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Full Length Review Article

SIGNIFICANCE OF MOLD FILLING ANALYSIS FOR FINDING OPTIMAL MATERIAL BASED ON GATE LOCATION IN INJECTION MOLDING PROCESS FOR PLASTIC PARTS

[1]Subba Rao, D., [2]Malleswar Rao, J. N. and [3,*]Rakesh, P.

[1]V. R. Siddhartha Engineering College, Kanuru, Vijayawada-07, A.P, India
[2]Asst.prof. of Mechanical Engineering, V. R. SiddharthaEngineeringCollege, Vijayawada-07, A.P, India
[3]PVPSIT, Kanuru, Vijayawada – 07, A.P, India

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ABSTRACT

Due to heavy increase in demand for more and more plastic products, plastic industries are developing in a fastest level. Plastic injection molding begins with mould making and then manufacturing of complex shapes; the optimum gate location is one of the most important criterions in mould design. Mold Flow analysis is a powerful simulation tool to optimize the gate location and to predict the Production time and other required factors that are related to the material of the plastic part at the lowest possible cost. Optimization of sequence occasion, keep away from scrap and manual interface plays a vital role in manufacturing of plastic parts to improve the productivity of the process and at the time it should not disturb the quality of the final product. This paper describes the influence of gate location and plastic material influence through a repeated number of analyses which is carried out by plastic injection molding module present in the design software called Autodesk Inventor Professional to reduce fill time and other parameters. The process parameters like fill time, shrinkage, weld lines, pressure drop, and air traps are analyzed by simulation in successive trials. From this paper we are showing the influence of the plastic material and also the gate location on the above mentioned parameters.

INTRODUCTION

Plastic is a material that will be used to produce many kinds of profiles that can be used by the humans in repetitive life as well as in many industrial applications. All of the plastic products can be produce from a number of ty pe of manufacturing operations or process. All of the plastic productsare produced with different type of plastic materials depending on a number of factors such as availability of various materials, manufacturability, cost…etc. Plastics are distributed into two different groups' they are thermoplastics and thermo sets. Plastics can be shaped into various forms and toughened for commercial use. Plastic is perfect for this modern age. It is light, strong, easily molded and durable. Although plastics are thought of as up-to-the-minute invention, there have always been "natural polymers" such as amber, tortoise shells and animal horns. These materials behaved very much likeToday's manufactured plastics and were often used similar to the way in which manufactured plastics are currently applied.

Corresponding author: Rakesh, P.
PVPSIT, Kanuru, Vijayawada – 07, A.P, India.

The typical process cycle time in injection molding machine varies from several seconds to tens of seconds depending on the part weight, part thickness, material properties and the machine settings specific to a given process. Process control of injection molding has a direct impact on the final part quality and the economics of the process. In the injection molding processes, gate location is very important design parameter with is in the relation with polymer competency, part shape and dimension, mould structure and mould condition, the selection of gate location influences the manner in which plastic flows in to the mould cavity. In order to set the processing parameters, the software has an algorithm inbuilt to assign them which has been developed from years of research by the Autodesk People.Thus the objective of the study is to show how parameters like fill time and others change with the gate location as well as plastic material.

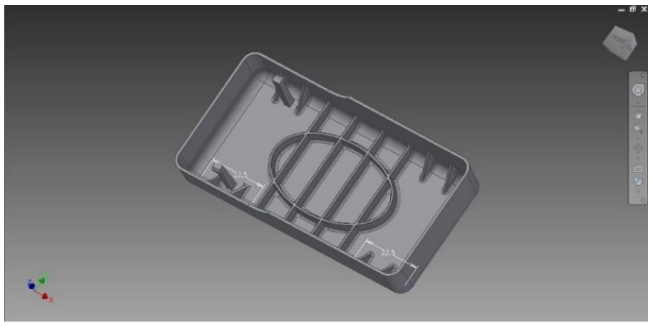
Problem Statement

For this work we have designed a simple plastic part with all required features of a typical plastic part like ribs, fillets, snap

hooks, mounting bosses...etc. which are generally little bit difficult to manufacture. We had designed this in Autodesk Inventor 2015 Software and analyzed it using the mold design module in Autodesk Inventor itself. Here we tried out three manual gate locations and one optimum gate location which had been calculated by the software and for a material we found out the parameters such as fill time, part weight...etc. and then we changed the material and the by applying the same conditions we performed the same task for different materials and we found out all of those and we put the data in the form of graphs.

