

DESIGN OF MULTI CAVITY INJECTION MOLDING TOOL FOR THE COMPONENT TORCH BODY BY USING HYDRAULIC SIDECORE

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ABSTARCT

Factors that affect the quality of a molded part can be classified into four categories: part design, mold design, machine performance and processing conditions. This dissertation work covers the Design of multi cavity Injection Molding Tool for the Production of torch body using hydraulic side core. **The design of injection molding systems for plastic parts relies heavily on experience and intuition. The main important thing in mold design is the location of gate (Optimum gate location). So it is necessary to go for a design optimization methodology.** Design Optimization methodology, which tackles the design of an injection mold by integrating the structural, feeding, ejection and heat-exchange sub-systems to achieve significant improvements. The objective of this work is to provide statistical evidence for optimizing parameters of an injection molding machine. The machine parameters to be investigated include cooling time, back pressure, and plasticizing limit. These parameters are evaluated against the problem of decreasing the cycle time for each part.

Keywords – Multi cavity, Injection, Molding tool, Torch body, Hydraulic Sidecore.

1. INTRODUCTION

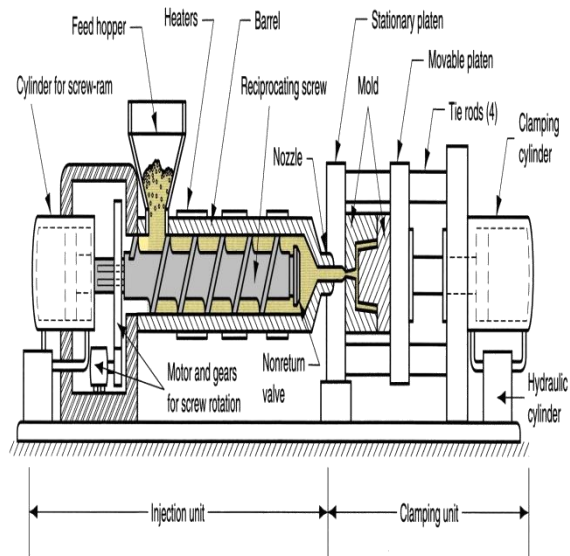
Injection molding is a manufacturing process in which a polymer melt is forced into an evacuated mold cavity that cools the polymer melt into a desired shape. Injection molding is a well-known process that is capable of economically producing very complex components with demanding specifications. Many different kinds of products, from compact discs to audio and video cassettes to cutlery and glassware, to automotive parts.

Plastic materials display properties that are unique when compared to other materials and have contributed greatly to quality of our everyday life which encompass low cost, light weight, available as transparent, translucent and opaque, ease of processing etc hence versatility is achieved in both material as well as production processes. During the process, a hot polymer melt is forced to flow into an empty cold cavity of desired shape and is allowed to solidify under high holding pressure.

A typical injection molding cavity system consists of sprue, delivery systems (runners), gates and part cavity. The thickness of most injection molded parts is usually very small compared to its other dimensions, facilitating fast heat dissipation. Proper placement of cooling lines reduces the overall process time and hence enhances productivity.

The process consists of four distinct operations such as

- Melting of the resin
- Injecting the resin in to the closed mold
- Cooling of the resin inside the closed mold
- Ejection of the molded part



2. LITERATURE SURVEY

C. T. Wong, S. Sulaiman, N. Ismail and A.M.S. Hamouda

This paper presents the design of plastic injection mold for producing a plastic product. Before proceeding to injection machine and mould design, this part was analyzed and simulated by using mold flow. The analysis and simulation can define the most suitable injection location, material temperature and pressure for injection. The predicted weld lines and air trap were also found and analyzed.

C.G. Li and Y. Wu

This research paper will facilitate the automation of plastic injection mould cooling system design. The cooling system is one of the most important systems in a plastic injection mould. It affects the quality and productivity of the molded part. Adhoc evolutionary operators and parameters adapting to the characteristics of cooling system design are devised. An experimental system is implemented to verify the feasibility of the approach, and the results of case study confirm the validity.

