

# **Importance of selection of runner system on the success of moulding large components of 1.5 mm thickness.**

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## **Abstract**

Mould makers often face challenges of developing a mould for product design which is not validated for manufacturing. Typically machine selection is based on mould size and product weight with no considerations to the geometry of the product or material and grade to be used. This results in long lead times before the mould is finally accepted and many corrective actions are taken as a compromise to make the mould successful.

The paper outlines how a typical thin section automotive component can be crucial in selection of gate location, number of gate points, feed system and the total impact on product cost.

Using Moldflow technology, Polysmart Technology Pvt Ltd., a Moldflow Silver Certified consultant explains the relationship of product design and mould design on the cost of the product.

## **Background**

Automotive components which are used below the body and have no functional requirements are designed with low thickness to optimize the cost. In the case study, we are taking an example of a wheel rim which is of size 816.8mm length x 385.94mm width x 549.8mm height and wall thickness of 1.52mm and with a volume of 811.09 cm<sup>3</sup>. The target machine is 1600 Tons. The material to be used is PP copolymer.

We are considering three different scenarios. First one is with 3 sequential valve gates, the second one is with 5 sequential valve gates and the third by using hot tip and cold runner system.

As we all know, when the flow is progressing against atmospheric pressure in the cavity, the pressure requirement is less. Pressure starts building in the cavity when the flow stops and the resistance to flow against the applied pressure builds pressure in the cavity. Thus, the cavity has to have a balanced feed system so that the extreme areas do not have much variation in filling time. This calls for a careful

selection of gate points. When using multiple gate points you have a problem of weld lines and if not vented properly, they can fail in actual use. Thus sequential valve gates are considered. We are also considering an option if a mould maker tries reducing his mould cost by using only hot sprue and rest of the product can be in cold runner.

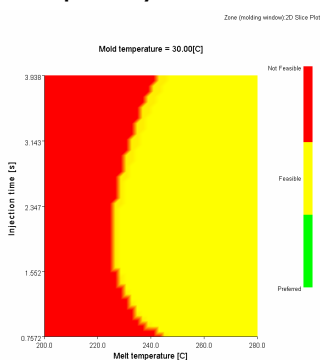
## Project

It is very essential to ascertain if the product can be manufactured with the specific machinery and moulding conditions. Our client wanted to manufacture the component on his 1600T injection molding machines with a hot runner system.

With the mold cost, being the main governing factor, two options were available. Either to use a hot sprue coupled with cold runner system or use hot runner system. Weld lines could be crucial and thus it was settled for sequential valve gating system.

We have selected a injection moulding machine of a clamp tonnage of 1600T and a maximum injection pressure of 1440 kg/cm<sup>2</sup>.

The initial run with hot sprue and 3 cold runner system indicated that the quality of moulding will be a problem. There would not be consistency in quality with process variations.



Also with three injection locations, the weld line is a major concern for a thin section component and flow front temperatures were important. Fig. 1 shows a quality plot which states that higher melt and mould temperatures will be necessary to manufacture the product. It should also be noted that there is no preferred window which guarantees the manufacturability of the product.

On simulating a flow on a 1600 T machine, the results show short moulding (Fig. 2). The temperature and injection pressure drops prevents the mould from filling the cavity. This calls for faster fill times which necessitate a higher injection pressure and resulting in higher clamp tonnage.

When the same mould was simulated on a higher tonnage machine, the moulding window

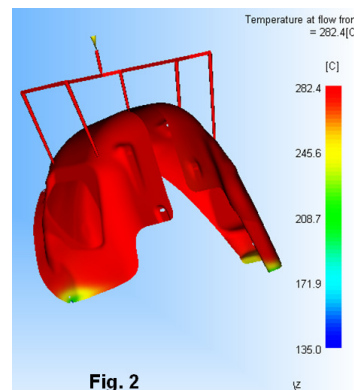


Fig. 2

showed a preferred window which indicates the quality of a product can be good if moulded on a higher tonnage machine with higher injection pressure. The moulding window can be seen in Fig. 3

Though one can mould the product on a higher tonnage machine, the cost of manufacturing is higher and this is a recurring cost. Also, the wastage of material in the form of sprue and higher cooling times on account of runner diameters makes it non viable.

In view of this, it was decided to simulate with a 3 point valve gating system. Fig. 4 indicates the moulding window which suggests using higher temperatures to mould the component.

The criticality of selecting the position is that both the ends of the component should fill within a time variation of 1%. If not, the imbalance would result in higher cavity pressures which would result in higher clamp tonnage requirements.

