Design and Development of Aluminium Die Casting for Automobile Wiper Motor Casting

Taranjyot Singh Birdi[1], Pranav Rajendra Salvi[2], Swapnil Dinkar Nehe[3]

[1]*Taranjyot Singh Birdi, Mechanical Engineering & Guru Gobind Singh College of Engineering and Research centre Nashik*
[2]*Pranav Rajendra Salvi, Mechanical Engineering & K K Wagh Institute of Engineering Education and research Nashik*
[3]*Swapnil Dinkar Nehe, Mechanical Engineering & K K Wagh Institute of Engineering Education and research Nashik*

Abstract - *The die casting process is an effective near-net shape manufacturing process for producing geometrically complex components which require a high production rate and an excellent surface finish. This work focuses on designing of aluminum casting die used for automobile wiper motor casing. There are two main types of die casting machines-hot chamber machines (used for alloys with low melting temperatures, such as zinc) and cold chamber machines for alloys such as aluminum alloy.*

Key Words: Die casting, Manufacturing process, Aluminum casting, Temperatures, alloys.

1.INTRODUCTION

Design is that the creation of an idea or convention for the development of an object, system or human interaction. Various components are created virtually with the assistance of software then assembled virtually. Software simulation comes in handy while calculating stresses over the article and also provides quick results as compared to sampling. Casting may be a 6000-year-old manufacturing process. Casting is most frequently used for creating complex shapes that may be difficult or uneconomical to create by other methods. There are two basic die casting processes, hot chamber and cold chamber. Hot chamber die casting is preferred for depression whereas cold chamber is preferred for top pressure. The die casting process involves the employment of a furnace, metal, die casting machine, and die. Pressure die casting will be defined as a process by which a casting is formed by injection molten metal under the high into a permanent mould, called a die.

1.1 LITERTURE SURVEY

Modern production of air mass die casting parts raises new challenges regarding planning, scheduling and analysing of the underlying manufacturing process. The described architecture enhances the event of recent information applications, accelerates the design and execution process and is totally orientated to the strain of users. Drawings part involves many parameters like punch and dies radius, clearance, lubrication, blank holding force and its trajectories etc. Process will be simulated by using finite element packages. Fertile element analysis was wont to analyses the draw-wall wrinkling during a stamping process. Die casting may be a manufacturing process which will produce geometrically complex metal parts through the employment of reusable molds, called dies. The continued growth of the die casting process depends, to an outsized extent, on the greater use of die castings within the automotive industry.

2. PROBLEM STATEMENT

High pressure die casting allows for continuous rapid manufacturing while also providing higher strength and surface finish. Mechanical properties of die cast components are passionate about the standard of the die castings. the flexibility of the fabric to tolerate wear induced by molten alloys and fatigue caused by multiple heating and expansion determines the die life.

3. PROPOSED METHOD/SYSTEM

The former methodology includes the standard way of product design following these steps. It includes cost and other financial parameters associating the manufacturing of the merchandise. The stages of tool design will be divided into three major divisions, namely; Analytical and experimental approach, Trial and Quality Check.

4. METHODOLOGY

1. Create a component and a tool: We receive a comprehensive 2D drawing of the component to be made up of the OEM (original equipment manufacturer). Using software, this drawing gets converted into a 3D model. The article area may be a reflexion of the cast which will be made. The stages of tool design are often classified into three categories: a) preproduction, b) production, and c) post production.c) Postproduction

2. Methodology (analytical and experimental)

3. Perform a shot

4. Internal control and testing

5. Quotation: It covers the value and other financial factors related to the product's manufacturing; because the fabric accustomed make the die is pricey, the OEM supplies us with the supplies. the subsequent factors are included within the quotation: a) Tool cost; b) Production – PDC machine tonnage; c) Machining – CNC, VMC, and standard machining; and d) Dispatch – packing.

4. DESIGN PROCEDURE

The following are some of the considerations to make when creating a casting to be made through casting method:

Wall Thickness: Keep the casting's wall thickness as consistent as possible, or have it taper gradually from the thinnest area farthest from the gate to the heaviest section at the gate. The wall thickness should be large enough to allow adequate filling but small enough to ensure quick cooling of the metal.

