Design And Fabrication of Rectangular Die For Stir Casting

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Abstract- *Stir casting is a liquid state method for fabrication of composite material in which a dispersed phase is mixed with molten matrix method by means of mechanical stirring it is the simplest, most cost effective and widely used method of liquid state fabrication. The stir casting setup is used to produce cylindrical and rectangular component samples, since there is commonly availability of only cylindrical die. Using this die, only the machining studies of turning and milling can be analysed. In case to study the machining characteristics of drilling, slotting it is needed to machine cylindrical sample into a rectangular or square component. This intake, increases the machining cost and production time. In this work, to overcome this problem a rectangular die is designed and it is fabricated for further preparation of rectangular samples.*

Keywords- Modeling software CATIA V5,Sand casting, Shot blasting ,conventional machining fabrication process .

I. INTRODUCTION

Stir casting is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix metal by means of mechanical stirring. The liquid composite material is then cast by conventional casting methods and may also be processed by conventional Metal forming technologies. In preparing metal matrix composites by stir casting method some of the factors that need considerable attention are as follows,

i) To achieve uniform distribution of the reinforcement material.
ii) To achieve wettability between the two main substances.
iii)To minimize porosity in the cast metal matrix composite

STIRRER DESIGN

It is very important parameter in stir casting process which is required for vortex formation. The blade angle and number of blades decides the flow pattern of the liquid metal. The stirrer is immersed till two third depth of molten metal. All these are required for uniform distribution of reinforcement in liquid metal, perfect interface bonding and to avoid clustering.

STIRRER SPEED

Stirring speed is an important parameter to promote binding between matrix and reinforcement i.e. wettability. Stirring speed decides formation of vortex which is responsible for dispersion of particulates in liquid metal.

STIRRING TEMPERATURE

Particle distribution depends on change in viscosity. The viscosity of matrix is mainly influenced by the processing temperature. The viscosity of liquid is decreased by increasing processing temperature with increasing holding time for stirring which also promote binding between matrix and reinforcement. Good wettability is obtained by keeping temperature at specified temperature.

STIRRING TIME

As stirring promote uniform distribution of reinforcement partials and interface bond between matrix and reinforcement, stirring time plays a vital role in stir casting method.

PREHEAT TEMPERATURE OF REINFORCEMENT

Casting process of Aluminium Matrix Composite's (AMC's) is difficult due to very low wettability of and agglomeration phenomenon which results in non-uniform distribution and poor mechanical properties. Reinforcement is heated to 500°C for 40 minutes. It removes moisture as well as gases present in reinforcement.

PREHEAT TEMPERATURE OF MOULD

Porosity is the major problem in casting. In order to avoid porosity preheating of mould is good solution. It helps in removing the entrapped gases from the slurry to go into the mould. Meld is heated to 500°C for one hour.

POURING OF MELT

Pouring rate and pouring temperature plays significant role in quality of casting. Pouring rate of slurry must be uniform to avoid entrapping of gases. The distance between mould and crucible also plays vital role in quality of casting. Apart from these size of reinforcement plays significant role in quality of casting.

EXPERIMENTAL SETUP AND PROCEDURE FOR FABRICATION OF AMC

The process of stir casting starts with placing empty crucible in the furnace. The heater temperature is then gradually increased up to 800°C. Aluminium alloy is cleaned to an improvement in mechanical electrical and thermal properties. Epoxy and its composites are widely used in coatings, potting, adhesives, encapsulation of semiconductors, laminates .Adding silica to epoxy matrix enables lower shrinkage on curing, reduction in coefficient of remove dust particles, weighed and charged in the crucible for melting. Required quantities of reinforcement powder and magnesium powder are weighed on the weighing machine. Reinforcements are heated for 45 minutes at a temperature of 500°C.

When matrix was in the semisolid stage condition at 650°C, 1 % by weight of pure magnesium powder is used as wetting agent. After five minutes the scum powder is added which forms a scum layer of impurity on liquid surface which to be removed. Heater temperature is then gradually increased to 800°C.

