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Design and Analysis of an Injection Mould Tool for Power Board Housing Used in Washing Machine

Abhilash V.^{a*}, L.G. Sannamani^{b*}, Dr. S.N. Ravi Shankar^{c*}

^aStudent, M.Tech in Tool Engineering, GT&TC, Mysuru-16, Karnataka, INDIA

^bHOD, Post Graduate studies, GT&TC, Mysuru-16, Karnataka, INDIA

^cPrincipal, Post Graduate Studies, GT&TC, Mysuru-16, Karnataka, INDIA

ABSTRACT

This work involves in the design, analysis, and fabrication of the three-plate single cavity injection mould for power board housing component. The part is used in the assembly of a washing machine power circuit housing. The plastic used is polycarbonate flame retardant. Three-dimensional model of the tool is designed by using NX 11.0 software and the mould flow analysis is done using Autodesk Moldflow Adviser software, this was carried out to determine how the part fills, and to analyze the gating position, weld lines locations, air entrapment areas, & filling time.

Keywords: Plastic Injection Mould, NX-11.0, Autodesk Mould flow Adviser, Polycarbonate flame retardant, Pin point gate, Defects, Tool design

1. INTRODUCTION

Plastic is the most ordinarily utilized material nowadays. It is difficult to assume modern day merchandise that doesn't use plastics. In countless cases, many products that we come across use plastics from chairs to tables, from bikes to airplanes, from toothbrushes to washing machines. Plastics are the wonder materials of the modern age. Plastic makes our lives comfortable and safe. Significant benefits of utilizing plastics are giving a minimal expense to execution proportion information on all handling strategies whether a given part can be manufactured and by measure. The various cycles used to manufacture parts are extrusion, injection moulding, blow moulding, rotational moulding, compression moulding, etc.

The present work covers the design & analysis of a single cavity, three plate injection mould for power board housing (component). Component is used as the power circuit board in Washing machine, made up of Poly carbonate flame retardant (PC FR) material. The task is focused on high production and great nature of segments with the allotted time. The Mouldflow Analysis has been done using the Autodesk Moldflow Adviser 2021 for the power board housing component in order to check the moulding parameters before moulding. The process parameters like, Injection pressure, temperature distribution, fill time, pressure drop, etc., were analyzed.

2. OBJECTIVES

- To provide systematic procedure about design & analysis of a single cavity, three plate injection mould for power board housing.
- To carry out the design calculations and conceptual design of injection molds.
- To analyze and create a component without any basic defects.
- To design and assemble the tool for manufacturing purpose.

* Corresponding author.

E-mail address: abhiabhilashv1997@gmail.com

3. METHODOLOGY

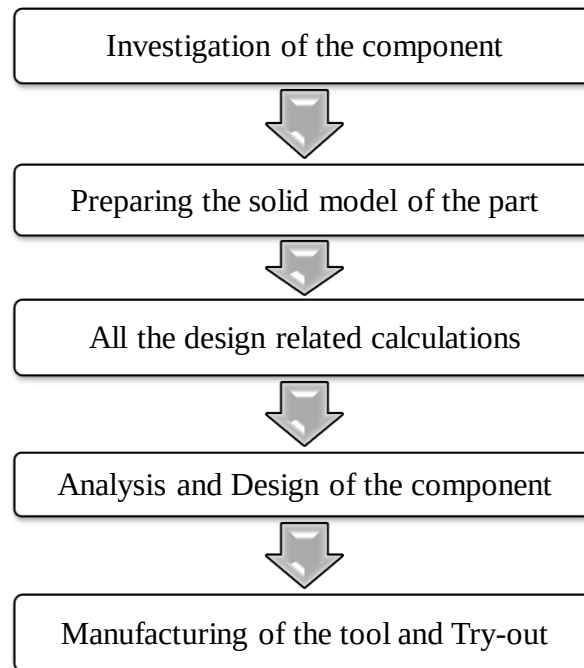
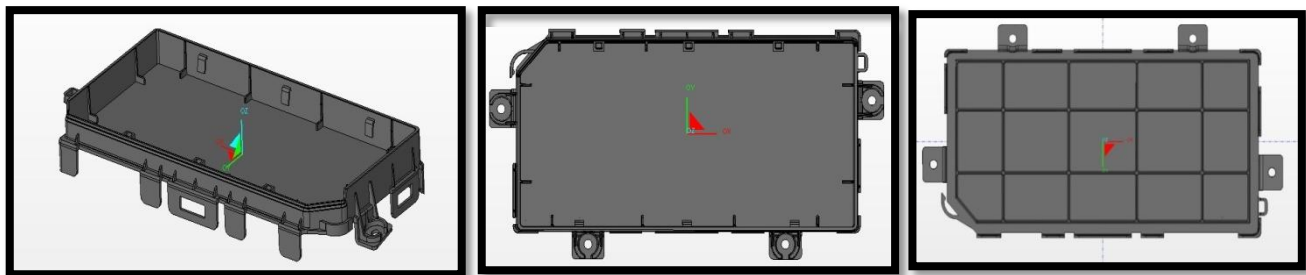


