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Simulation and development of counter weight casting

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There is renewed interest in sand casting components due to new technological developments and simulation techniques. Several researchers have developed algorithms and softwares to simulate casting process and predict defects such as porosity, blow holes, cracks and cold shuts. The objective of this paper is to obtain defect free counter weight casting (component) by best gating system based on flow simulation. CAD model of one such critical component counter weight is done in ADSTEFAN software where process parameters like weight, type and temperature of the molten metal and no-bake sand are given as input and flow simulations of three iterations of different gating systems to obtain defect free casting are performed. Actual castings for three gating systems are developed and results (defects) are compared. From first principle, the sizes of risers and flow offs are calculated with cross sections being either rectangular/cylindrical/conical shapes.

Introduction

Counterweights are used to counterbalance load or to ensure better control. There are many examples in shipbuilding the keel acts as the boat counterweight, and counterbalances the roll.Counterweights are also used in several off-highway and material handling vehicles, such as excavators, mobile cranes they prevent vehicles from tipping over under the load.They are also used in agriculture to prevent tractors from tipping over under the load they are pulling or to penetrate deeper into the soil, and increase efficiency.Finally, they can be used as ballasting solutions for towers, wind turbines, tidal turbines just as a boat keels.

The mathematical formula to calculate the proper counterweight dimensions is always the same, starting with the force to be counterbalanced. The counterweight, due to its unique weight, has to provide a force which is at least equivalent but in an opposite direction.

The weight of a counterweight depends on its volume and on the mass density of the material used, using the following formula:

$P = V \times \mu \times g$

P is the weight of the required counterweight;

V is the volume;

μ is the mass density of the counterweight's material;

g is the gravitational constant.

Materials and Methods

1.Fabrication of Al/Diamond Particles Functionally Graded Materials by Centrifugal Sintered-Casting Method

The continuous graded structure of functionally graded materials (FGMs) can be created under a centrifugal force. Centrifugal sintered-casting (CSC) method, proposed by the authors, is one of the fabrication methods of FGM under centrifugal force. This method is a combination of the centrifugal sintering method and centrifugal casting method. In this study, Al/diamond particle FGM was fabricated by the proposed method.

2. Engineering design of centrifugal casting machine

Centrifugal casting is a metal casting process in which metal liquid is poured into a rotating mold at a specific temperature. Given round will generate a centrifugal force that will affect the outcome of the casting. Casting method is suitable in the manufacture of the casting cylinder to obtain better results. This research was performed to design a prototype machine by using the concept of centrifugal casting. The design method was a step-by-step systematic approach in the process of thinking to achieve the desired goal of realizing the idea and build bridges between idea and the product.

3. Surface Hardening of Composite Material by the Centrifugal-Casting Method

The effect of rotation flow emerging under centrifugal casting on the first-order phase transition, i.e., crystallization, has been studied using the example of producing a gradient composite material of AK12 aluminum alloy in a mixture with basalt fibers. It has been shown that a material with a hardened surface can be created. Distribution of admixtures in the main material when there is macroscopic motion has been found.

4. Pressure distribution in centrifugal dental casting

Equations are developed for liquid metal pressure in centrifugal dental casting, given the instantaneous rotational velocity, den-

Note : This work is partly presented at Joint Event On 21st International Conference on Advanced Materials & Nanotechnology on September 04-06, 2018 | Zurich, Switzerland

sity, and certain dimensions of the casting machine and casting pattern. A "reference parabola" is introduced making the fluid pressure concept more understandable. A specially designed specimen demonstrates experimentally the reference parabola at freezing.

5. The potential of centrifugal casting for the production of near net shape uranium parts

This report was written to provide a detailed summary of a literature survey on the near net shape casting process of centrifugal casting. Centrifugal casting is one potential casting method which could satisfy the requirements of the LANL program titled Near Net Shape Casting of Uranium for Reduced Environmental, Safety and Health Impact. In this report, centrifugal casting techniques are reviewed and an assessment of the ability to achieve the near net shape and waste minimization goals of the LANL program by using these techniques is made. Based upon the literature reviewed, it is concluded that if properly modified for operation within a vacuum, vertical or horizontal centrifugation could be used to safely cast uranium for the production of hollow, cylindrical parts.

