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Design and Simulation Study of Electronic Enclosure Component using Solid Works for Mould Flow Analysis

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A B S T R A C T

Products made by plastic are in high demand in the current world due to their numerous helpful characteristics. Injection moulding is one of the most used methods of producing plastic items. A moulding tool is required to create the desired form. This study focus on the moulding of electrical housing connectors. ABS FR AN450M is the material used to manufacture the component. This component can be made using standard moulding techniques. For a better understanding, the first component study and design are completed. A conceptual design is completed prior to tool manufacturing, since manufacturing requires designs and drawings for reference. Mold flow analysis, which takes into account the physical and thermal properties of the material, provides a better knowledge of the required parameters for tool design. The tool design process begins with moulding process that uses a screw and an external heating device to melt the material and then injects it into a mould to make the appropriate product as the mould cools.

Keywords: Housing Connector, Contact cavities, Pin ejector, Mould flow, defects, tool design and assembly

1. Introduction

Plastics are one of the most widely utilized materials in a wide range of applications. They are adaptable, lightweight, and long-lasting. There are various methods for transforming plastic raw materials into finished products. Injection moulding is the most well-known and commonly utilized method. The raw plastic is melted in the injection moulding process before being injected into the mould via a gate. The finished product is then ejected once it cools and solidifies. The injection mould is the piece of equipment used to mould and form the component. The injection moulding process cycle is divided into four stages: melting, injection, cooling, and ejection.

The mould is closed during the melting step, and plastic granules in the hopper are gravity fed into the heated barrel and moving screw. Granules form as a result of high pressure, friction, and temperature. Injection is the stage in which molten plastic is forced into the mould cavity by means of a rotating screw. Pressure is maintained until material packing is accomplished and cooled. The item is then cooled, which is commonly accomplished via cooling circuits built into the mould. Water is circulated in these circuits to solidify the part and keep the mould temperature stable. As the screw retracts backward, the final ejection stage occurs, in which the mould is opened and the ejector mechanism pushes the component out of the mould. This completes one cycle.

Similar publications are looked to get a sense of the process methodology. In [1,] the mould design and analysis for a four cavity cable ceiling holder base is completed. A modified circular component is created from a previously existing square-shaped model. Filling and cooling times are also analyzed. In [2] and [3], conceptual mould designs for their individual components are completed, and process is outlined. [4] Shows the results of an analysis and

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design for a FRP component, including pressure distribution, fill time, weld lines, and so on. Paper [5] provided a full research and methods for producing the L&T power box side panel. These comprised calculations, analysis, and a thorough mould design and explanation. These papers offered

2. Objective

- Design and analysis of one full shot.
- Calculation and conceptual design of injection mould.
- Detailed study and design of component.
- To produce the component with no major defects.

3. All about component

The component is a housing component that is an electronic enclosure. Because of its high practical durability and heat distortion temperature, electronic enclosures are widely employed.
ABS FR AN450M, a terpolymer, is created by polymerizing styrene and acrylonitrile with polybutadiene. The percentages of acrylonitrile, butadiene, and styrene can range from 5% to 60%, 15% to 35%, and 5% to 30%, respectively.
Bhansali Engineering sells flame-retardant acrylonitrile butadiene styrene (ABS) resin under the brand name ABS AN450M. Injection moulding can be used to handle it. ABS AN450M is recommended for electrical and electronic components.

Table.1. Component details

Name of the component	**Electrical Enclosure**
Thickness of the Material	4mm
Material	ABS FR AN450M
Shrinkage	0.4% - 0.6%
Tensile Strength	42 Mpa
Yield Strength	57Mpa
Length (L)	85mm
Width (W)	50mm
Height (H)	25mm
Colour	Grey

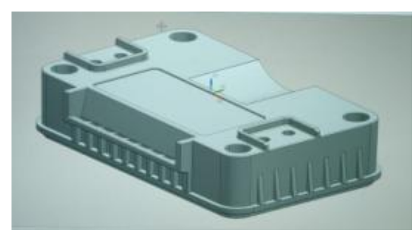
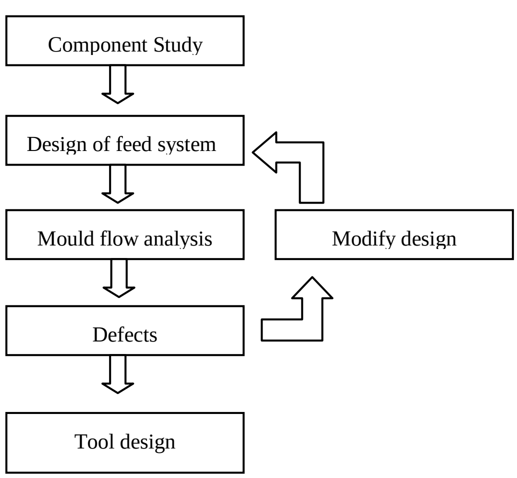


Fig 1-Component image

4. Methodology



5 Model study of component

The model is studied from the 2D drawing. The part has ribs present for stability and strength. 3D model is done by using NX11.0 software. It is very essential to give drafts in the vertical features for easy ejection from mold and avoiding catching unless no draft is mentioned in the drawing. Criticality involved in the component includes ten contact cavities and pin protector.