Figure 1.Stir Casting Setup

At this heater temperature stirring is started and continued for five minutes. Stirring rpm is gradually increased from 0 to 300 RPM with the help of speed controller. Preheated reinforcements are added during five minutes of stirring. Reinforcements are poured manually with the help of conical hopper. The flow rate of reinforcements measured is 0.5 gram per second. Stirrer rpm is then gradually lowered to the zero. Then molten composite slurry is poured in the metallic mould without giving time for reinforcement to settle down at crucible bottom. Mould is preheated at 500°C temperature for one hour before pouring the molten slurry in the mould. This is necessary to maintain slurry in molten condition throughout the pouring.

II. DESIGN RECTANGULAR DIE BY USING CATIA V5 SOFTWARE

Commonly referred to as a 3D Product Lifecycle Management software suite, CATIA supports multiple stages of product development CAx, including conceptualization, design CAD engineering CAE and manufacturing CAM. CATIA facilitates collaborative engineering across disciplines around its 3D experience platform, including surfacing & shape design, electrical, fluid and electronic systems design, mechanical engineering and systems engineering.

CATIA facilitates the design of electronic, electrical, and distributed systems such as fluid and HVAC systems, all the way to the production of documentation for manufacturing.

CATIA enables the creation of 3D parts, from 2D sketches, sheetmetal, composites, molded, forged or tooling parts up to the definition of mechanical assemblies. The software provides advanced technologies for mechanical surfacing & BIW. It provides tools to complete product definition, including functional tolerances as well as kinematics definition. CATIA provides a wide range of applications for tooling design, for both generic tooling and mold & die. In the case of Aerospace engineering an additional module named the aerospace sheetmetal design offers the user combine the capabilities of generative sheetmetal design and generative surface desin.

MATERIAL REQUIREMENT

Rectangular Sample of Size 152mm x 82mm x 12mm

Mass = Density x volume

Density for aluminium = 2700 kg/cm3

Volume = 152x82x12

= 149568 mm3

Mass = Density x Volume

= 2700x1.495x10-4

= 0.4036 kg

DIE DESIGN – CATIA V5

As per the drawing the design can be done by using CATIA V5 modeling software.

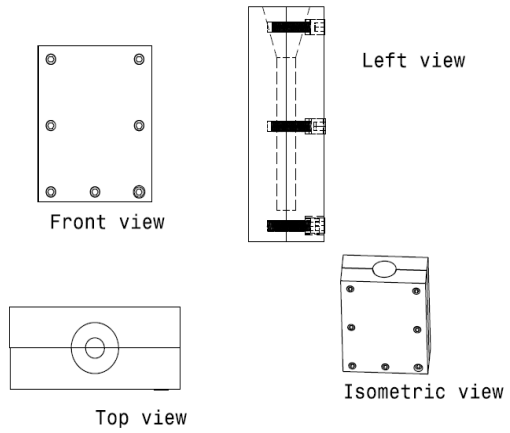

Figure 2. Rectangular die.

DIE 1 DESIGN

Die 1 is designed as per the dimension given below.standard

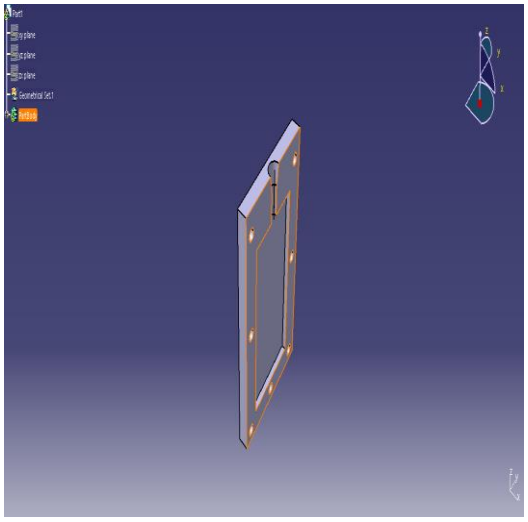

Figure 3. Rectangular die 1 part moduling

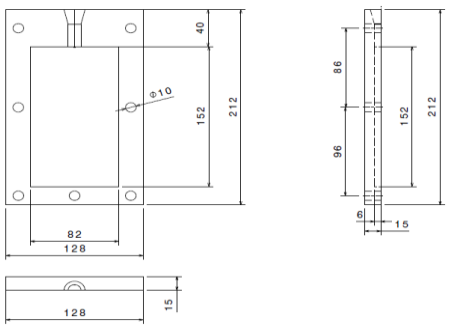

Figure 4. Rectangular die 1 dimensions in mm

DIE 2 DESIGN

Die 2 is designed as per dimension given below.

