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"Alternative Casting Methods for Large Sized Component over Sand Casting Methods: A Review "

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ABSTRACT

In this research work an attempt has been made to check the suitability of other mtheod of casting for large sized bed casting. When a large sized compent is to be made by sand then we need to break whole casting in more than one section and wooden or metal pattern also be manufactured according to section. These pattern are costly and requires drafting allowances. So when we need to cast large sige component it leads to wastage of material given by drafting allowances and increase the cost of material. So in this research we find out other suitable method of casting for large sized component.

Keyword: *Sand, Pattern, Casting, Cavity, Mold*

I. Introduction

Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a *casting*, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various *cold setting* materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods. A large number of metal components in designs we use every day are made by casting.

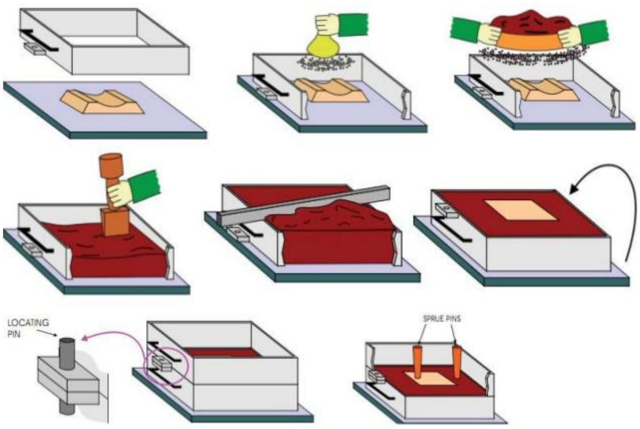

Figure1.1 Sand Casting

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1.1 Other Methods Of Casting:

1.1.1 Centrifugal casting

Centrifugal casting is both gravity and pressure-independent since it creates its own force feed using a temporary sand mold held in a spinning chamber at up to 900 N (90 g). Lead time varies with the application. Semi- and true-centrifugal processing permit 30-50 pieces/hr-mold to be produced, with a practical limit for batch processing of approximately 9000 kg total mass with a typical per-item limit of 2.3-4.5 kg. Industrially, the centrifugal casting of railway wheels was an early application of the method developed by German industrial company Krupp and this capability enabled the rapid growth of the enterprise.

1.1.2 Permanent mold casting

Permanent mold casting (typically for non-ferrous metals) requires a set-up time on the order of weeks to prepare a steel tool, after which production rates of 5-50 pieces/hr-mold are achieved with an upper mass limit of 9 kg per iron alloy item (cf., up to 135 kg for many nonferrous metal parts) and a lower limit of about 0.1 kg. Steel cavities are coated with a refractory wash of acetylene soot before processing to allow easy removal of the workpiece and promote longer tool life. Permanent molds have a limited life before wearing out. Worn molds require either refinishing or replacement. Cast parts from a permanent mold generally show 20% increase in tensile strength and 30% increase in elongation as compared to the products of sand casting.

1.1.3 Continuous casting

Continuous casting is a refinement of the casting process for the continuous, high-volume production of metal sections with a constant cross-section. Molten metal is poured into an open-ended, water-cooled copper mold, which allows a 'skin' of solid metal to form over the still-liquid centre. The strand, as it is now called, is withdrawn from the mold and passed into a chamber of rollers and water sprays; the rollers support the thin skin of the strand while the sprays remove heat from the strand, gradually solidifying the strand from the outside in. After solidification, predetermined lengths of the strand are cut off by either mechanical shears or travelling oxyacetylene torches and transferred to further forming processes, or to a stockpile. Cast sizes can range from strip (a few millimeters thick by about five meters wide) to billets (90 to 160 mm square) to slabs (1.25 m wide by 230 mm thick). Sometimes, the strand may undergo an initial hot rolling process before being cut.

1.1.4 Investment casting

Investment casting (known as lost-wax casting in art) is a process that has been practiced for thousands of years, with lost wax process being one of the oldest known metal forming techniques. From 5000 years ago, when bees wax formed the pattern, to today’s high technology Waxes, refractory materials and specialist alloys, the castings ensure high quality components are produced with the key benefits of accuracy, repeatability, versatility and integrity.

The process is suitable for repeatable production of net shape components, from a variety of different metals and high performance alloys. Although generally used for small castings, this process has been used to produce complete aircraft door frames, with steel castings of up to 300 kg and aluminum castings of up to 30 kg. Compared to other casting processes such as die casting or sand casting it can be an expensive process, however the components that can be produced using investment casting can incorporate intricate contours, and in most cases the components are cast near net shape, so requiring little or no rework once cast.