Fig 2-Core and cavity side of component

6 Design of feed system

D1 = D2 + 2 L tan(A)

Where, D2 is the diameter of sprue at upper end,

D1 is the diameter of sprue at lower end i.e., 6 mm end,

SH or L= length of sprue selected by the designer = 63 mm and

A = tapered angle (2˚ to 5˚) =2˚ taken

D1= D2 + 2Ltan A = 6 + 2(50) × tan (2˚) = 9.5

Hence the diameter of sprue is 9.5 mm which is rounded off to 10 mm

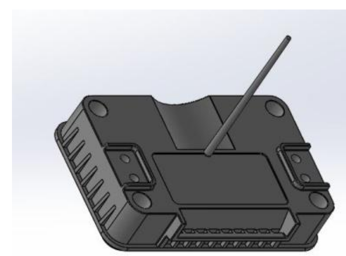


Fig 3-Component designed with sprue

7Mould flow analysis

The mould flow study was carried out using Solidworks software. Based on sprue and material parameters, the software can forecast fill time, injection pressure, air traps, and probable shrink marks.

- Figure 4 (a) depicts the component's actual filling time. It takes 1.96 seconds to fill the component completely.
- The Solidworks is optimistic that the component will be filled. It's also shown in Fig. 4 (b) with a 100% high confidence fill.
- The pressure required to inject the material into the mould space is predicted by the Solidworks to be 51.1316 MPa, as illustrated in fig.4 (c)
- The deformation of a plastic moulded component induced by a density difference between melt and solid plastic is known as shrinkage. After the injection, the plastic begins to shrink as it cools. As demonstrated in Fig. 4(d), the proportion of shrinkage is about maximum depth is 0.0175 mm and average is 0.009 mm.. It's also acceptable in terms of design.
- Air traps are more common in the last fill stages. A common source of air traps is the absence of properly sized design and vents. Figure 4(e) shows trapped air in the outer region, which can be evacuated by building suitable vent pathways.
- Figure 4(f) displays the available weld lines for the component that has the fewest weld lines.