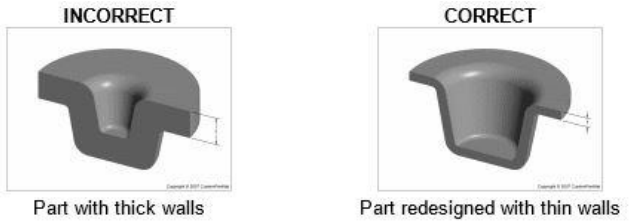

Fig -1: Wall thickness

Cu, Mg = 1.27 to 2.29 mm minimum wall thickness 0.76 to 5.03 mm Al 0.38 to 1.29 mm Zn 0.76 to 1.52 mm Sn Maximum thickness of the walls 7.93 mm is preferred, but 12.7 mm is more common. As the surface area of the casting rises, the section thickness increases.

Ribs: Ribs can be used to strengthen the casting's strength and stiffness. This reduces the weight of the casting, which allows for better metal distribution within the die. rib height >/ 5*wall thickness.

Corner radii and fillets: Sharp corners and fillets should be avoided in all castings. Corners must have appropriate radii. Because the metal is injected into the die under high pressure, die casting allows for the smallest corner radii when compared to other casting methods. Fillet radius = 1/2 * wall thickness for low melting point alloys. The fillet radius should not be higher than the wall thickness to avoid an unwanted concentration of metal at a corner.

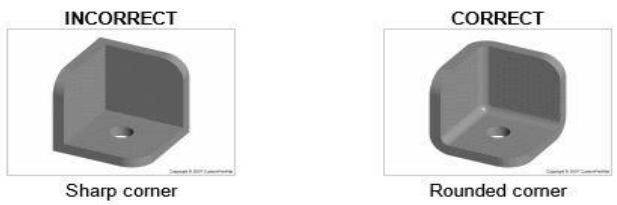

Fig -2: Corner radii and fillets

Draft: The amount and position of draught on a casting are determined by the placement of the casting in the die and whether it is an exterior surface or a cored hole. The casting can be expelled without undue wear on the die cavity due to draught on the die surfaces normal to the parting line. The following is an example of a draught allowance: 1 in 100 for Al and Mg (minimum 1 degree draught, maximum depending on task length) 1 in 200 when it comes to Zn.

Machining allowance: Various products in the casting process require machining such as drilling, CNC/VMC, and so forth. The extra material was then poured into the casting. Other characteristics: Dimensional tolerance 0.025 to 0.178 mm up to first 25 mm size 0.025 to 0.050 mm for additional 25 mm size. Machine finish allowance: 0.79 to 0.40 mm .Surface roughness: 1.02 to 2.54 µm. overall size: Maximum=Zn = 34 kg Al = 45 kgMg = 20 kgMinimum = < 0.028 kg .Optimum lot size: 1000 to 1,00,000. Tooling cost: high. Direct labor cost, finishing cost, scrap loss: low

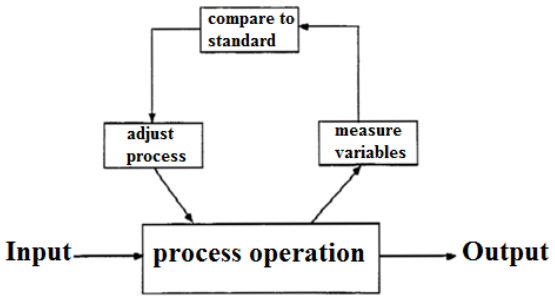

Chart -1: Design procedure

4. DIE COMPONENTS AND DESCRIPTION

1. 3D model of the Die:

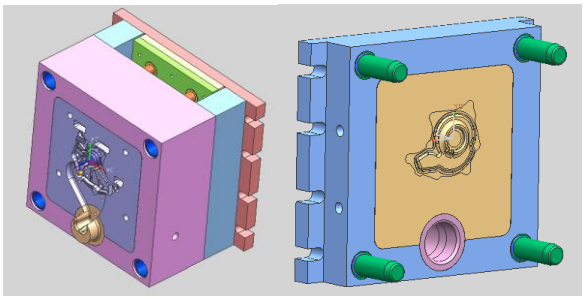

Fig -3: 3D model of moveable and fixed housing

2. Parting line: A mark or line generated on the cast at the junction of the parting dies is known as a parting line.

3. Fixed housing: Assemble the housing: this is the tool's first part. It contains a provision for plunger shot and supports the die tool's fix insert. During the operation of the machine, the housing remains stationary, as the name implies.