Fig. 1 Steps in methodology

4. COMPONENT STUDY



a) Isometric view

b) Top view

c) Bottom view

Fig. 2Component

- The Component named “POWER BOARD HOUSING” is made of Poly-carbonate flame retardant (PC FR) material. The main purpose of the said product is to use it as an electrical panel Board Housing for Washing Machine. The main consideration for the selection of the plastic material PC FR is to have it as shock proof material from electric power and also fireproof.

Table 1. Component Data

Name	Power board housing
Material	Poly carbonate flame retardant (PC FR)
Type of gate	Pin-point gate
No. of cavity	1
Application	Washing machine power circuit housing
Quantity	10000/Month

4.1 Feasibility study of the component

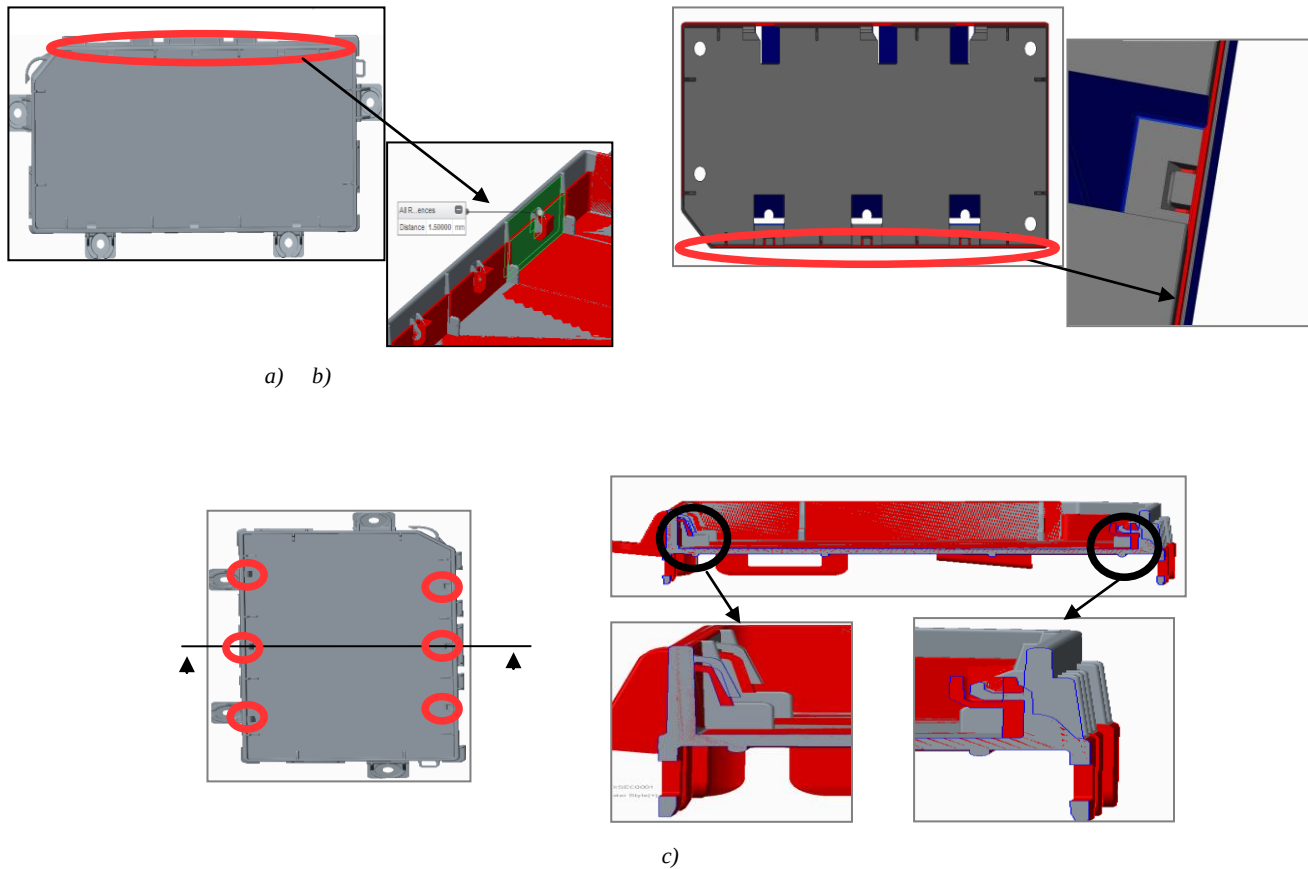


Fig. 3 a) Component surface has shifted by 1.5mm
 b) Insert line has to be shifted and lifer pockets profile has to be changed. Hence it is necessary to replace core insert.
 c) Lifter profile has changed in all the 6 places.

4.2 Feed system calculation:

- Diameter of runner:**

$$D = \frac{\sqrt[4]{L}}{3.7} \times \sqrt{W}$$

d = Diameter of a circular runner.

W = Weight of moulding for one cavity = 79.86 g.

L = Runner length = 90 mm.

$$\text{Runner diameter, } d = \frac{\sqrt[4]{79.86 \times \sqrt[4]{90}}}{3.7}$$

Runner diameter, $d = 7.439 \text{ mm} \approx 8 \text{ mm}$

*Since, standard circular cutter available is of 8 mm thick and is chosen accordingly.

- Gate design for pin point gate:**

Since, the gate is pin point, final diameter of the gate on part is 1 mm

5. ANALYSIS RESULTS

Moldflow Adviser is a maker of recreation programming for top line plastic injection molding computer-aided engineering (CAE). It is possessed via Autodesk. Autodesk stable delivery is Mold flow 2021. Autodesk Moldflow Adviser is the practical answer for recreating the plan during part improvement. Autodesk produces Moldflow Design, Moldflow CAD Doctor, Moldflow cooperative energy, Moldflow Magic's STL Expert, and Moldflow Structural Alliance that fill in as network instruments for other CAD and CAE programming. The Moldflow Adviser reenactment programming allows one to investigate issues with plastic injection and compression molding. It likewise serves to investigate the design development and decides the manufacturability of plastic part design.