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1.1.5 Lost Wax Casting

Lost-wax process, also called cire-perdue, method of metal casting in which a molten metal is poured into a mold that has been created by means of a wax model. Once the mold is made, the wax model is melted and drained away. A hollow core can be effected by the introduction of a heat-proof core that prevents the molten metal from totally filling the mold. Common on every continent except Australia, the lost-wax method dates from the 3rd millennium BC and has sustained few changes since then.

To cast a clay model in bronze, a mold is made from the model, and the inside of this negative mold is brushed with melted wax to the desired thickness of the final bronze. After removal of the mold, the resultant wax shell is filled with a heat-resistant mixture. Wax tubes, which provide ducts for pouring bronze during casting and vents for the noxious gases produced in the process, are fitted to the outside of the wax shell, which may be modeled or adjusted by the artist. Metal pins are hammered through the shell into the core to secure it. Next, the prepared wax shell is completely covered in layers of heat-resistant plaster, and the whole is inverted and placed in an oven. During heating, the plaster dries and the wax runs out through the ducts created by the wax tubes. The plaster mold is then packed in sand, and molten bronze is poured through the ducts, filling the space left by the wax. When cool, the outer plaster and core are removed, and the bronze may receive finishing touches.

1.1.6 Lost Foam Casting

Lost foam casting technique (LFC) is known by different generic and propriety names like lost foam, evaporative pattern casting, evaporative foam casting, full mold, etc. Similar to the full mold process, in this process the pattern evaporates when the metal is poured into the mold. Lost foam casting is a type of metal casting process that uses expendable foam patterns to produce castings. Expanded polystyrene foam is used which melts when molten metal is poured into the mold.

Application: Lost foam casting is used mostly for automotive applications. Cast iron, aluminum alloys, steels, nickel and in some cases stainless steel and copper alloys are cast in this process. The flexibility of LFC is useful in making complicated casting assemblies for automotive parts like cylinder heads, weldments etc. This simple and inexpensive method is used in hobby foundry work.

1.1.7 Injection moulding

Injection moulding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection moulding, which vary greatly in their size, complexity, and application. The injection moulding process requires the use of an injection moulding machine, raw plastic material, and a mold. The plastic is melted in the injection moulding machine and then injected into the mold, where it cools and solidifies into the final part.

Injection moulding is used to produce thin-walled plastic parts for a wide variety of applications, one of the most common being plastic housings. Plastic housing is a thin-walled enclosure, often requiring many ribs and bosses on the interior. These housings are used in a variety of products including household appliances, consumer electronics, power tools, and as automotive dashboards. Other common thin-walled products include different types of open containers, such as buckets. Injection moulding is also used to produce several everyday items such as toothbrushes or small plastic toys. Many medical devices, including valves and syringes, are manufactured using injection moulding as well.

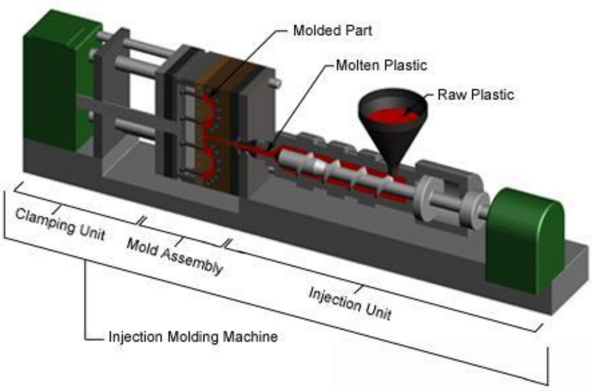

Figure1.2 Injection Moulding

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II. LITERATURE SURVEY

Rupinder Singh [1] studied on Comparison of Investment Castings Prepared With Wax and ABS Patterns. In his research work comparison has been made for dimensional accuracy of hip joint prepared by investment castings process using conventional wax and acrylonitrile butadiene styrene (ABS) as pattern material. Two controllable process variables namely: numbers of slurry layers and type of pattern material have been considered for comparison. An approach to model dimensional accuracy of hip joint has been proposed and applied. International tolerance (IT) grade of cast components was tested and found acceptable as per ISO standard UNI EN 20286-I (1995) and further at proposed parametric settings, process has been found to be statistically controlled.

Rupinder Singh[2] also studied himself with Investigations for Dimensional Accuracy of Investment Casting Process after Cycle Time Reduction by Advancements in Shell Moulding. In the present work advancement in replication techniques for a biomedical component having a real 3D shape has been introduced. A hip joint, made of ABS material, was fabricated as a master pattern (as one of a real 3D biomedical implant) by fused deposition modelling (FDM). After this mold was made by the deposition of primary, secondary and tertiary coatings with the addition of nylon fiber (1-2cm in length of 1.5D) as per the Taguchi L9 control log of experimentation. This study outlines replication procedure of hip joint in detail from the master pattern to a final product with some investigation on dimensional accuracy. The results of study highlights that during shell production, fiber modified shells had a much reduced drain time. This gave a higher ceramic retention rate after dipping and led to a thicker coat compared to that produced without fiber addition.

