DESIGN OF FEED SYSTEM OF PLASTIC INJECTION MOLD FOR HOUSING RETAINER

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Abstract: This paper deals with Design of Feed System of plastic Injection Molding for Housing Retainer. Design of mold plays very important role in making the good and accurate component. The material characteristics and the associated process of manufacturing further underline the need to undertake the assessment of 'Design' for the mold in a critical manner and outlook. Quality of the component produced is depends upon the Design of the Mold and the processing parameters. hence while designing a mold, the designer needs to consider many factors such as type of material, type of gate selection and position of gate, feed system details like gate size, sprue dimension & runner dimension. The mold designer also considers the various defects generated during molding process and work to reduce the defects.

Index Terms: **Housing Retainer, Mold flow, Meshing, Runner model,**

I. INTRODUCTION

The main concept of plastic injection molding is filling a molten state polymer into the mold cavity, allowed to solidify so that the polymer can take the required shape. It is necessary to consider the combined effects of part geometry, material selection, mold design and processing conditions to avoid the high costs and time delays problems associated with the start of manufacturing,. With the help of different analysis tools to simulate the injection molding process can evaluate and optimize interactions among these variables during the design phases of a project, where the cost of change is minimum but the impact of the change is greatest. From the simulation and analysis, the software for flow simulation provides sufficient information regarding injection pressure, filling time, various defects like air traps, weld lines, sink mark, warpage etc. With the help of these results, we can avoid the defect of the plastic in actual injection. The analysis will help to design a mold with minimum modifications and which will also reduce the cost and time.

II. LITERATURE REVIEW: For this entire research work following literature is reviewed

Lu *et al* [1] Investigated an adaptive decoupling temperature control for an extrusion barrel in a plastic injection molding process. The decoupling control design was derived based on the minimization of a generalized predictive performance criterion. The set-point tracking, disturbance rejection, and robustness capabilities of the proposed method can be improved by appropriate adjustments to the tuning parameters in the criterion function. Through the experimental results, the proposed method has been shown to be powerful under set-point changes, load disturbances, and significant plant uncertainties.

Erzurumlu *et al* [2] Investigated on minimization of the warpage and sink index in terms of process parameters of the plastic parts have different rib cross-section types, and rib layout angle using Taguchi optimization method. Considering the process parameters such as mold temperature, melt temperature, packing pressure, in addition to rib cross-section types, and rib layout angle, a series of mold analyses are performed to exploite the warpage and sink index data. Confirmation analysis test with the optimal levels of process parameters are carried out in order to demonstrate the goodness of Taguchi method.

Jianga *et al* [3] investigated an implicit control volume finite element method for simulation of injection molding, the time steps were controlled for both flow and thermal simulation by local flow information, and then the computing complexity analysis was conducted. The implicit scheme was based on updating the melt–air interface.

Hassan *et al* [4] Investigated gate location is among the most critical factors in achieving dimensionally accurate parts and high productivity of the molding process. To investigate the effect of the gate location on the cooling of polymer by injection molding, have carried out a full three dimensional time-dependent analysis for a mold with cuboids-shape cavity having two different thicknesses. The cooling of the polymer material is carried out by cooling water flowing inside six horizontal circular channels.

Chen *et al* [5] Optimal process parameter is important parameter influences productivity, quality, and cost of production in the plastic injection molding (PIM) industry. Previously, production engineers used either trial-and-error method or Taguchi's parameter design method. these methods are unsuitable in present PIM because the increasing complexity of product design and the requirement of multi-response quality characteristics. have proposed an approach in a soft computing paradigm for the process parameter optimization of multiple-input multiple-output (MIMO) plastic injection molding process.

Baltussen *et al* [6] studied the viscoelastic flow front instability in the full non-linear regime by numerical simulation. A two-component viscoelastic numerical model is developed which can predict fountain flow behavior in a two-dimensional cavity. The extended Pom-Pom (XPP) viscoelastic model is used. The difficulties arising from the three phase contact point modeling are addressed, and solved by treating the wall as an interface and the gas as a compressible fluid with a low viscosity.

