect of various parameters such as roll speed, initial temperature of the melt and heat transfer coefficient on temperature distribution and roll separation force was investigated in detail. During twin roll casting process, irregular melt flow such as reverse flow or vortex can occur and affect the temperature distribution of the strip. The melt smoothly moves inside the nozzle with minimized irregular flow. When twin roll casting process begins, the melt moves into the roll nip through the nozzle. Right after contacting the roll surface, solidification of the melt proceeds from the outer surfaces of the strip contacting to the rolls towards the centre line, and the temperature of the casting rolls became stable.

IV. MODELING AND SIMULATION OF DIE CASTING PROCESS FOR A356 SEMI SOLID ALLOY

Jinlong Fu and Kaikun Wang [6] modeled two non-Newtonian equations to describe the flow behaviors of semi-solid state alloy A356. Isothermal shear experiment is used to obtain the parameters in experiment. The Computational Fluid Dynamics software *PROCAST* is used to simulate the process of die filling. The filling temperature is 585°C. Based on result it is found that material in semi-solid state flows much more smoothly than Newtonian fluid due to higher viscosity. The behavior of semi-solid fluid is typical non-Newtonian fluid. Semi-solid slurry presents the shear-thinning behavior at the isothermal conditions. The viscosity decreases apparently when the shear-rate increases. There exists a significant difference between conventional liquid processing and semi-solid processing over the filling pattern. Due to the higher viscosity of semi-solid slurry, the flow is smoother than the Newtonian fluid. This helps reducing the possibility of gas inclusion and overlap on the final components and thus, improving the quality of the final components.

V. NUMERICAL SIMULATION OF DIFFERENT TYPES OF VOIDS CLOSURE IN LARGE CONTINUOUS CASTING BILLET DURING MULTI-PASS STRETCHING PROCESS

Liwen Zhang et. al. [7] used finite element (FE) software DEFORM 3D to investigate the void closure in large continuous casting billet during multi-pass stretching process. During stretching process wide die heavy blow forging (WHF) method is used. The critical forging ratio for large billets from Φ500 mm to Φ1000 mm was obtained as 2.40. The actual production shows that all defects can be completely eliminated in the forgings by adopting the proposed method and criteria, which illustrates that the simulation results and the proposed criterions in this research are reliable.

VI. DESIGN OPTIMIZATION OF GATING AND FEEDING SYSTEM THROUGH SIMULATION TECHNIQUE FOR SAND CASTING OF WEAR PLATE

Sachin L. Nimbulkar and Rajendra S. Dalu [8] carried out the design and optimization of gating and feeding system. The gating/riser system design plays a very important role for improving casting quality. Many researchers reported that 90% of the defects in casting are obtained only because of improper design of gating and feeding system. The main objectives were to study the existing design of gating and feeding system, to optimize the gating and feeding system using Auto-CAST X1 casting simulation software, to prepare the sand mold and cast the part, to compare the simulated result and experimental results, to reduce rejection rate and to enable the company to again start the production. The result shows that as many solidification defects were present at the center of casting vertical gating and feeding system was not suitable for thick casting components. By using casting simulation method, the percentage of rejection of casting due to gating and feeding system related defects has been reduced by30%.

VII. CONCLUSION

Many techniques are used for simulation of casting. The simulation of casting can be carried by using numerical techniques, modeling and software. After carrying the simulation of casting design the quality of final casting increases by reducing the casting defects.

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