M.A. Sellés [3] Analyses and reviews different tools to calculate the production economics in injection molding. This was done to make a small review of computer-aided software based mainly on the calculation of the injection molding cost. Only a representative portion will be discussed in this paper. An injection molding machine can produce thousands of pieces per day, depending on many factors. A small improvement in the cost per piece can have a significant impact on the industry. These factors have to be carefully considered by the software in order to make accurate estimations. A total of 5 programs are fully analyzed in this contribution, and this is useful to achieve good cost estimation for the injection molding process. The main characteristics and/or features of each of them are also described.

D.Caulk [4] describes the analysis method, assumptions, and governing equations, paper discusses applications of the analysis to a variety of pattern shapes that exhibit different types of mold filling behavior, many of which are unique to lost foam casting. The first example compares mold filling in a horizontal foam strip filled from the side with filling in the same strip oriented vertically and filled from the top or bottom. The results illustrate the unusual effect that pattern orientation and thickness have on metal fluidity in lost foam casting. The second example, a rectangular plate filled through a single inlet located on a top, bottom or side edge, illustrates how different modes of foam decomposition can interact during the filling of a single pattern. The mold filling sequence turns out to be dramatically different depending on inlet location and pattern thickness. The third example is a generic box pattern that has long been used at GM and elsewhere to study the lost foam process. This pattern is filled from the back through three separate inlets, creating two merging flow fronts inside the cavity. The likelihood of these metal fronts enclosing foam between them when they come together is explored by examining the concavity of their flow front profiles. For several cases considered in this paper, the results of the analysis are compared with X-ray and neutron radiography images taken during actual mold filling.

M. khodai et all.[5] In the Lost Foam Casting process, melting point temperature of metal, as well as volume and rate of the foam degradation have significant effect on the mold filling pattern. Therefore, gas generation capacity and gas gap length are two important parameters for modeling of mold filling time of the lost foam casting processes. In this paper, the gas gap length at the liquidfoam interface for a low melting point (aluminum) alloy and a high melting point (Carbon-steel) alloy are investigated by the photography technique. Results of the photography technique indicated, that the gas gap length and the mold filling time are increased with increased coating thickness and density of the foam. The Gas gap lengths measured in aluminum and Carbon-steel, depend on the foam density, and were approximately 4-5 and 25-60 mm, respectively. By using a new system, the gas generation capacity for the aluminum and steel was measured. The gas generation capacity measurements indicated that gas generation in the Aluminum and Carbon-steel lost foam casting was about 50 CC/g and 3200 CC/g polystyrene, respectively.

S. Shivkumar [6] Explained In the Lost Foam Casting process, melting point temperature of metal, as well as volume and rate of the foam degradation have significant effect on the mold filling pattern. Therefore, gas generation capacity and gas gap length are two important parameters for modeling of mold filling time of the lost foam casting processes. In this paper, the gas gap length at the liquidfoam interface for a low melting point (aluminum) alloy and a high melting point (Carbon-steel) alloy are investigated by the photography technique. Results of the photography technique indicated, that the gas gap length and the mold filling time are increased with increased coating thickness and density of the foam. The Gas gap lengths measured in aluminum and Carbon-steel, depend on the foam density, and were approximately 4-5 and 25-60 mm, respectively. By using a new system, the gas generation capacity for the aluminum and steel was measured. The gas generation capacity measurements indicated that gas generation in the Aluminum and Carbon-steel lost foam casting was about 50 CC/g and 3200 CC/g polystyrene, respectively.

III. OVERVIEW

Comparing the advantages and disadvantages of various metal casting processes, sand Casting, no-bake sand molding, resin shell sand molding, lost wax investment casting, die casting, lost foam, permanent mold, and centrifugal molding processes. It is observed that Lost foam casting has good results for large sized. Lost foam casting has less prepration cost as compare to other method with best in class surface finish.
Lost foam casting has zero drafting allowances as pattern is made by thermocol and evaporated at the time of pouring moten metal. This saves lots of wastages and reduces machining time.

III. CONCLUSION

Sand Cassting is oldest form of casting, it requires time as well as cost and not very much suitable for large sized component casting. So if large component is to cast then Lost foam casting is good because it hold following points:

- Can be used for precision castings of ferrous and non-ferrous metals of any size.
- Fewer steps are involved in foamcast - lost foam casting process as compared to sand casting.
- Core making is eliminated.
- Binders or other additives and related mixing processes are eliminated.
- High dimensional accuracy can be achieved and thin sections can be cast (i.e. 3 mm).
- There is lower capital investment.
- The flasks used are less expensive and easier to use because they are in one piece.
- The need for skilled labor is reduced.
- Multiple castings can be combined in one mold to increase pouring efficiency.
- Consistent casting quality

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