ROLE OF ALUMINUM 6063 IN AUTOMOBILE MANUFACTURING BY USING VARIOUS MOULDS ATTRIBUTES IN SAND CASTING PROCESS

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Abstract

One of the most crucial steps in developing a product for the demands and happiness of the consumer is casting. The industrial world offers a variety of casting processes. Sand casting is one of the key casting techniques that is frequently used for both ferrous and non-ferrous materials. The range of molten metal's solidification determines the product quality in the sand casting process. A standard casting design method is necessary to prevent casting flaws including shrinkage, porosity, and hot tears during the solidification process, which may be accomplished by an experimental inquiry. Aluminum (6063) has recently assumed a significant position in the automotive, industrial, nuclear, and marine industries. In this paper, the various mopuld attrinutes are analyzed research articles are discussed.

Keywords: Sand Casting Process, Aluminum (6063), Design of Experiments, Hardness, ANSYS, ANN

Introduction

The majority of manufacturing sectors favor using production processes like machining, casting, forging, or welding to produce their goods. One of the crucial casting techniques for both ferrous and non-ferrous materials is sand casting. Excellent dimensional geometry, simplicity of pattern development, improved production rate, and shorter solidification times are the main advantages of choosing the sand casting technique over die casting. The vent hole, gating system, spruce & riser design, pattern allowances, and tolerances are the most important process variables taken into account in the sand casting process. Physical and mechanical characteristics, crystal structure, and intermetallic compounds all influence the bonding processes. The right choice of input process parameters and materials determines the quality of the test specimen. The literature review is essential to forecast the hardness of the test specimen during sand casting process.

There are more than 10000 manufacturing industries in India. In this (69-70)% of industries use sand casting as their choice for Manufacturing. This project aims to minimize the cost and the working time required for manufacturing. This research aims to reduce the lean manufacturing by combining multiple mould boxes.

Literature Review

Jeet Desai et al [1] Investigating on reducing porosity for alloy steel casting. In this investigation various defects due to porosity of casting sand was studied and various ways to reduce the defects occurring due to porosity are discussed. Mohd Imran Ansari et al [2] studied on the analysis of molten metal flow through sprue in casting process. In this flow pattern of molten metal in sprue for different and optimum shapes, modeling and meshing of sprue geometry and flow analysis are studied using CFD simulation, GAMBIT 6.3.16 and FLUENT 6.2.26.Shashank.V.Gulhane et al [3] researched To improve the productivity of casting technology by reducing weight of gating system. The various defects due to problem associated with gating system of ginning dead weight are researched.

M.Alagar et al [4] Analyzed optimisation techniques implemented in Various cutting parameters in CNC turning operation of EN8 steel using Al2O3 and CuO nanofluids as a coolant. In this investigation L9 orthogonal array implemented and found optimum cutting parameters in CNC machines. Maryam.S et al [5] investigated the evolution the effect of different sprue shapes on some of the physical and mechanical properties of casting alloys. Purpose of this study was to evaluate the marginal fit and syrface roughness by comparing between four sprue design.Atinderpal Singh Sandhu et al

Studied various process in an industry and casting defects to provide an introduction to the causes and remedies of the main solidification defects in casting.

Muhammad huzaifa raza et al [7] worked on investigating the effects of gating design on mechanical properties of aluminium alloy in sand casting process and observed that bottom gating system has better configuration as compared to top gating configuration. G.Mahesh et al [8] Discussed about various mechanical properties of in sand casting process using intelligent techniques. The major tool of Design of Experiment and Artificial Neural Network (ANN) used for this investigation. Sachil L.Nimbulkar et al

studied design optimization of gating and feeding system through simulation technique for sand casting of wear plate. Study the existing design of gating and feeding system , to optimize the gating and feeding system using auto -CAST X1 to prepare the sand mouls and cast the part and to compare the simulated results and experimental result. G.Mahesh et al [10] Investigated the Experimental Investigation and Optimization of Hardness in Sand Casting Process by using the Design of Experimental Approach for various vent hole and vent angle parameters. The optimum parameters are analyzed by using design of experiments