Series of simulations lead to an ideal location for the 3 points of sequential gates. The gates would open sequentially as the material reaches the point so that weld lines are not formed and the pressure drop is not observed

with flow length. The pressure required to fill with 3 sequential gates is high and the resultant clamp tonnage exceeds the intended machine capacity of 1600T. Fig. 6 shows a required injection pressure (121 MPa).

The target machine is 1600T and hence it was decided to design mould with 5 sequential gates. The moulding window with this gating system is very encouraging and is shown in Fig. 7.

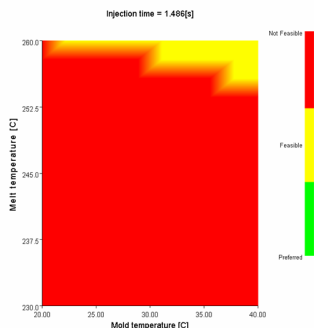
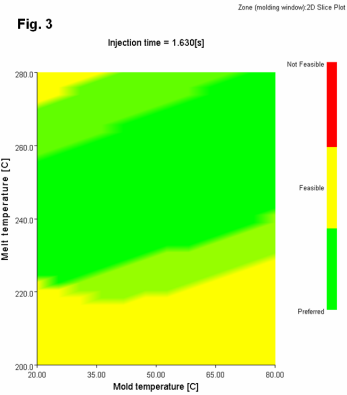


Fig. 4

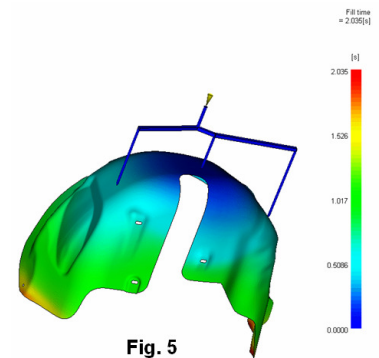


Fig. 5

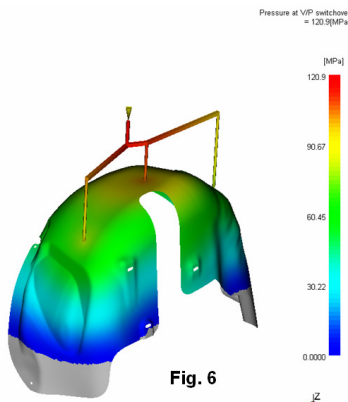


Fig. 6

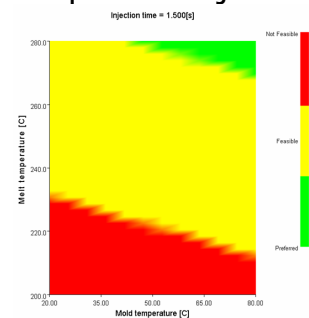


Fig. 7

The Quality plot (Fig. 8) indicates that the best quality can be obtained in a fill time of 1.5 s and any slow filling would deteriorate the quality of the moulding.

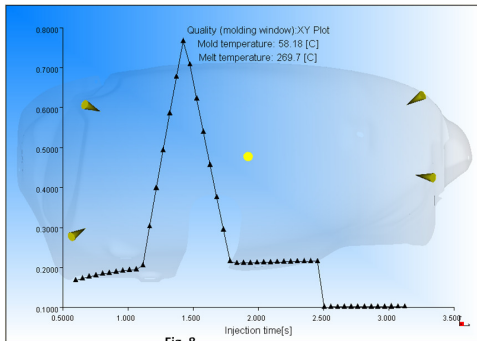


Fig. 8

With the study, we could conclude that with a five point sequential gating, the product would be possible to mould in a 1600 T moulding machine.

The Moldflow technology can be used to validate the product design for manufacturability. Most of the time, when a product designer designs a plastic component, he tends to give least importance to detailing. The thicknesses assigned to bosses and ribs may be very less to take care of sink marks but these pose a threat to the manufacturability of the part. A software like Moldflow can be used to validate product design as well as mould design to cut the development time.



*Polysmart Technologies is the only Moldflow certified consultant in Asia providing Engineering Services from concept design to rapid prototyping & soft tooling with focus on plastic products. The services include, Concept design, product detailing, meshing, structural analysis, thermal analysis, Moldflow simulation for Flow, Cool, Warp, Coinjection and Gas Assist.*

*Polysmart has developed Best Practices & Processes for offering services in designing plastic components and serves global customers. Polysmart employs a perfect synergy of human intelligence, Six Sigma processes and advanced digital technology such as CAD/CAM/CAE.*

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