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Short Communication

# ANALYSIS OF CENTRIFUGAL CASTING DEFECTS ON THEIR MANUFACTURING PARAMETER

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**Abstract** The defects of the centrifugally cast samples was decrease the strength and quality of product. Randomly design the experiments has been used, to analyses the influence of process parameters on the defects during centrifugal casting of aluminum alloy. Tests carried out on Eight design of experiment characterized by different variation of Speed Temperature and Type of cooling on aluminum alloy that solidify and analysis the defects of shrinkage and blow holes produce during cooling. The process of centrifugal casting has to be optimizing their quality.

**Key Words:-**Centrifugal, Defects, Casting.

## Introduction

Centrifugal castings are usually poured while the mold is spinning; however, for certain applications, particularly in the case of a vertical casting, it is sometimes preferable that the mold be stationary when pouring begins. The centrifugal casting process consists of pouring the molten metal at a suitable temperature into a rapidly rotating mould or die. It is essential that pouring temperature of molten metal should be high enough to enable it to reach the farthest point in the mould before solidification commence. The roll works in contact with molten Material at a temperature of 1100$^{o}$ C and its outer surface should not exceed temperatures between 425 and 475$^{o}$C. During the glass rolling operation, the roll is cooled internally by water circulation. According to information, the inner walls of the cylinders are lined with hard chromium to avoid the formation of deposits, which may reduce the cooling efficiency of the roll. The stir casting process is carried out by first liquefying the metal, then introducing the ceramic particles in the melt by different processes and at the end letting it to solidify on its own or by using controlled solidification mechanism.

The distribution of reinforcement is also achieved by temperature of the melt, the mechanical stirrer speed, way of stirring, the particles size and their density and surface area. The other variables may include design of the mold, proper gating system and temperature of

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mold before pouring. Commercial grade aluminum is liquefied first and ceramic material is added in the desired manner and magnitude followed by agitation via mechanical means. The difficulty of doing so is that alloying elements that are beneficial for improving the former property are usually detrimental for the latter. In order to achieve reliable results a high number of specimens have to be produced and tested.

**Preparation of Ceramic Moulds**

The ceramic shell process has become the predominant technique for a majority of engineering applications, displacing the solid mold process. Nowadays, medium strength titanium alloy, such as Ti-6Al-4V, is widely used in aerospace industry. With the development of new generation aircraft, it is important to develop high strength titanium alloy components. Researchers in United States, Japan, and Britain obtained significant achievements in Ti-15V-3Cr- 3Al-3Sn alloy research and applications Ceramic shell is the key in titanium investment casting. Chinese researchers have mastered main titanium casting shell technologies such as graphite shell, metal surface layered ceramic shell, and oxide surface layered ceramic shell. In this study yttrium oxide surface layered ceramic shell was used. This kind of oxide ceramic shell has high strength and low reactivity

**Centrifugal Technique**

Centrifugal casting uses the centrifugal forces generated by rotating the mold to propel the metal and to facilitate filling. Vacuum arc skull furnaces discharge titanium alloy at a temperature just above its melting point, and the centrifugal casting is usually needed to ensure good filling. Dental and jewelry casting use centrifugal casting to fill thin sections and fine detail. The centrifugal technique is used primarily for the production of hollow components, but centrifugal casting is used to create solid parts The centrifugal casting process is generally preferred for producing a superior-quality tubular or cylindrical casting, because the process is economical with regard to casting yield, cleaning room cost, and mould cost. Another advantage of centrifugal casting is the elimination or minimization of gates and risers. Centrifugal casting machines are categorized into three basic types based on the direction of the spinning axis: horizontal, vertical, or inclined. Centrifugal casting processes also have three types.

- True centrifugal casting (horizontal, vertical, or inclined)
- Semi centrifugal (centrifugal mold) casting.
- Centrifuge mold (centrifugal die) casting.

Centrifugal castings are usually poured while the mold is spinning; however, for certain applications, particularly in the case of a vertical casting, it is sometimes preferable that the mold be stationary when pouring begins. The machine then accelerates the speed of the rotating mold either during the filling of the mold or after completion of pouring. In other cases, such as horizontal centrifugal casting, it is often desirable to have the mold rotating at a lower speed during pouring, followed by rapid acceleration to a higher speed during the solidification period. The application of centrifugal force to a molten metal as it solidifies can be used to achieve a dense, sound casting. The centrifugal casting process is most widely used for manufacturing of cast iron tubes, pipes, cylinder liners and other axis-symmetry parts.