6. Solidification microstructure of centrifugally cast Inconel 625

Full Text Available Centrifugal casting is a foundry process allowing the production of near net-shaped axially symmetrical components. The present study focuses on the microstructural characterization of centrifugally cast alloys featuring different chemical compositions for the construction of spheres applied in valves made of alloy IN625 for operation at high pressure. Control of the solidification microstructure is needed to assure the reliability of the castings. Actually, a Ni-base superalloy such as this one should have an outstanding combination of mechanical properties, high temperature stability and corrosion resistance. Alloys such as IN625 are characterised by a large amount of alloying elements and a wide solidification range, so they can be affected by micro-porosity defects, related to the shrinkage difference between the matrix and the secondary reinforcing phases (Nb-rich carbides and Laves phase.

7. Centrifugal Casting Features/Metallurgical Characterization of Aluminum Alloys

This paper deals with the study of centrifugal effects on aluminium castings under high G values. Most of the studies in this domain (FGMs obtained by centrifugal casting) deal with functionally graded composites reinforced with a solid phase such as silicon particles or others. However, in this study it will be shown that unreinforced aluminium alloys may be significantly influenced by the centrifugal effect and that functionally graded castings are also obtained. It has been observed that the centrifugal effect may increase in some alloys, depending on the relative position in the castings, the rupture strength by approx. 50%, and rupture strain by about 300%, as compared to the gravity casting technique. The Young's modulus may also increase by about 20%. It has also been reported that in vertical centrifugal castings there are mainly three aspects that affect the components thus obtained, namely: fluid dynamics; vibration (inherent to the system); and centrifugal force. These features have a different effect on the castings depending on the aluminium alloy. In this paper, an analysis of the most important effects of the centrifugal casting process on metallurgical features is conducted.

8. Casting methods

A casting device includes a covered crucible having a top opening and a bottom orifice, a lid covering the top opening, a stopper rod sealing the bottom orifice, and a reusable mold having at least one chamber, a top end of the chamber being open to and positioned below the bottom orifice and a vacuum tap into the chamber being below the top end of the chamber. A casting method includes charging a crucible with a solid material and covering the crucible, heating the crucible, melting the material, evacuating a chamber of a mold to less than 1 atm absolute through a vacuum tap into the chamber, draining the melted material into the evacuated chamber, solidifying the material in the chamber, and removing the solidified material from the chamber without damaging the chamber.

Results

In metalworking and jewellery making, casting is a process in which a liquid metal is somehow delivered into a mold (usually by a crucible) that contains a negative impression (i.e., a three-dimensional negative image) of the intended shape. The metal is poured into the mold through a hollow channel called a sprue. The metal and mold are then cooled, and the metal part (the casting) is extracted. Casting is most often used for making complex shapes that would be difficult or uneconomical to make by other methods.Casting processes have been known for thousands of years, and have been widely used for sculpture (especially in bronze), jewellery in precious metals, and weapons and tools. Traditional techniques include lost-wax casting (which may be further divided into centrifugal casting, and vacuum assist direct pour casting), plaster mold casting and sand casting.The modern casting process is subdivided into two main

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categories: expendable and non-expendable casting. It is further broken down by the mold material, such as sand or metal, and pouring method, such as gravity, vacuum, or low pressure.

Summary

Casting is a process in which a liquid metal is somehow delivered into a mold (usually by a crucible) that contains a negative impression (i.e., a three-dimensional negative image) of the intended shape. The metal is poured into the mold through a hollow channel called a sprue. The metal and mold are then cooled, and the metal part (the casting) is extracted. Casting is most often used for making complex shapes that would be difficult or uneconomical to make by other methods.Casting processes have been known for thousands of years, and have been widely used for sculpture (especially in bronze), jewellery in precious metals, and weapons and tools. Traditional techniques include lost-wax casting (which may be further divided into centrifugal casting, and vacuum assist direct pour casting), plaster mold casting and sand casting.The modern casting process is subdivided into two main categories: expendable and non-expendable casting. It is further broken down by the mold material, such as sand or metal, and pouring method, such as gravity, vacuum, or low pressure.

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