Design Problem

We have used the model of a Plastic part which is shown in Fig.1 for the analysis.



Now, we placed the gate location at 3 manually selected positions and then the fourth position was placed in the optimum location that was calculated and then we also changed the plastic material and calculated all the parameters such as Actual filling time, Actual injection pressure, Clamping force required, Total cycle time and part –weight which are the major factors to be seen in the production of the plastic parts. After analyzing all these results some graphs to show the behavior of the material and optimal position and also along with those we also found out the confidence of fill and other plots. The Materials used for this are BJ500, ACCUTECH HPP333G25CD1, AQUALOY 125B, ER-36-BK 920911 and the graphs that are plotted are given below:

The plots for material AQUALOY 125B are

Here the 4 experiments represent the respective four positions of the gate in which 3 were manually selected and another position was selected automatically by gate location calculation which is an option present in Autodesk inventor professional software and likewise we also plotted all this results for all the other three materials and then a set of comparison graphs were plotted for all the four materials by selecting the values that were plotted for the materials and selecting the optimal position from all the 4 positions for each material which can show which material is best for that purpose and this procedure can be applied in any project that involves the design of plastic part and to select material from the available materials from the available material.

The Comparison graphs that are plotted are given below

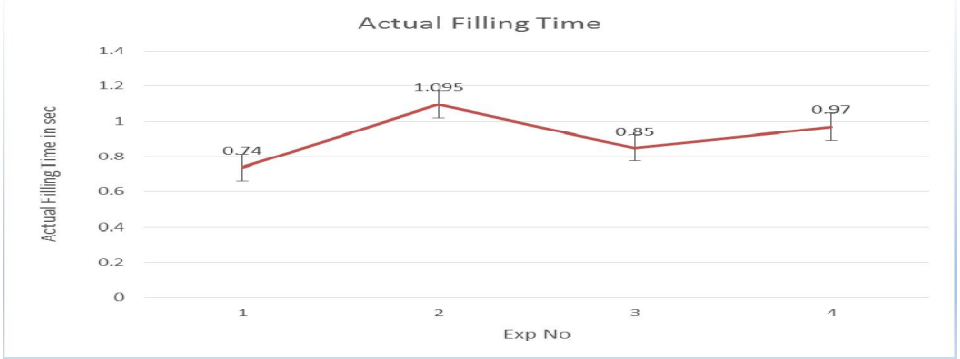


Fig. 2. Actual Filling Time for the 4 experimentalpositions

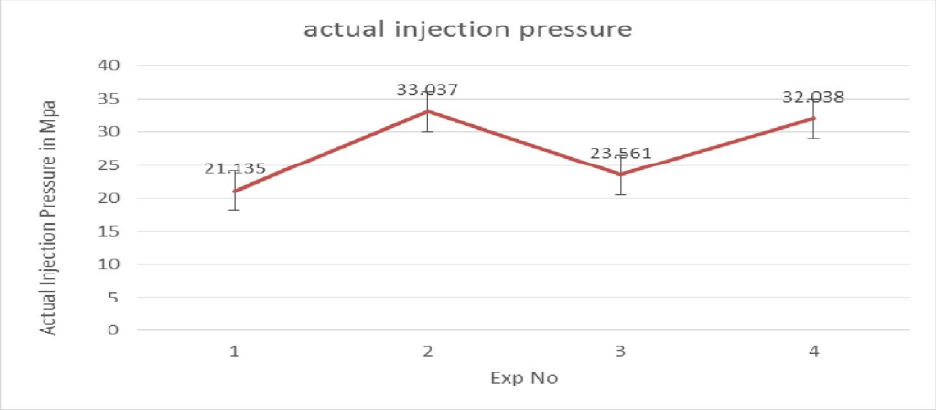


Fig. 3. Actual Injection Pressure for the 4 experimental positions

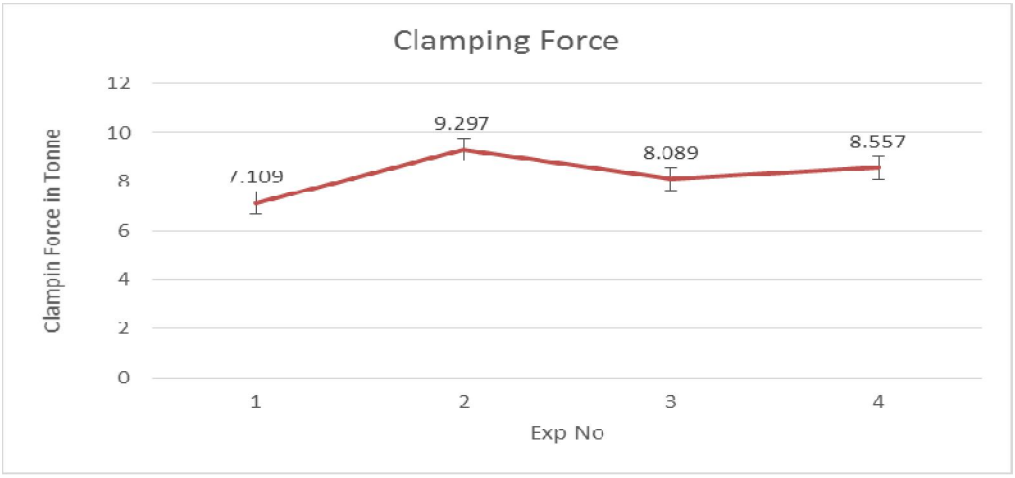


Fig. 4. Clamping Force for the 4 experimental positions

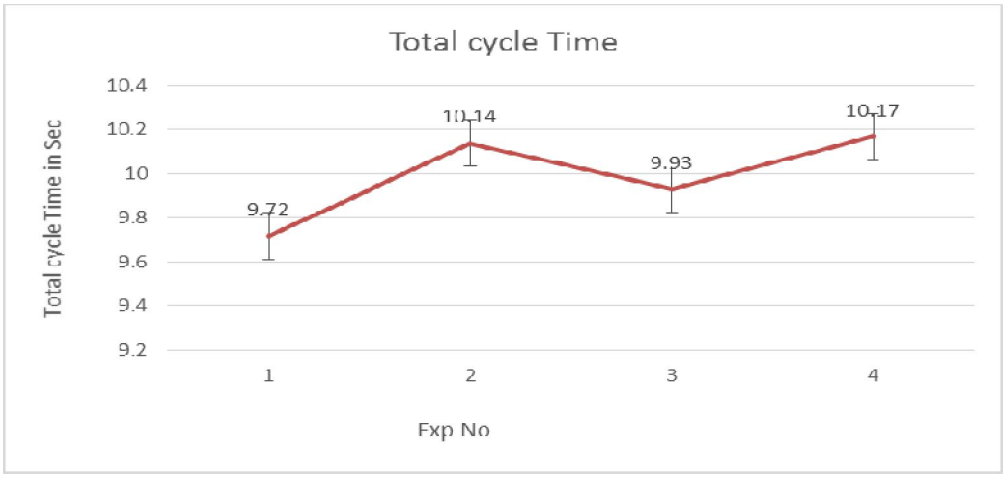


Fig. 5. Total Cycle Time for the 4 experimental positions

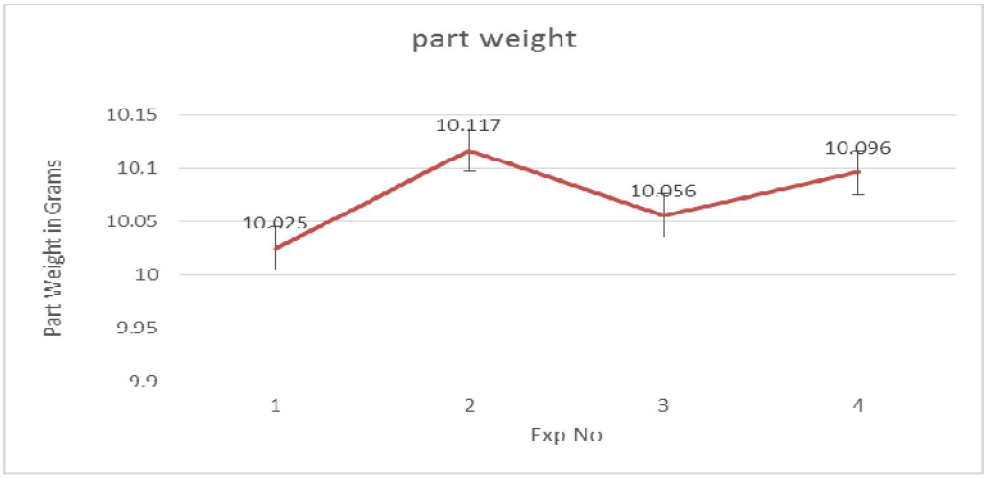


Fig. 6. Part Weight for the 4 experimental positions