**Pattern Materials**

Pattern materials currently in use are waxes, and plastics, while other pattern materials are used sometimes, and for specific applications. Waxes, blended and developed with different compositions, are more commonly used, while use of plastic patterns, generally polystyrene, may sometimes be required, to produce thin-walled, complex -shaped castings, such as in aerospace integrally cast turbine wheels and nozzles. Waxes, in general, are moderately priced, and can easily be blended to suit different requirements.

**Background of Work**

The greater thickness of the melt prevents the ceramic phase to settle down in the bottom of the pan. There are several stages where there are chances of irregular distribution of particles in the melt as shared is summarized at the time of mixing while the melt is being continuously heated and stirred. At the time of pouring into the mold there has been observed irregular flow of the melt. However, beyond a level of 25-30 percent SiC, the results are not very consistent, and depend largely on the uniformity of distribution of SiC in the aluminum matrix. [1]. Effects of Hot Isostatic Pressing and heat treatment on the mechanical properties and microstructure of the Ti-15V-3Cr-3Al-3Sn alloy were studied. [2]

**Objective of Work**

Therefore, it is necessary to analyze the flow field of the molten metal in the centrifugal casting process. Researches about the centrifugal casting mainly focus on the as-cast defects. In the process of the centrifugal casting, the molten metal flow has a great influence on the quality and the performance of the roll. Preparation of a casting slip with suitable additives and fabrication of ceramic body use the centrifugal casting setup and drain casting.

**Methodologies Adopted**

Centrifugal casting is one of the advanced casting techniques widely used in metallurgical industries. However, it is rarely used in ceramic. Few literatures are available on fabrication of ceramic body using centrifugal casting technique. It has been reported that centrifugal technique is very useful for production of functionally graded porous membranes for gas permeable applications. A detailed study of the principle and operations of centrifugal casting machines available commercially suggests that there exist two types of centrifugal casting machine designs. The chemical composition of the Aluminum alloy and the heat treatment details are given in Table 4.1**.** The castings were produced in the form of circular pipe (approximately 2 cm thick by 10 cm outside diameter by 8 cm inside diameter) using two different mold rotation speeds, 800 to 1000 rpm.

**Mechanical Property Evaluations**

The tensile, creep and fatigue tests were conducted at 427, 540 and 650$^0$C in air. These temperatures were achieved through resistance heating except for fatigue tests at 427 and 540$^0$C where induction heating was employed. The reported data represent the mechanical properties of the alloy cast at mold speeds of 800 and 1000 rpm for pipe and ring specimen orientations. Tensile tests were conducted by using Universal Testing Machine. The calculated values of 0.2% offset tensile yield strength were based on extension derived from motion of the crosshead.

**Results and Discussion**

There exists a differential centrifugal force among the particles present in slurry. The centrifugal forces on a large particle will be more as compared to the small particles. As the result the large particles are likely to consolidate quickly as compared to the small particle. Thus the microstructure of the cast body will have distrusted particles along the thickness of the cast layer. The outer layer will have large particles as compared to the inner surface which will has small particles only. The observation can be an important clue to identify the causes of sudden defects. In particular centrifugal casting, used for manufacturing specimens, may generate a turbulent flow that produces gas entrapment and then air pockets or porosity formation after solidification. Other casting techniques allow a slower filling of the mould. If the liquid metal enters the mould with quiescent flow gas defects are greatly reduced. The analysis of cracks highlights that fracture paths seem to follow the trend of the turbulent flow and fracture surfaces are characterized by the presence of gas defects.

By using fine particle size, the problem arising from the centrifugal force can also be minimized that produces segregation in the melt due to which the non-uniform properties are attained. This suggests that in order to prevent this phenomenon the charge materials should be degreased and afterwards they should be preheated together with the crucible in a muffle to evaporate surface moisture. Further improvement can be obtained by pouring the alloy in vacuum in a preheated mould, leaving the casting to cool down in a furnace.

**Conclusions**

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