E. O'Neill, C. Wilson and D. Brown

This paper seeks to outline the benefits of the solid model within the injection molding industry in greater detail. Solid modeling used as a fundamental tool for communicating geometric information. Solid modeling has become a core communication of concurrent engineering. The major benefit of CAE tools is reduced 'time to market'. The reduced design time is an outcome which is a more important benefit of CAE is higher product quality.

R. Dubay, B. Pramujati and J.Hernandez

A new approach for controlling part cooling in plastic injection molding is developed using a Plastic Injection controller and coolant flow rate as the manipulated variable. The method uses an average part surface temperature within the mold as the set point parameter. A mechatronic system was developed for providing variable coolant flow rates.

M. Dastagiri, and M. M. Annamacahrya

Present work attempts applying the axiomatic design & its software Accelero DFSSV5 to process design of the component in injection molding process. By this the number of process design iterations are reduced in design aspect as well as manufacturing aspects. The accurate war page in the model predicted using Mold flow Plastic Insight (MPI) 5.0 software.

3. OBJECTIVES OF THE STUDY

It is helpful for the toolmaker by providing basic knowledge about design aspects, raw material selection, manufacturing process and so on. The information present in this project report can be an asset not only to a toolmaker but also anyone concerned to tool making and production.

Core objectives include:

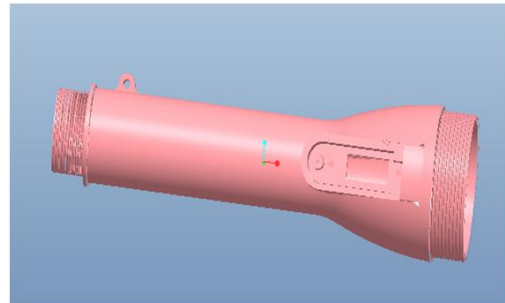
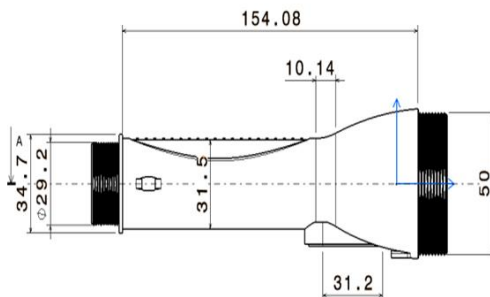
- 1) Choosing Optimal designs for production which includes best gate location, providing suitable draft angle, shrinkage allowance, proper cooling, runner balance and proper ejection with higher dimensional stability.
- 2) Lead time should be less, less cost.
- 3) Before ongoing for analysis, rheological properties of material used should be known.
- 4) Analysis carried out, should result in proper prediction of defects, fill time, quality etc.

4. METHODOLOGY

The injection molding tool for the production of these component is manufactured with the following methodology. Methodology is a systematic approach for the realization of total task. It consists of the following detail:

4.1 Study of the Component

The component drawing is studied in detail in order to understand the various features available in the component. The component consists of many variable cross sections with critical features. Solid modeling of component has been done using PRO E considering all the critical dimensions. The created solid model is used to determine the location of centroid of the mass, volume, surface area of the component, projected area, area of cross section etc



4.2 Component Description:

Component name	:	Torch body
Plastic material	:	Acrylo-Nitrile Butadiene Styrene
Shrinkage	:	0.6%
No. of cavities	:	4
Type of gate design	:	Edge Gate
Type of ejection	:	Pin ejection
Type of mold	:	Two plate mold