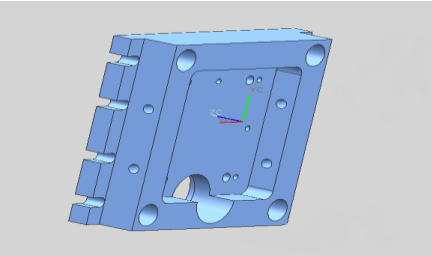

Fig -4: Fixed housing

4. Moving housing: The moving housing is the part of the die tool that slides back and forth while clamping and unclamping of the two housings. It has the provision for ejection holes and is the working part of a die tool with toggle link and hydraulic actuations.

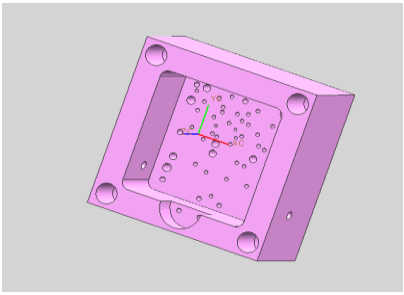

Fig -5: Moving housing

5. Fixed insert & Moving insert: The name comes from the fact that it is the half of the actual tool that is installed on the fixed insert. Moving insert it holds the opposite side of the instrument in place. It is susceptible to a variety of forces that are always changing.

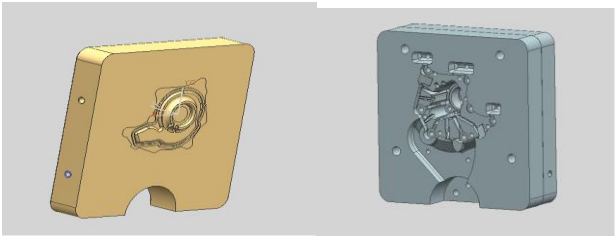

Fig -6: Fixed Insert & Moving Insert

6. Ejector plate & Ejector back plate: This plate is responsible for holding the ejector pins and bushes. With ejection pins, bushes, and ejection pillars, it supports the ejector plate. It serves as a supplemental support for the moving housing, with the primary function of actuating the ejector pins.

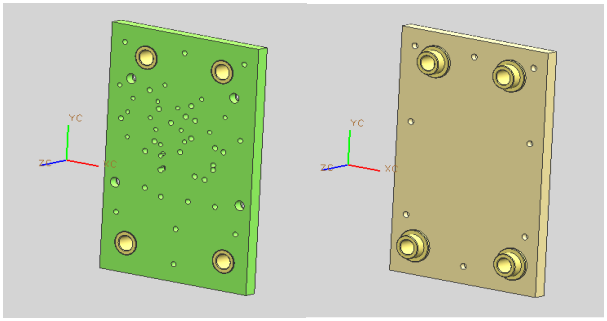

Fig -7: Ejector plate & Back plate

7. Die back plate & Diffuser: It supports the die block as well as the movement of the moving housing in the toggle link action. This device was used to direct molten metal to the casting gate.

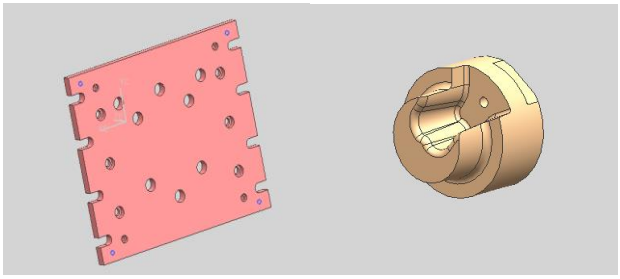

Fig -8: Die back plate & Diffuser

5. SCOPE / ASPECTS

PEC's product and manufacturing solutions are distinguished from the competition by a desire for innovation. Casting is the most cost-effective and efficient method of creating alloy components that have higher toughness and rigidity than welded or machined components. The current situation — The OEM (original equipment manufacturer) is dealing with issues such as manufacturing delays and work loads for various products. As a result, for a cheaper cost and the same quality of product, the OEM imports components from diverse mass producers.

6. CONCLUSION

Die Tool design was recognised for the component water pump housing. The housing design is finished and forwarded to the factory for production. Manufacturing will take place in a precision engineering business in Nashik on a tool producing VMC machine. The proposed die tool will aid in high precision while also shortening the time between jobs. As a result, the rate of output increases. We've established a new fill ratio of 70:30, in which 70 represents the article and 30 represents waste. Because of the new material selection, the tool's life will be extended, and the die tool's wear will be reduced. The performance of the die tool for manufacturing will undoubtedly satisfy those in the sector.

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