Rajalingam *et al* [7] Investigated the process parameters which will affect the shrinkage defect on a plastic cell phone shell component. The process parameters selected in this study are the mould temperature, injection pressure and screw rotation speed. The Design of Experimental (DOE) approach was used to investigate and identify the optimal moulding process parameters setting. Statistical results and analysis are used to provide better interpretation of the experiment.

Ahamed *et al* [8] Have worked on Designing and Optimizing the Parameters which affect the Molding Process using Design of Experiment In injection molding the processing condition have critical effect on the finished molded products.the effect of various factors like Melt temperature, Injection pressure,and Cooling time are selected for the experiment. A Plastic product polycarbonate plastic material was taken for the experiment with optimal injection molding conditions and its tensile stress test was conducted in order to minimize defects and increase its strength.

Mehdi Moayyedian *et al* [9] This paper is based on design of new cross sectional shape of runner system in the plastic iinjection molding. The purpose of the new geometry is to reduce the cycle time and scrap easier ejection of runner system from mold tools.

Vijaykumar *et al* [10] This paper is based on component referred to as flow reducer where chosen for a comprehensive design review and mould flow analysis. The design of this product and the mould were made by the designing analysis software Autodesk Inventor software, Which is then simulated by the use of Autodesk Mold Flow software.

III. COMPONENT DETAIL

This part is fixed at the bottom of the housing containing lubricating oil. Typically, the retainer has external treads that engages with the tapping in the Aluminum housing. The part is required to withstand the torque applied during fitment with the housing. Weld line, Warpage also needs to be controlled.. The housing retainer is as shown in fig 1

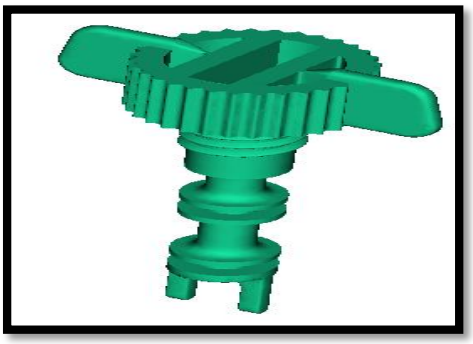

Fig No 1 Housing Retainer

IV. ANALYTICAL SOLUTION

In the analytical solution 3D model and mold design created using CAD software such as CATIA. Then Meshing is carried out with the help of pre-processor software. Simulation or Analysis can be performed using suitable software in the CAE domain. The popular software used in the industry can be identified as Mold Flow/ Moldex / Any customized software used by Industry, etc. For this simulation work we use Autodesk mold flow software. The analysis will help the designer to design a perfect a plastic injection mold with minimum modifications and which will also reduce the cost and time. Thus simulation or analysis provides an insight into the nature of processing and offers valuable inputs towards the proper design of the mold.

V. MOLD FLOW ANALYSIS

Analysis of the product using Autodesk Mold flow software helps us optimize and validate the plastic parts, injection molds, and the injection molding process. The software guides designers, mould makers, through simulation setup and results interpretation to show how changes to gate location, material, geometry and wall thickness, affect manufacturability. Simulating the molding process reduces the need for costly physical prototypes, and helps deliver innovative products to market faster. Autodesk Simulation Mold flow software can better predict the flow behavior of melted plastics and achieve higher-quality manufacturing.

VI. MESHING AND MESH STATISTICS

In order to analyze fluid flows, flow domains are divide into smaller sub domains that are collectively known as meshing. Following are the ways of meshing a product design 1) Midplane Mesh, 2) Dual Domain mesh and 3) 3D Technology. In this project Dual Domain mesh is used. The meshed model is shown in fig no 2