Olawale Olarewaju Ajibola et al [11] investigated the effects of moulding sand permeability and pouring temperatures on properties of cast 6061 aluminium alloy. Effects of moulding sand permeabilities prepared from combination of four proportions of coarse and fine particle size mixture and puring temperatures varied were studied on the hardness porosity and strength. Sumaiya Shahria et al [12] studied the optimization of moulding sand composition for casting Al alloy. The aim is to reduce aluminium casting defects by optimizing proportion water and bentonite added to a recycled sand mould. G.Mahesh et al

Investigated Modeling evaluation and optimization of riser design in sand casting process. The various geometry of risers are analyzed by using ANSYS software and optimized best result of the riser geometry.

Hyung-Yoon Seo et al [14] Analyzed design of a gate system and riser optimization for turbine housing and the experimentation and simulation of a sand casting process. The optimum gating system for manufacturing turbine housing is designed in this study and a heater as a heat source provided to the riser, attempting to reduc e its size.C.Narayanaswam et al [15] Studied the casting defects and supply chain in cast iron foundry process and presents the analysis of casting defects and identification of remedial measures and the supply chain between foundry process.

R.Dojka et al [16] Analyzed optimized gating system for steel casting and presents the results of an approach to test the behavior of the filling systems designed to fill completely thereby excluding all air so far as possible ,and thereby reduce or prevent the occurrence of surface turbulence and the entrainment of bubbles. Tharoon T et al [17] investigated diminishing the casting defects by using optimization technique. Quality of the casting producs are improved with zero defects by using various kinds of optimizat ion techniques.

Premvrat Kumar et al [18] discussed the effect of mechanical mould vibration on the properties of sand casting aluminium (A-1100) alloy. The effect of mechanical mould vibration and the properties of sand casting alloys is studied. John O. OJI et al [19] studied the effects of mould and pouring temperatures on the ultimate tensile strength of aluminium alloy sand castings. The effects of sand casting process on the ultimate tensile strength of an aluminium alloy sand casting based on the analysis ANOVA technique is proposed in this paper.

Victor ANJO et al [20] Researched the Gating system design for casting thin Aluminium alloy (Al-Si) plates and discussed the design of gating system produced thin aluminium cast alloy plated of different size and thicknesses using the non pressurized gating and green sand molding technique. Nandagopal et al [21] Study of sand casting gating system. Major element of gating system, various types of gates and risers are explained. Rahul T patil et al [22] studied the causes of casting defects with remedies. Different defects in aluminium alloy die casting and providing the remedies with their causes are provided. Jain [23] investigated the furnace parameters like preheat air temperature, melting time, excess air percentage, flame temperature and rotational speed of the furnace. The modeling, optimization and simulation have been analyzed using artificial neural network and the optimum model was being created for the further investigation.

Kraev et al. [24] developed for bottom blowing of metal for acid converter and provision of stable argon pressure in FLU (Furnace Ladle Units). Daily inspection of argon and nitrogen pipelines in metal FLU and FLU were needed and then replacement of joints in steel casting is done to reduce the time (40 min) of melt processing. Many industrial tests were also conducted, from that most stable and operating indices in processing metal with argon in FLU was found to be a best process. Shishimirov [25] made steel more stable at lower cost, by adopting the different methods such as de- oxidation, alloying, inert gas blowing, and degassing, where tried in furnace.

Different metal samples were being tested and their chemical combustion was determined by OBLF spectrometer. The analysis of semi product and average density gave the way to produce stable steel. Filatov et al. [26] discussed about the slag segregation in transport and casting ladles. The composition of the coating which results in

contamination of hot metal depended on carbon content and the temperature coating samples were taken by a skimmer special sampling devices. The coating mass is determined as the product of apparent density and volume. The decrease in concentration and reduction of Si and other elements is done for decreasing thickness of coating or slag segregation. Tim Heinemann [27] analyzed the aluminum die casting value chain system. Modeling was done for specific set of Al die casting value chains. The analyzing of samples was carried out for creating generic energy and material flow.