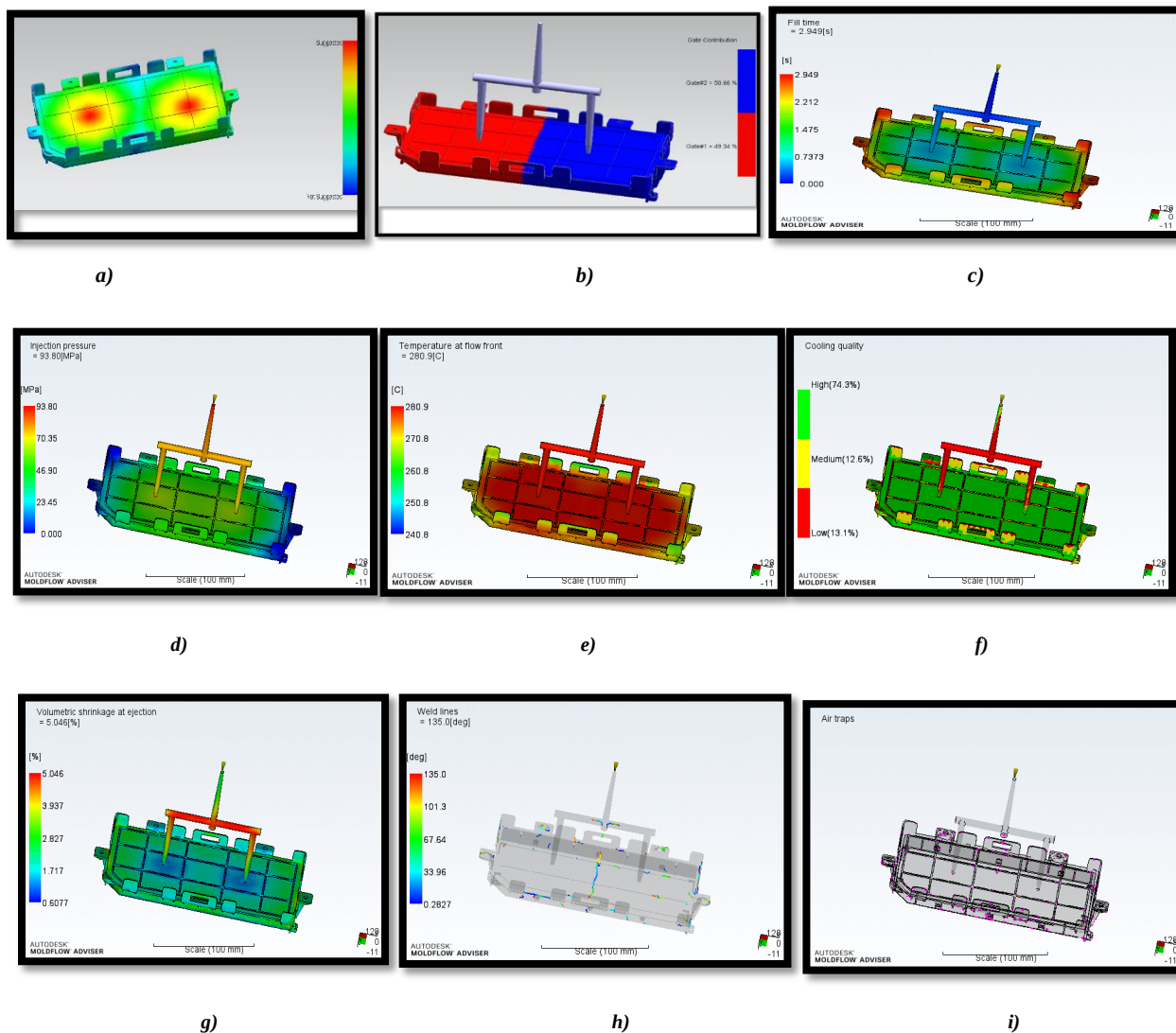


Fig. 4 a) Best gate locations b) Gate contribution c) Fill time d) Injection Pressure e) Temperature at flow front
f) Cooling quality g) Volumetric shrinkage h) Weld lines i) Air-traps

Result from Moldflow Advisor

Possible issues found in analysis – **Air traps**

Problem Description: Air traps found within the cavity. This might cause voids or surface defect.

Solution:

- Increasing the filling time up to 4 s
- Changing the gate location and give 3 gates if possible.
- Reducing the injection pressure to less than 93.80 Mpa
- Modifying the size or area of the vents.