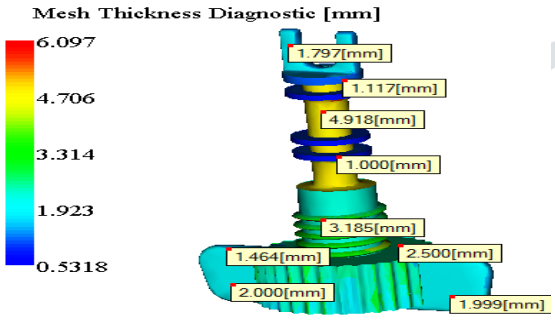

Fig No 2 Meshed Model

Fig No 3 Mesh Statistic

After Meshing is done, it's compulsory to check the mesh statistics to check if there are problem that needs fixing making sure that the mesh has no flaws. The mesh statistics is shown in fig 3 The first analysis about the mesh is the Connectivity Region. It always connected and represented as one region. The second analysis will be the Edge Details; it is where the surface edge is checked the Free Edges has to be zero; meaning that all the edges in the elements are connected. A Manifold Edge has two elements attached to it.

VII. RUNNER MODEL AND LAYOUT (ITERATION 1ST)

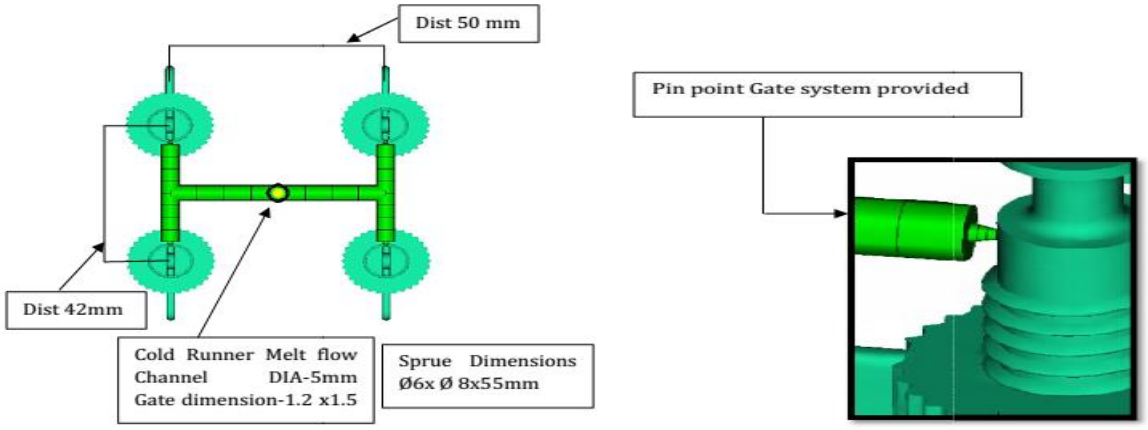

Fig No 4 Runner Model and Layout (Iteration 1st)

VIII. RUNNER MODEL AND LAYOUT (ITERATION 2ND)

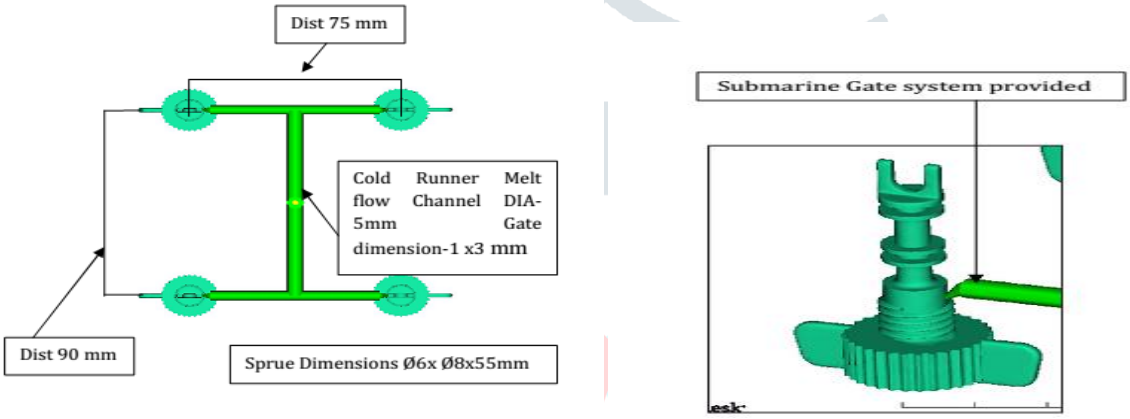

Fig No 5 Runner Model and Layout (2nd Iteration)