5. SCOPE OF THE WORK

4.3 Selection of Component Material

4.4 Selection of Tooling Materials

4.5 Core and Cavity Extraction

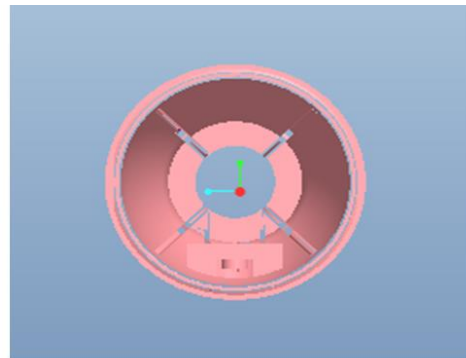
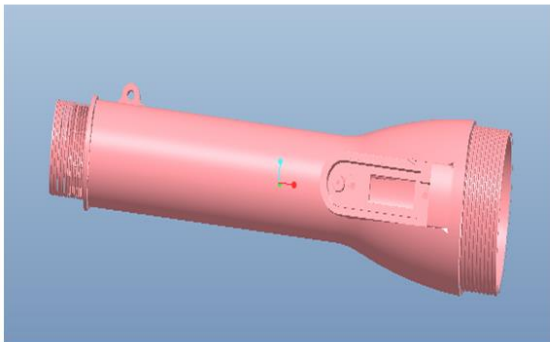
4.6 Solid Modeling of the Tool

Various approaches have been adopted while designing the tool for producing defect free components.

- 1 Study of various features involved in the component for selection of parting line, gate location, vent locations, cooling circuits, etc.
- 2 Choice of various tooling materials and molding machine to produce large volumes of plastic component.
- 3 Basic calculations for determining cavity wall strength, shot weight, clamping force, cooling and cycle times, etc. are carried.
- 4 3D modeling of the tool has to be done for physical representation before manufacturing

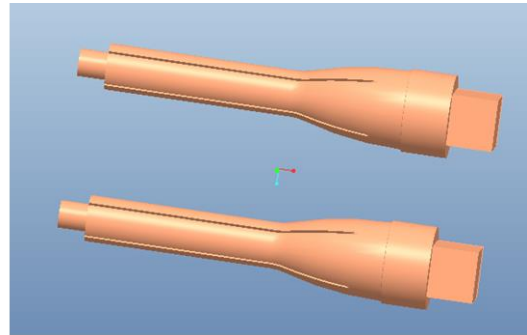
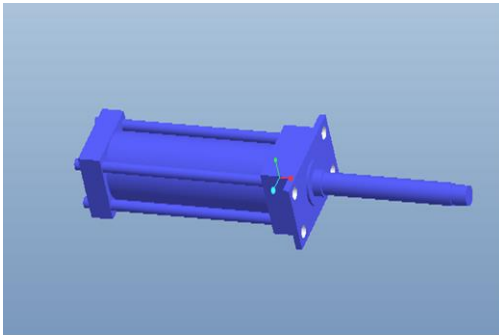
6. 3D MODELLING

6.1 Component Drawings



The component drawing is studied in detail in order to understand the various features available in the component. The component consists of many variable cross sections with critical features.