6. TOOL DESIGN

6.1 Selection of parting line:

The selection of parting line entirely depends on the shape and geometry of the component. After in-depth study of the component drawing, moulding sample, a profiled parting plane is chosen. Initially at the parting line there is no flat surface available, hence parting line is taken at the shifted position after the edge.

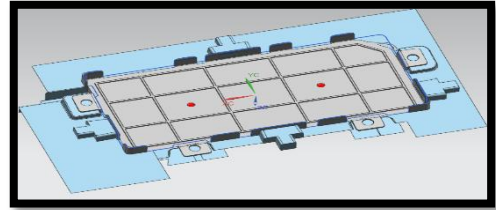
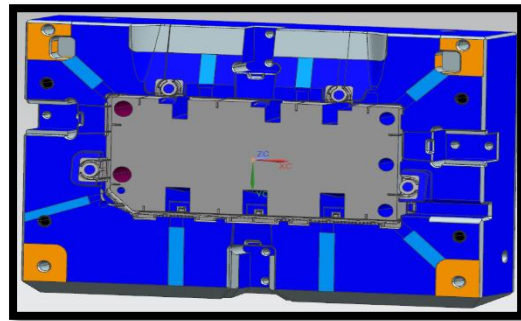
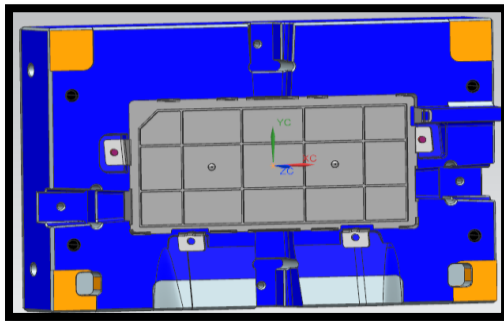


Fig.5 Parting line

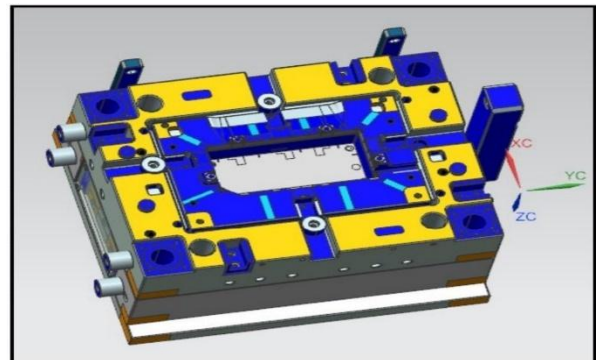
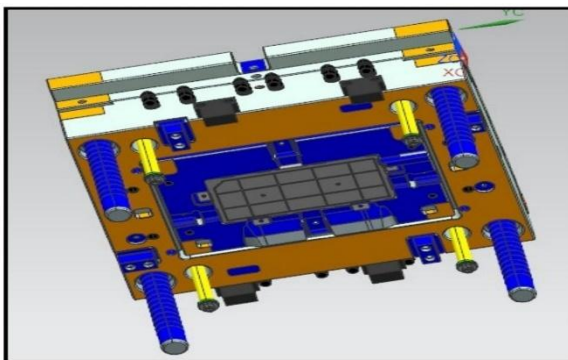
6.2 Core & Cavity Extraction



a)b)

Fig. 6 a) Cavity insert b) Core insert

6.3 Top & bottom half assembly



a)

b)

Fig. 7 a) Top half Assembly b) Bottom half assembly

6.4 Assembly of two halves

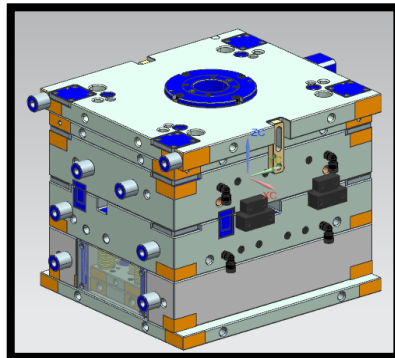


Fig. 8 Isometric view of Tool Assembly

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