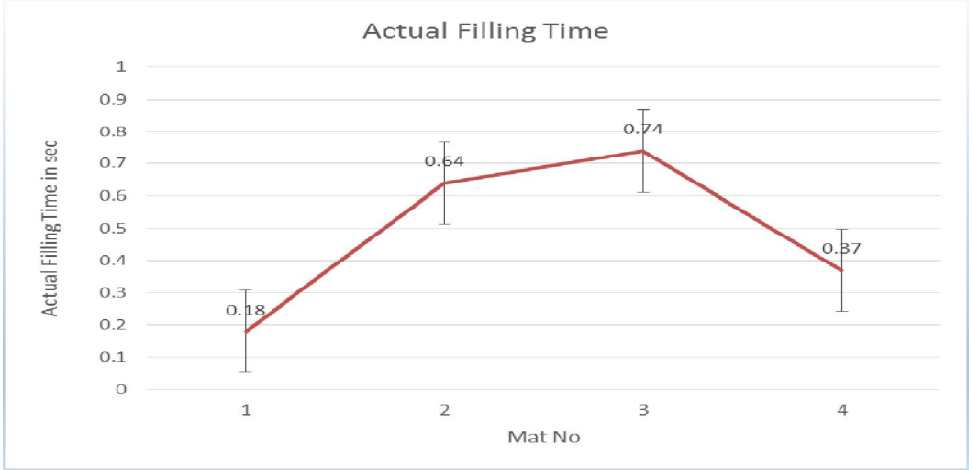


Fig. 7. Actual filling time for all 4 materials

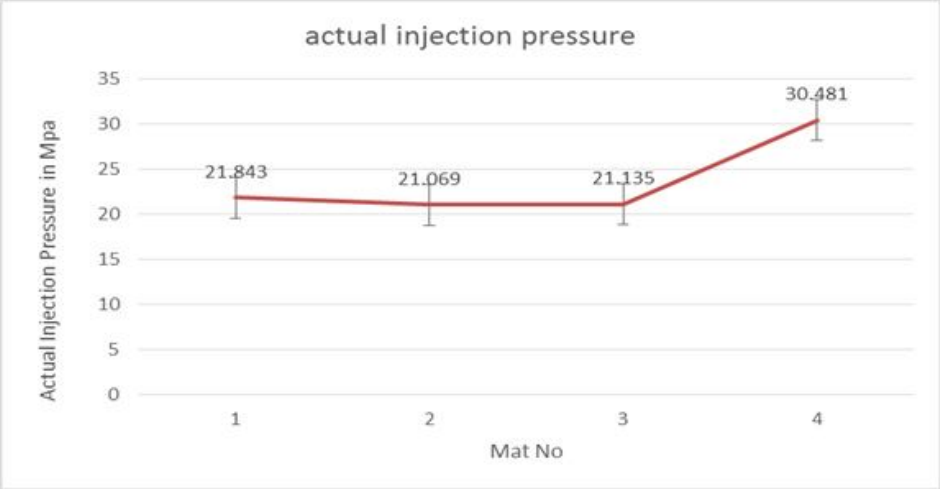


Fig. 8. Actual injection pressure for all 4 materials

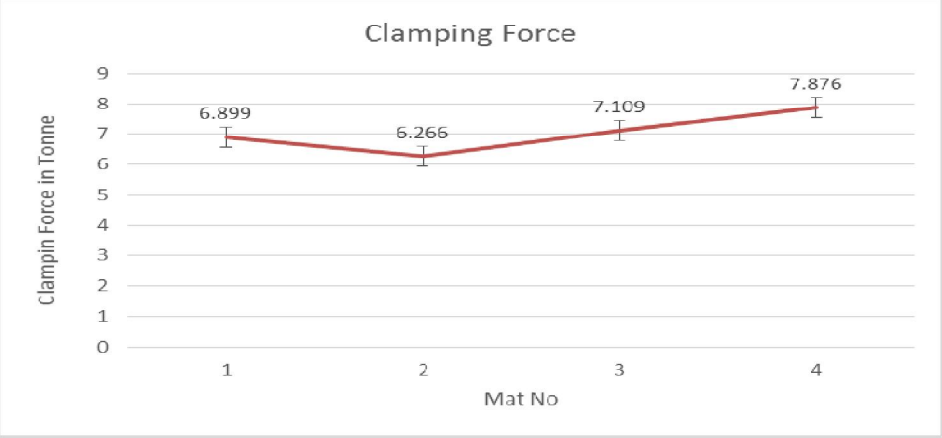


Fig. 9. Clamping force required for all 4 materials

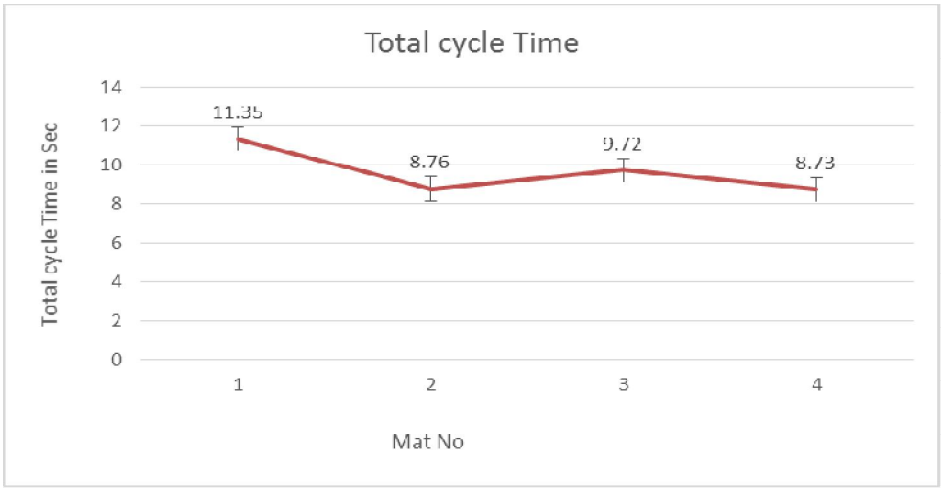


Fig. 10. Total Cycle time required for all 4 materials

Fig. 11. Total Cycle time required for all 4 materials

Conclusion

From the above graphs and according to the required conditions we can predict for the above plastic part design we can best use the material AQUALOY 125B very effectively for this design problem and this same procedure can be used for and plastic part design problems.

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