

A Design and Analysis of Two Plate Injection Mould Tool For Wi-Fi Router Thermoplastic Product

S Prasanth¹, S Akhil², S Ramesh³, B Pavan Kumar⁴, Y Hemanth⁵,
M Sandeep⁶

¹(Assistant Professor, Satya Institute of Technology and Management, Vizianagaram, India).

^{2,3,4,5,6}(Mechanical Department, Satya Institute of Technology and Management, Vizianagaram, India)

¹ Corresponding Author: Prasanthsadhu57@gmail.com)

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Abstract: This A Wi-Fi router is a device that performs the function of a wireless access point, it is used to provide access to the internet or a private computer. It is the hardware device that provide basic infrastructure for a home or small office network. Proposed to make a single impression semi-automatic family mould to design top and bottom cover for Wi-Fi router to make it more aesthetic, to reduce material cost, better heat dissipation, and to reduce the tooling cost, to make the product more competitive in the market. It is proposed select the suitable plastic material, to modify the existing plastic product design and to develop a suitable two plate family mould of one impression each using SIEMENS NX software. It is also proposed to make detailing of mould parts and its assembly for manufacturing using SIEMENS NX software. The analysis was done in AUTODESK MOLDFLOW. The mould cost, raw material cost and processing cost per component are to be estimated to find the cost per component and to compare it with the existing component part.

Keyword: Single impression; Semi automatic; Cost effective; Mouldflow

I. Introduction

This project report mainly focused on the product of "WIFI ROUTER". This project fully concentrate to how to make the "INJECTION MOULD" for by using the least economic processing and tooling method and it also help to get the very deep knowledge about the "Role Of CAD/CAM Technology In Modern Mould Making Industries" which is playing a fantastic role in the modern age. Finally the aim of the project is to estimation of the mould which should be least economic and also introduced the new sense in CAD/CAM.

Over the years plastics replacing other materials like, metals, glass, wood, etc. because of its impressive advantages over others such as light weight, faster production, low cost, non-corrosiveness, wide range of colour possibilities with great design freedom to achieve aesthetic appearance and wide range of material availability to suit the functional requirements. In addition to the above advantages plastics has great advantage of moulding many smaller parts into one single part to reduce assembly time and to improve part strength.

Varieties of processing techniques are used to transform raw plastics into the objects that we use. Some of the plastics processing techniques includes; Injection moulding, Blow moulding, Extrusion, Compression moulding, Transfer moulding, Rotational moulding, Thermo forming, etc. Injection Moulding process is ideally suited to manufacture mass produced plastic parts of complex shapes requiring precise dimensions with wide range of material to use. In this process, hot polymer melt is forced into a cold empty cavity of a desired shape and is then allowed to solidify under a high holding pressure. The mould is then opened and the part is ejected. The complete injection moulding cycle includes, mould filling, cooling, and ejection.

II. Design Methodology

Design is the universal term being used everywhere. So a product design deals with conversion of ideas into reality and aims at fulfilling human needs. The primary concept involved in design is shape, size, aesthetics and function. This paper highlights the design procedure of a plastic product of wifi router and its injection mould design

and plastic flow analysis of the product. While designing a product the designer should consider some factors such as need, physical reliability, financial feasibility, optimality, design criterion, design process, etc. designing a plastic product checklist has to be prepared to evaluate the product in order to evaluate the product design. The emphasis on designing with engineering plastics are wall thickness, parting line, ribs, bosses, gussets, radii, gate size and location, location of ejector pins, tolerances, shrinkage, surface finish etc. For production this plastic product injection mould is selected for this process because the material selected is polystyrene(PS). So while designing a plastic injection mould the designer can economise the tooling of the mould by selecting standard steel grades, steel sizes and standard machined plates. The injection mould is mainly divided into two parts,

1. Fixed half(where the melted plastic flows into the component area through this half),
2. Moving half(here the injected plastic gets cooled and ejected by using the external source of injection moulding machine).