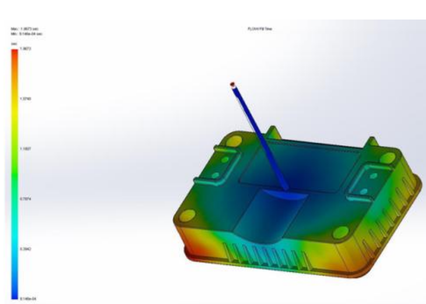


Fig 4(a)- Fill time

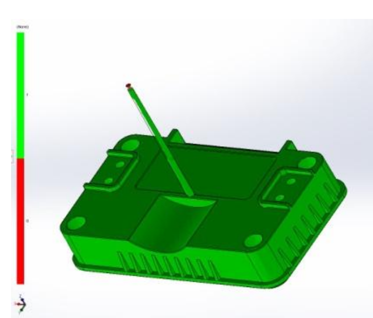


Fig4(b)- confidence of fill

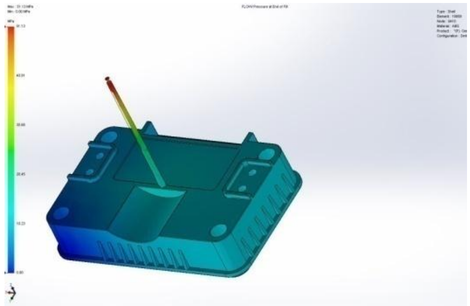


Fig 4(c)-Pressure at end of fill

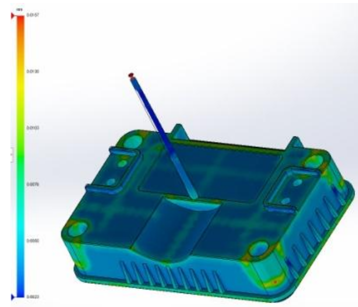


Fig 4(d)- Shrinkage

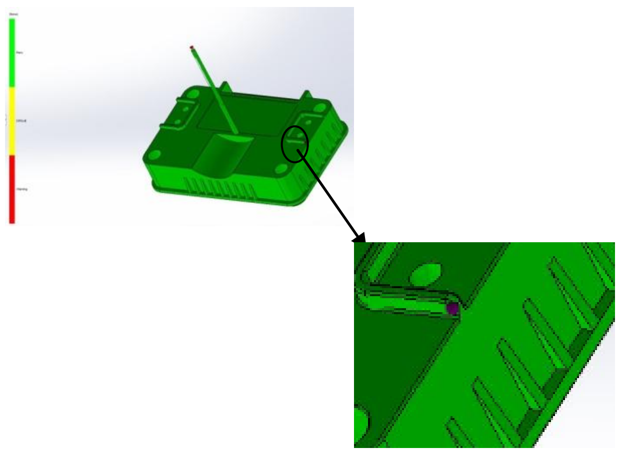


Fig 4 (e)-Air traps

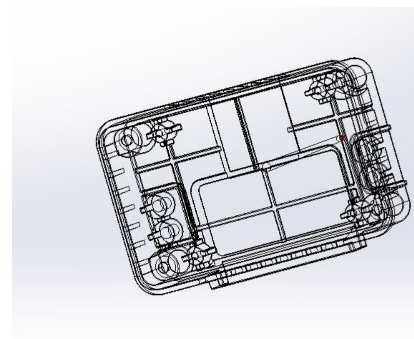


Fig 4(f)-Weld lines

8 Tool design

8.1 Core cavity design

Core and cavity inserts contain core and cavity surface areas. Because these inserts will come into touch with melt injected material, they must be made of a strong material. The insert high hardness steel material is made of P20. The cavity insert is shown in Fig. 5, with the highlighted area representing the component's cavity. The inserts are made from tiny steel blocks. The male component of the inserts is the core insert. Screws and fittings are used to secure the inserts in the bolster or housing.

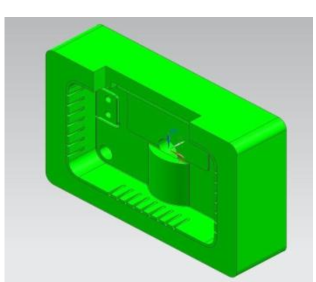


Fig 5-cavity insert

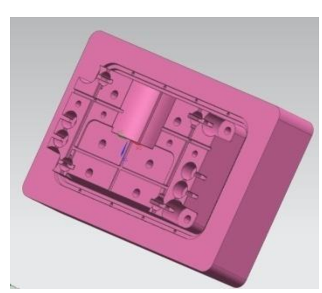


Fig 6-core insert

8.2 Two halves

A typical two-plate mould consists of one fixed half and one moveable half. All of the mould components are assembled in either the fixed or moveable half. The separation surface is the line surface that connects these two sections. The mould's fixed half is connected to the machine's fixed platen, while the moving half is connected to the machine's moving platen. The core is usually positioned in the moving half of the mould, while the cavity is in the stationary half. The ejection system is also integrated in the moveable half of the mould. Because the portion has shrunk, this is the case. When the mould is removed after the part has shrunk while cooling, the core parts of the component remain.

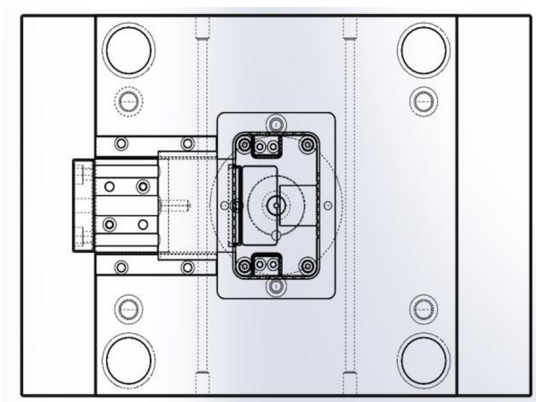


Fig 9-cavity half assembly

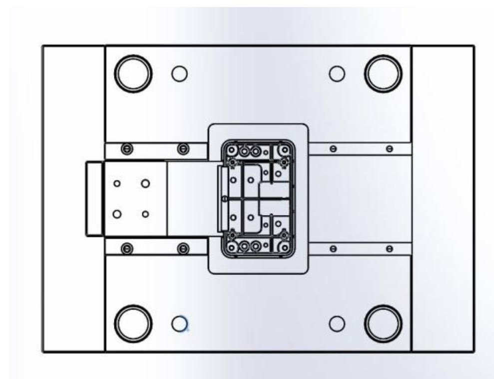


Fig 8-core half assembly

8.4 Tool Assembly

Following the design of all mould elements, the entire mould assembly is evaluated, and individual part drawings are created.

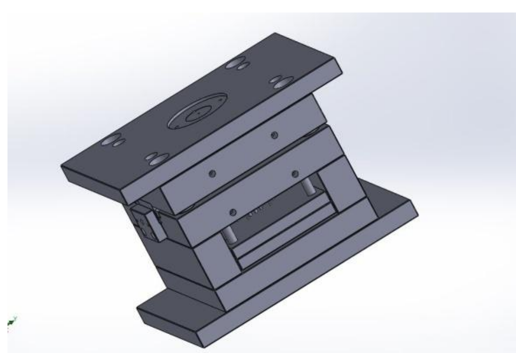


Fig 10-Tool assembly

8 Conclusions

- This project describes the development of a plastic injection mould for the production of Electronic enclosure.
- A mechanical, thermal, and electrical analysis of the component material was performed.
- Calculations are performed to assess whether the machine is suitable for mould production.
- The analysis is carried out and understood using Solidworks software. A detailed evaluation of the sorts of faults and the underlying causes of the problems is essential before attempting to correct them, as is the design of a tool that appears to work successfully during testing phases and is constructed after following the manufacturing procedure.

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