Martin et al. [28] stated that the Controlling of non-metallic inclusions in Al melts is a tedious process because estimating the parameters to reduce inclusions for separate process is difficult. It gave some experimental concentrated data, which is coupled with mathematical models to get a clear understand of physical processes at work during settling. Zhe Xu et al. [29] the continuous casting billet for hot rolling line of Electro Magnetic induction heat process is done to reach billet temperature of steel, but it is difficult due to conventional voltage. This research is done to establish ARX model, which the algorithm to improve the output voltage. The optimization improved the control of temperature range in casting billet.

Narasimha Murthy et al. [30] the granulated blast furnace slag is decided to use as mold material by replacing existing sand in foundry Industry. Some investigation has been done on silica slag by using various sodium silicate-CO2 compositions. Three types of sand slag and their combination were prepared. The both laboratory and industrial tests are done effectively, results reveal that slag models makes good surface finish and no surface defects. Mahrabi et al. [31] discussed that the methods of dropping waste and saving energy in casting process. In this paper, the author investigated the several stages of casting process were analyzed. It is optimized the input parameters and increased the efficiency.

Jerald Brevick et al. [32] analyzed the high technology manufacturing process in terms of both economical and energy utilization of die casting. It has some advantage but the design and operational decision is decided inside die casting process lead to emission of more carbon di-oxide. The Markov chain model of die casting process has more efficient steps (operational decision, model sub parts, etc.).

Eskin et al. [33] investigated the experimental investigation of melting temperature and casting flow on structure throughout direct chill casting of Aluminum alloys. The temperature and melt flow distribution in the sump of billets cast were analyzed. The porosity slightly varied the melting temperature and amount of non-equilibrium eutectic in the center of billet. Christian Schmidt et al. [34] stated that the major disadvantage of twin-roll was lagging in entire solidification process. For this reason a heat loss analysis wss being determined along with the process of chain starting at the melting furnace. The heat losses are investigated in different stages of solidification process.

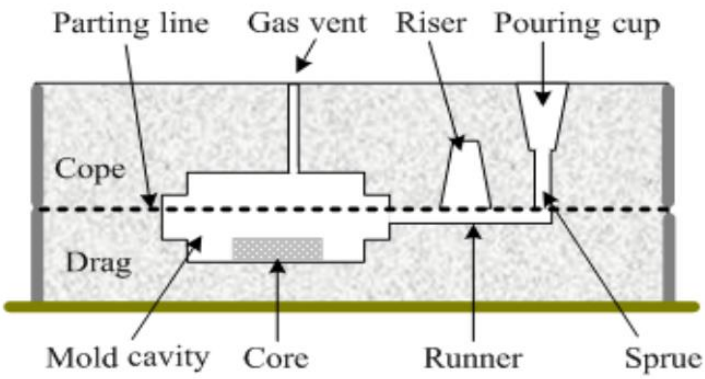

Fig.1. Mold for sand casting

CONCLUSION

The knowledge acquired from domain experts, is coded in the system. This can help foundry engineer to know in advance the outcome of the input process conditions. The improvement expected in minimizing the variation is 37.66 percent which means reduction of casting defects from present 6.16 percent to 3.84 percent of the total castings produced in the foundry. This also reflects that by using Taguchi method the factor levels when optimized will result in reduction of casting defects and increase the yield percentage of the accepted castings without any additional investments. . The on-line application using internet enhances the scope and also helps in making the expertise knowledge of defects and their causes to novice engineers Mathematical models developed for the estimation of compatibility, green compressive strength, spalling strength and permeability may be a very useful tool for predicting these molding properties on the shop floor.

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