Finally while designing the mould the designer should consider the type the moulding machine, parting line, ejection system, feed system, etc.,

III. CAD/CAM for Mould Design

Mould designing is practically based on requirement of opening system, runner system, moulding process, type of material to be injected, cavity layout, etc.,this paper consists of conceptual design of the product, design of the mould, plastic flow analysis of the product and detailing of the product and mould. For this CAD/CAM software are used to design and analyse.

1. The designer should consider the ease of manufacturability, assembly and positive ejection of the component within the minimal time and cost to produce a good FRP component.
2. The component was carried out in SIEMENS NX software.
3. The two plate single cavity mould design was carried out in SIEMENS NX software.
4. The plastic flow analysis is done to the component in AUTODESK MOLDFLOW software.
5. The detailing of the component was done in SIEMENS NX software.

Fig.2 shows the Flowchart for practical tool design and Manufacture. The flow chart of the methodology followed for the manufacturing of mould design is as follows.

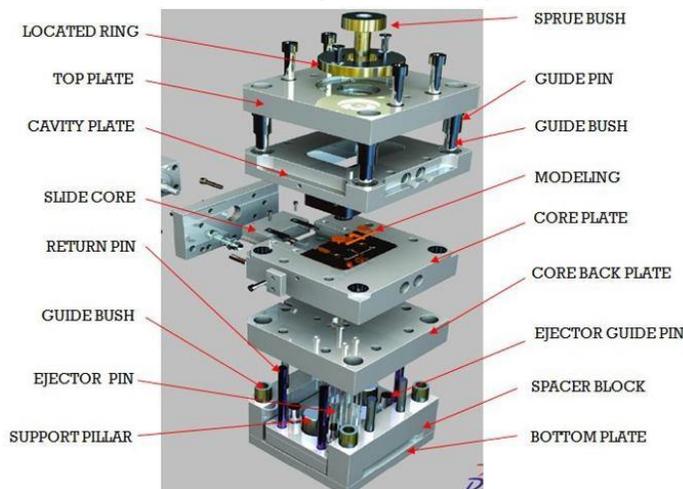


Fig.1 Standard Two PlateMould

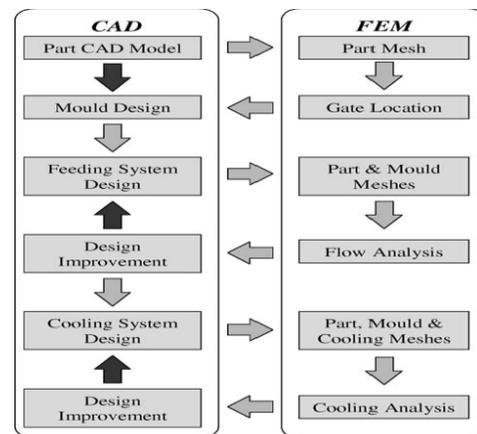


Fig.2 Flowchart for practical tool design and Manufacture

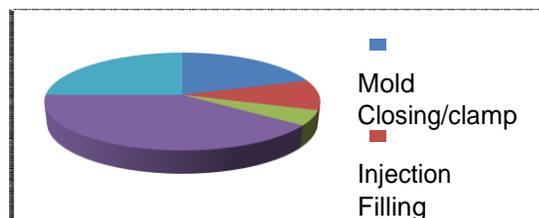


Fig. 3 Injection mould cycle

IV. Injection Mould Cycle

Time for producing the required component during the injection mould is closed and process takes place is called cycle time. Cycle time ranges from 20 sec to 60 sec which produces the components at high production rate with good dimensional ability, tolerance and surface finish.