IX RUNNER MODEL AND LAYOUT (ITERATION 3RD)

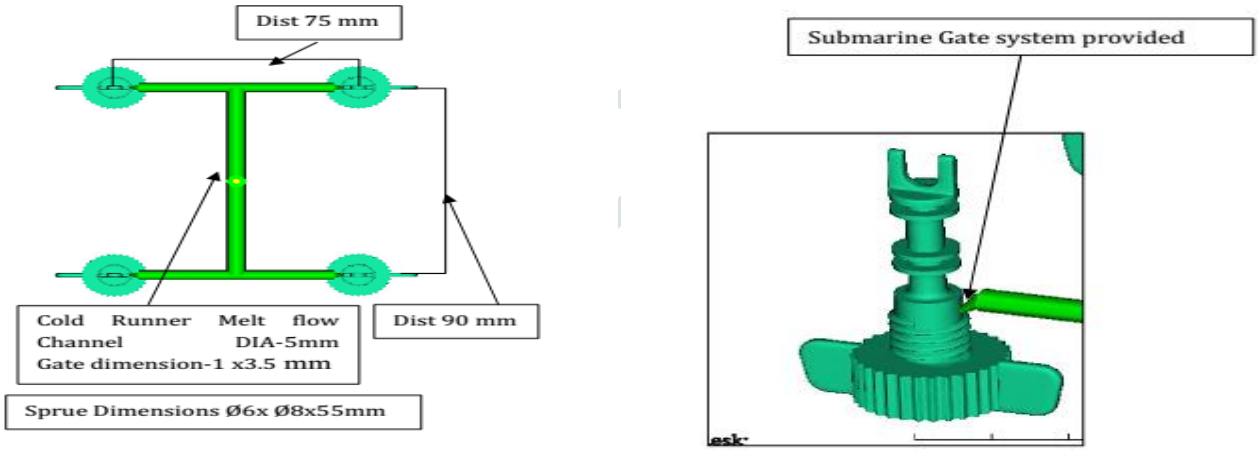

Fig No 6 Runner Model and Layout (3rd Iteration)

X.RESULT AND DISCUSSION

After the feed system is designed the analysis is carried out with the help of Autodesk Mold Flow Software. The software provides the information about different parameter and defect in the component. From this result we can avoid the defect in actual injection molding. The result obtained in analysis is given in table.

	Iteration 1st	Iteration 2nd	Iteration 3rd
Type of gate	Pin point gate Dim :1.2x1.5mm	Submarine gate. Dim:1 x 3mm	Submarine gate. Dim:1x3.5mm
Fill time	1.257 Sec.	1.226 Sec.	1.226 Sec.
Injection Pressure	14.77 Mpa	18.41 Mpa	18.41 Mpa
Temp. At Flow Front	265 ºC	266.6 ºC	266.6 ºC
Sink Marks	0.2540 mm	0.2935 mm	0.2935mm
Air Traps	Acceptable	Acceptable	Acceptable
Weld Lines	Acceptable	Acceptable	Acceptable
Warpage	0.7143 mm	0.7522 mm	0.7525 mm

Among all this iteration 1st is the best iteration. by considering this iteration the part can be molded without defects and no hesitation with the provided feed system and process conditions. So iteration first is considered for mold design. The result of mold flow software for 1st iteration (best iteration) as below