6.2 Hydraulic Cylinder and Side Core



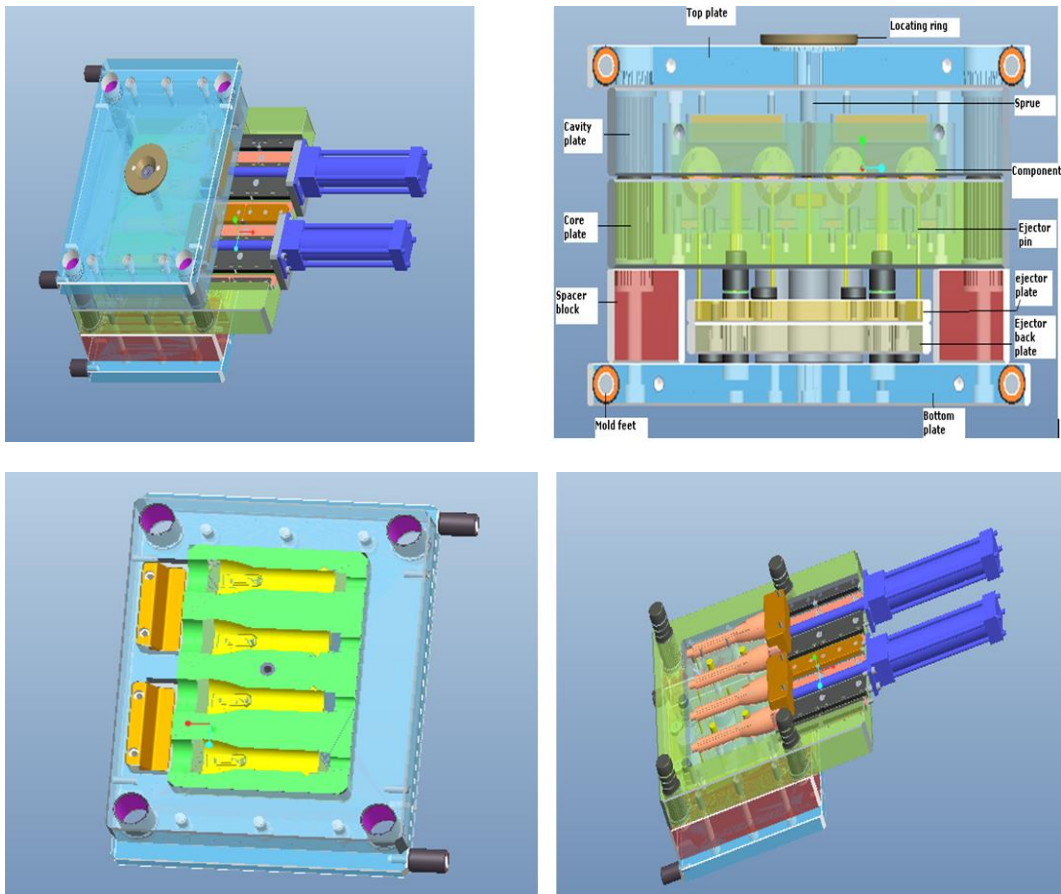
In this system, splits are actuated hydraulically and unlike the other actuation systems i.e. not dependent on the opening movement of the mold. The splits can be operated automatically at any specific time by including its functions in the operation program of the machine. Machine which does not program auxiliary cylinder control, it is necessary to add a separate hydraulic operating circuit to the existing system.

The splits can be actuated at any time after they are clear of the locking heels. Even in an extreme case, when the mold is fully opened. However to reduce the cycle time to a minimum, it is desirable to operate the splits while the mold is opened. On the return stroke i.e. actually splits are closed before they re-enter the chase bolsters.

When removing the component from the mould, we need some device so that the component, which contacts to the undercut, can be moved to remove the component from the mould since the component will not be removable directly without the device.

Any recess or projection on the outside surface of the component, which prevents its removal from the cavity, is termed as external undercut component, which incorporate external undercuts, is shown in figure.

6.3 3D Assembly Tool



Solid modeling of assembly tool of four cavity injection molding has been done using PRO E considering all the critical dimensions. The created solid model of the component is used to determine the location of centroid of the mass, volume, surface area of the component, projected area, area of cross section etc.

6.4 2D Drawings of the Component Torch Body

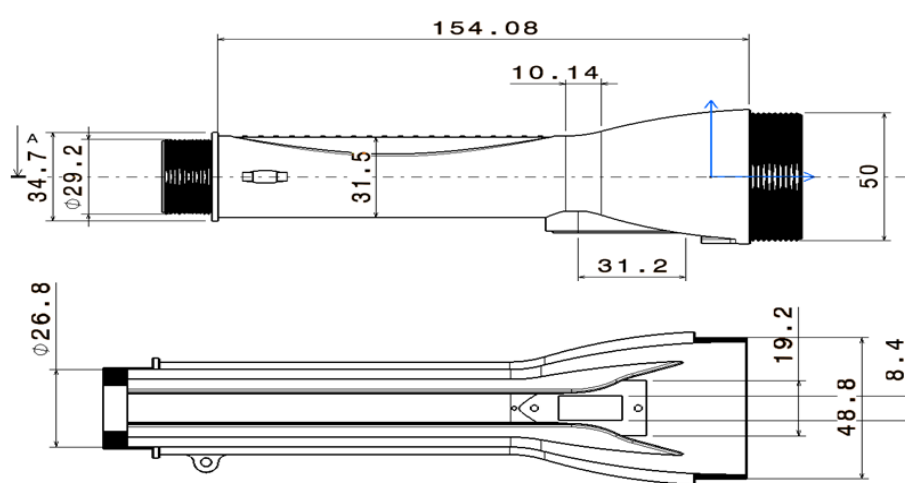


Fig 6.9: Component Drawings

6.5 2D Assembly Drawings

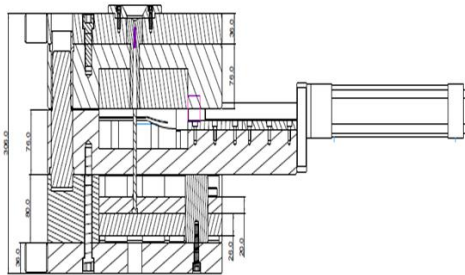


Fig 6.10:

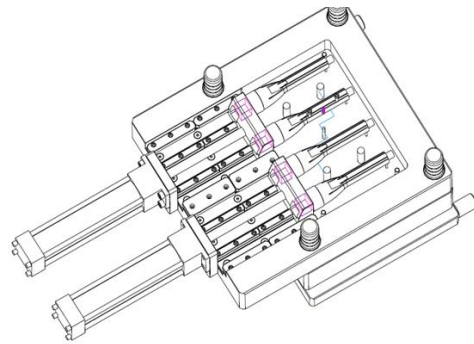


Fig 6.11:

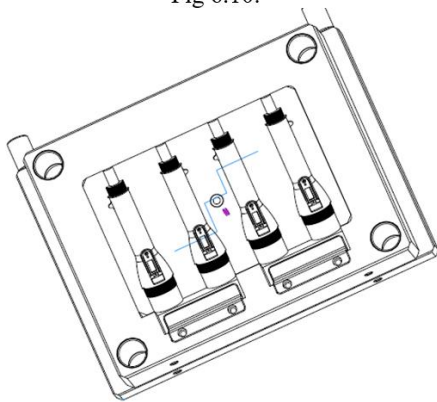


Fig 6.12:

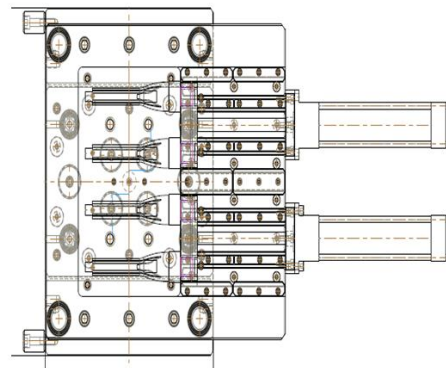


Fig 6.13:

7. RESULTS AND DISCUSSIONS

A four cavity injection mold tool for the production of the Torch Body undergoing development has been designed. The tool has been designed according to injection mold design protocols. The component has been 3D modeled on Pro-E software and processing details including injection pressure, melt temperature as encountered in actual practice have been given as inputs to the

software. Parameters influencing the quality of the component such as Sink marks, Air traps, Shrinkage, War page and Weld lines which are the outputs of the analysis ensured the satisfactory nature of the design.

The work has been carried out in a typical environment engaged in the manufacture of plastic components and the preparation of process planning sheet for the production of the Torch Body with the designed tool is expected to contribute towards optimization activities involved in their production

8. CONCLUSION

Application of scientific approaches and empirical relations were used for design of the tool. Some data obtained from the experience were also used as an instrument in developing the tool. Producing part to the specified dimensions and limits is an important aspect. It mainly depends on the skill of the operators and the machine available in the shop.

Although several options were recognized while selecting the parting plane, cooling circuits, feed systems, venting, etc. the most advantageous option was selected depending on the geometry of the component.

9. SCOPE FOR FUTURE WORK

The next stage of my work can be done in various areas like analysis and manufacturing. Flow and fill analysis can be carried out using higher level software like computational fluid dynamics and mold flow plastics insight to get accurate results and to reduce the defects to get high quality component. Transient heat transfer analysis can be carried out to reduce the defect that occurs due to heat. In order to increase the productivity quick changing dies technology can be implemented.

There is a huge scope to carry out the research work in the area of design of the mould, i.e., the design to be done by implementation of scientific methods. The Mould flow analysis can further be used to carry out cooling and war page analysis. The results can be used for, further optimization of the tool design.

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