Injection mould is most commonly used process to produce a component at lowest price, high production rate, good surface finish, tolerance and dimensionability. The cyclic process takes place in three phases namely, (i) filling, (ii) packing, (iii) cooling. During the first phase the melted plastic flows from the nozzle of injection mould machine to the parts cavity to get the designed shape through locating ring, sprue bush, runner, gate, cavity. Later packing phase starts where additional melted plastic enters to get the parts shrinkage during the process. Now the cooling phase starts that is the melted plastic gets cooled and takes the designed or machined shape of the component by using external cooling agents gets contact with the plastic through jackets designed in the mould. During these phases the plastic gets shape due to its properties, machine parameters, and machine process makes products more fabrication complex. After this phase the component gets ejected through the mould by using ejector pins with the support of ejector plate, ejector back plate etc.,

Component Detail:

Component Name: WI-FI Router
Component Material: Poly Styrene(PS)
Shrinkage: 1.5%
Component Weight: 16.96gms
Moulding Type: Single Cavity Moulding Tool

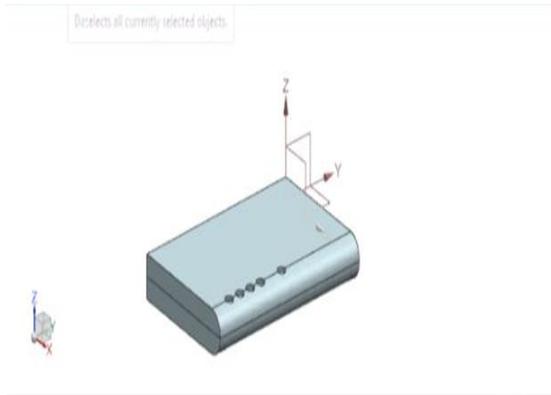


Fig. 4 3D ComponentDetails[2]

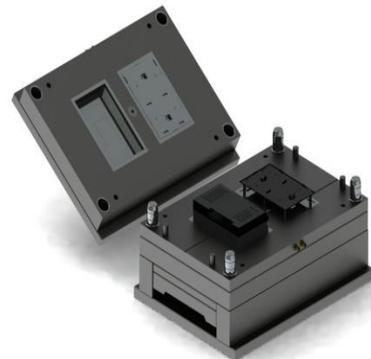


Fig. 5 Full Tool assembly [2]

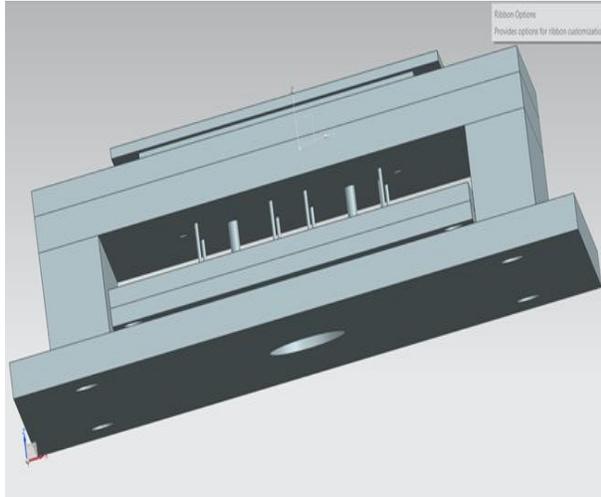


Fig. 6 MovingHalf [2]

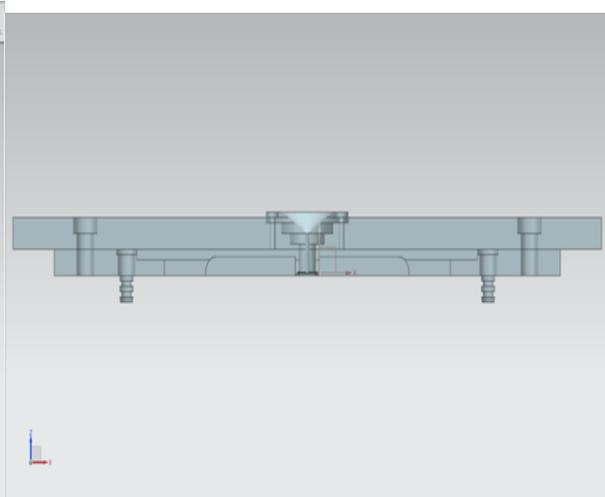


Fig. 7 Fixed Half[2]