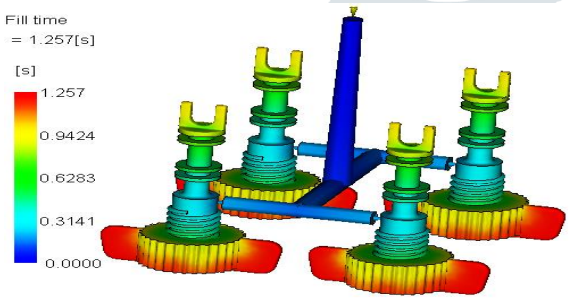

Fig No 7 Fill Time Analysis Result

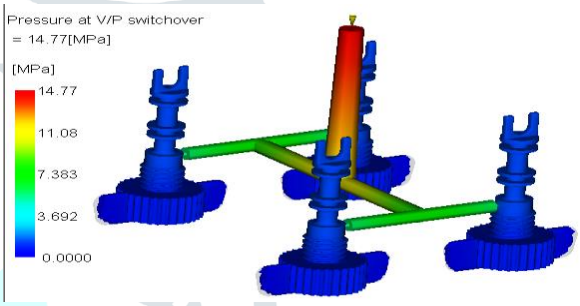

Fig No 8 Injection Pressure

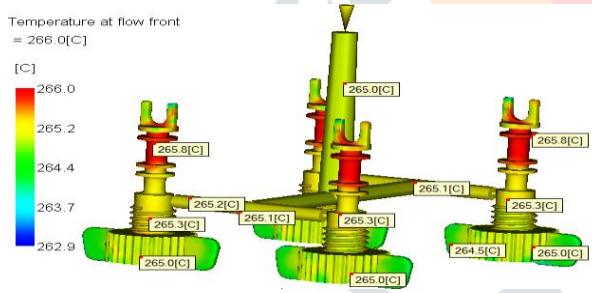

Fig No 9 Temperature at Flow Front

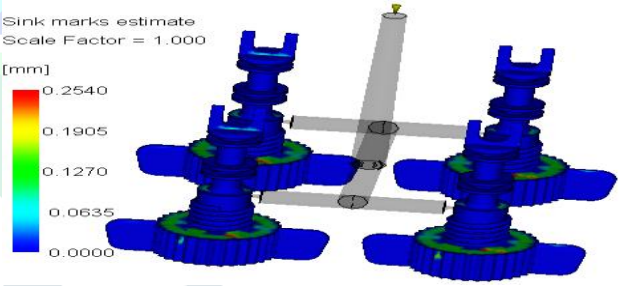

Fig No 10 Sink Marks Analysis Result

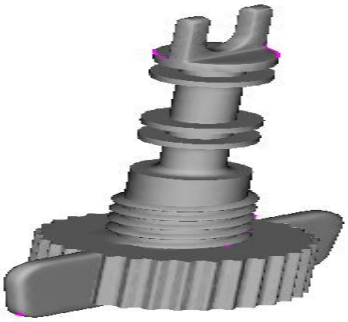

Fig No 11 Weld Lines Analysis Result

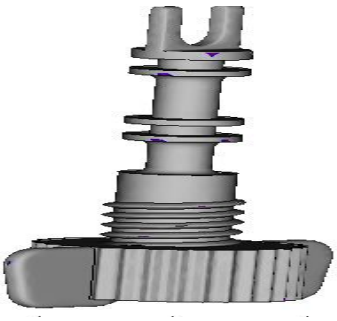

Fig No 12 Air Traps Analysis Result

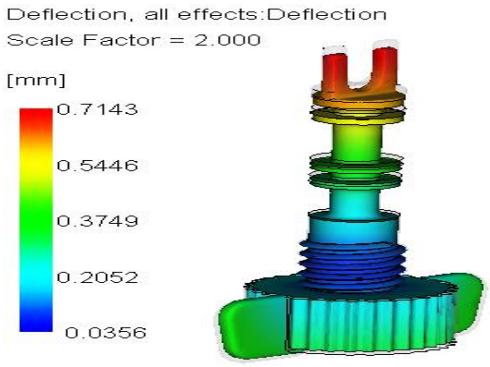

Fig No 13 Warpage analysis Result

XI. CONCLUSION

The feed system help the mold designer to design a perfect mold with minimum modifications and which will also reduce the time and cost. In the analysis we use mold flow software which provide important information regarding the mold design, hence the mold flow software is a corrective and preventive tool, that helps the engineer to analyze the process to decrease the cycle time and to improve the Quality of the Product.

XII. REFERENCES:

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