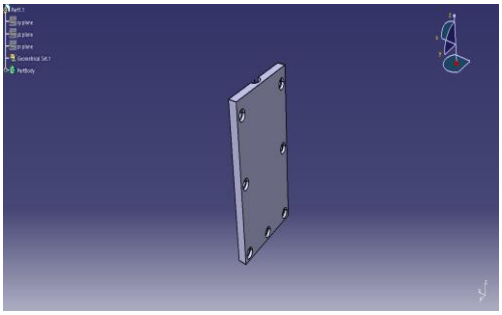

Figure 5. Rectangular die 2

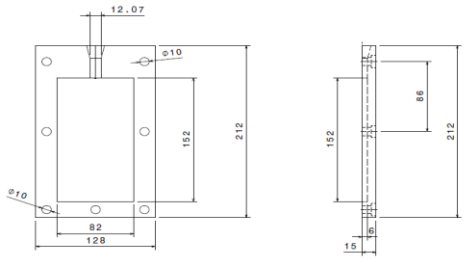

Figure 6. Rectangular die 2 dimensions in mm

ASSEMBLY

The rectangular die is designed and assembled by using CATIA V5 software.

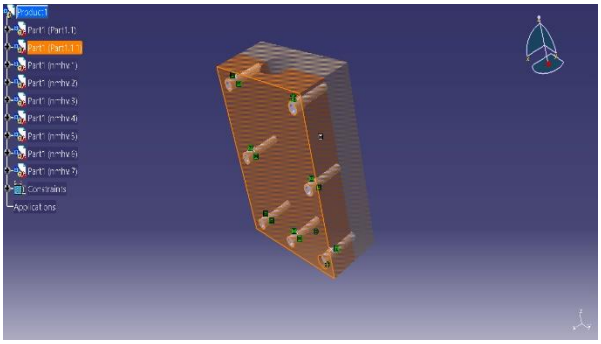

Figure 7. Rectangular die assembled view

III.DIE FABRICATION

SAND MOULDIND

Sand Moulding Method used in Casting Process-Ramming and Compressing: Whatever the force required for ramming and compressing of moulding sand if it is obtained from a human hand, then it is called as hand moulding.

Figure 8. Sand moulding after pouring

FACE MILLING

In face milling, the cutting action occurs primarily at the end corners of the milling cutter. Face milling is used to cut flat surfaces faces into the workpiece, or to cut flat-bottomed cavities.

Figure 9. Face Milling Operation

POCKET MILLING

Pocket milling has been regarded as one of the most widely used operations in machining. It is extensively used in aerospace and shipyard industries. In pocket milling the material inside an arbitrarily closed boundary on a flat surface of a work piece is removed to a fixed depth. Generally flat bottom end mills are used for pocket milling. Firstly roughing operation is done to remove the bulk of material and then the pocket is finished by a finish end mill. Most of the industrial milling operations can be taken care of by 2.5 axis CNC milling. This type of path control can machine up to 80% of all mechanical parts. Since the importance of pocket milling is very relevant, therefore effective pocketing approaches can result in reduction in machining time and cost.[9]NC pocket milling can be carried out mainly by two tool paths, viz. linear and non-linear.

LINEAR TOOL PATH

In this approach, the tool movement is unidirectional. Zig-zag and zig tool paths are the examples of linear tool path. In zig-zag milling, material is removed both in forward and backward paths. In this case, cutting is done both with and against the rotation of the spindle. This reduces the machining time but increases machine chatter and tool wear.

Figure10. Pocket milling operation and zig zag tool path

DRILLING

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips from the hole as it is drilled.

TAPPING

A tap cuts or forms a thread on the inside surface of a hole, creating a female surface which functions like a nut. The three taps in the image illustrate the basic types commonly used by most machining.

ASSEMBLING

The rectangular die is manufactured as per the dimension and it can be assembled by using align screw.

Figure 11. Assembled view of Rectangular die

IV. CONCLUSION

The rectangular die has been designed and fabricated. In general, circular die section are widely used. By fabrication of this particular Die, rectangular samples can be fabricated which shall be used for machining studies of milling, drilling and slotting operations.

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