V. Need for Simulation

The process of producing plastic component using injection moulding process is more complex because it is based on the right combination of the material, part and mould design and processing parameters. Due to this defects may occur which leads to high costs. For this the optimal setting up of injection moulding process variables plays a very important role. For this computer aided Engineering (CAE) tool can be used to simulate a wide variety of phenomenon that occur during the manufacturing of plastic parts.

The simulation of mould filling in injection process can be presented. The simulation results can be used to correct the defects on the final part by adjusting process settings or modifying the mould design. Injection moulding process is a challenging process for many manufacturers to produce products at lower rate. If the error occurs the rework tooling process increases the component cost. For this the calculation should be done beforely and correctly. For this computer aided engineering (CAE) is adopted to reduce the cost of the product to reducer errors occurred during the process. For this AUTODESK MOULDFLOE will help the designer to estimate required caiculations, values, and errors easily.

VI. Mould Flow Analysis

The mould flow analysis is to be done before the moulding process to get finalized to know the filling time, injection pressure, air traps, weld lines errors etc., in AUTODESK MOULDFLOW the moldflow analysis was done in the following process;

1. First of all 3D designed component is to be converted to STEP file format.
2. Open the autodesk moulflow cummilator software.
3. Import the step file of the designed component.
4. Now select the injection location.
5. Select the material and start analyse by which the properties of component is known to it.
6. When the analyzing is completed start reviewing results.

By this it shows the filling time, injection pressure, air traps, confidence of fill, temperature etc., by this software we can also produce pack analysis, cooling analysis, wrap analysis, runner position, gate location.

Fill Analysis:

The Thermoplastic polymer flow inside the mould during filling phase is known by fill analysis. This analysis calculates the time for filling the molted plastic material inside the mould during process from injection location.it

also shows the velocity pressure switchover point. It produces the results by calculating on four laminates through the thickness and symmetrical cooling boundary conditions are assumed.

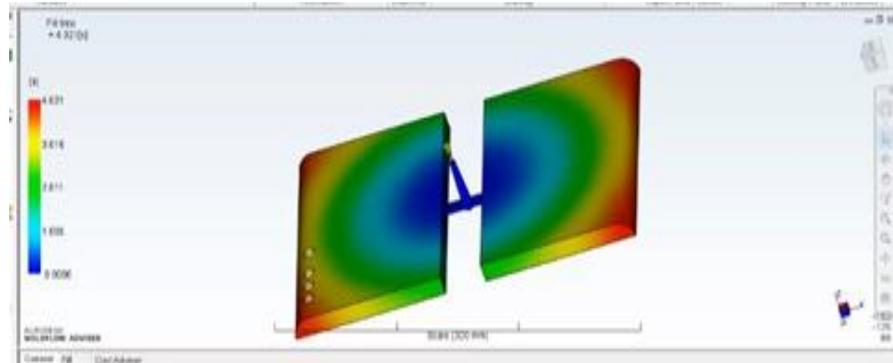


Fig. 8 Fill time plot

Injection Pressure:

In plastic flow analysis process the injection pressure is analysed that is the pressure distribution required for the flow path inside the mould at the time of result was shown. Actually polymer always moves in the direction of the negative pressure gradient from higher pressure to lower pressure gradient. Thus the maximum pressure always occur at the polymer injection locations and the minimum pressure occurs during the filling stage when it is in melt front. The colour at each place on the model represents the pressure at the place on the model. Fig shows two colours that is red(highest pressure) and blue(lowest pressure).

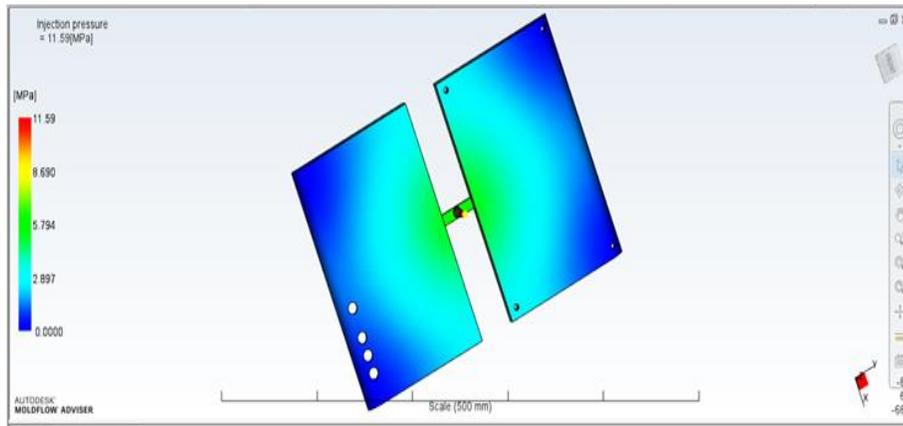


Fig. 9 InjectionPressureDistribution

Temperature Flow Front:

For mould flow process the temperature plays a prominent role. Because it is very important to the value because to know the temperature at which the plastic should be melted to maintain a constant flow in the mould during filling process. Here the figure shows the two colours that is red (highest temperature) and blue (*lowest temperature).

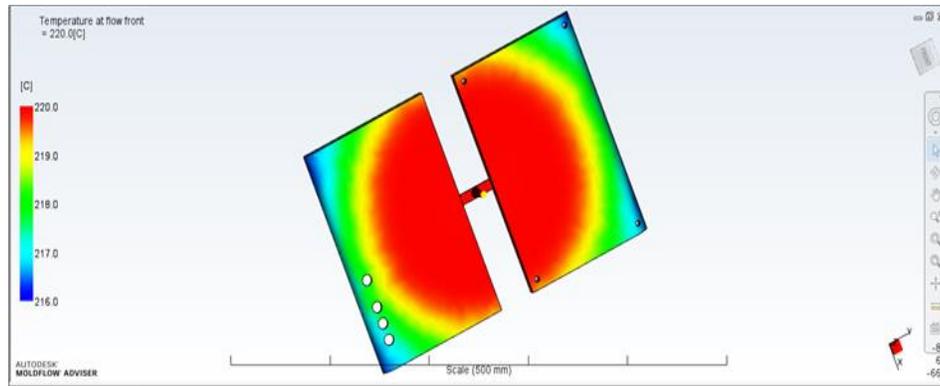


Fig.10 Temperature Flow Front

VII. Conclusion

Thus the existing Wi-Fi router is made in two different mould for top and bottom cover. So the mold cost is high. In case, in our project we made the family mold for top and bottom cover of Wi-Fi router to reduce the mold cost as we compared to the existing mold cost. With aesthetics look for component as per customer requirement.

Along with all these above mentioned information project component drawing in 2D & 3D has been drawn with accurate dimensions mold design for the component has also been finished in 2D, with core & cavity extraction done using 3D, core insert, cavity insert denoting feed system, cooling system, has been extracted and shown in the report, the injection side and ejection side of the mold has also been drawn with closed views.

The mold drawing has been drawn using auto cad software, the mold drawing consists of plan view, inverted plan view, section AA', section BB'

A long with bill of material which consists name of the plate/part, size, no of quantity used, heat treatment and remarks.

We have used a two plate injection family mold to manufacture this component, the material used for manufacturing the component is Poly Styrene, we have found out product volume, feed system runner diameter, projected area, and clamping force. The machine selected to manufacture product according to the calculations is Servo 150 injection molding machine.

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