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# Design of slanted glass injection mould for flow visualization of molten plastic

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**ABSTRACT** – A modified two-plate injection plastic mould having a new method of embedded slanted glass at mould cavity side was designed where it can be used to visualize the flow of molten material moving inside the mould cavity. The slanted glass mould was design and fabricated in order to find whether the flow pattern of the molten plastic material fills the cavity area affected the product quality. Through glass observation window, the flow pattern of molten plastics can be detected and the relations between machine parameters and the responses, i.e, weldline, sink mark and air burble, can be investigated in order to produce better quality of plastic products.

## 1. INTRODUCTION

It is important to understand the polymer flow phenomena in molten stage during mould cavity filling. This is because of economical reason such as reducing the plastic part defects as well as increasing the quality requirements of moulded parts. Therefore, it is useful to carry out research both in visualization [1] and simulation [2] during flow of molten polymer during injection moulding process [3]. Recently, the polymer flow using visualization techniques in plastic injection mould have studied by several researchers. Bociga and Jaruga investigated the polymer melt in the cavity filling with various accesses and found that visualization technique had been able to improve various problems that cannot be seen during simulation [4]. Kanetoh and Yokoi studied the flow fronts of plastics melt using glass insert mould. They used the direct visualization method and found that defect of flow marks was observed at plastic parts where it was closely related to plastic behaviour in the flow front [5]. Result from simulation can be compared with visualization where the parameters of machine injection can be optimized using various optimization method such as using full factorial [6], response surface method [7] and Taguchi method [8].

This project discuses the design mechanism of slanted glass mould that will be used for visualize the molten polymer flow through transparent glass. There are three locations of digital camera to view of the molten polymer, firstly at the surface front view, secondly at surface side view and lastly at the surface top view of the plastic product.

## 2. METHODOLOGY

Figure 1 shows the flow chart of mould design. To design the slanted glass injection mould, it begins with familiarization the CAD software that is used and in this case is Solidworks™ software version 2013. Injection mould design had been study in order to understand what type of mould suitable for the slanted glass mould and type of components should have in order to make it works. Lastly the mould base is selected and the direction of mould clamping, direction of ejection, water cooling system and suitable view direction for taking of the image of molten polymer were decided.

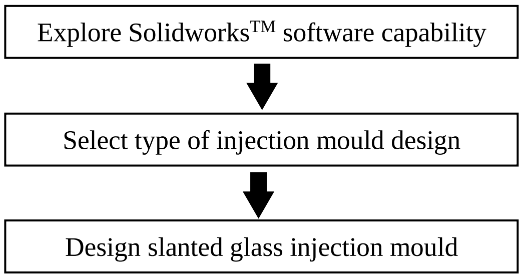

Figure 1 Mould design flow chart

## 3. SLANTED GLAS MOULD SET-UP

In order to design the slanted glass mould, the main concept and design have been done in a view of a diagram as shown in Figure 2. Front view shows the position of the slanted glass where digital camera no. 1 can capture the flow image from the top view of the product from the deflection of the mirror at the slanted part of the mirror.

Top view in Figure 2 shows the digital camera no. 2 and no. 3 that can capture the flow image from front and side of the product through the glass part. All digital cameras capture the flow image simultaneously during each injection shot.

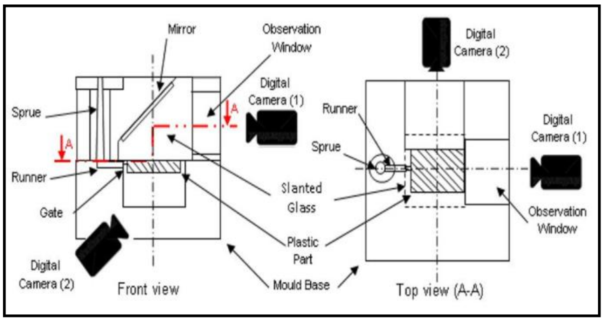

Figure 2 Slanted glass mould diagram

## 4. STATIONARY / MOVEABLE MOULD DESIGN

The two-plate injection mould design consists of two main plates and that are the core plate and the cavity plate. The cavity plate is known as stationary plate and the core plate known as the moveable plate.

### *4.1 Stationary Mould Design*

Figure 3 shows five main parts in the assembly of stationary part of the slanted glass injection mould. For each process cycle, molten material is shot from the machine through nozzle and go through the sprue. The material is then flow to the cavity side following the shape of the cavity or product. The slanted glass is fixed to the cavity plate by using slot.

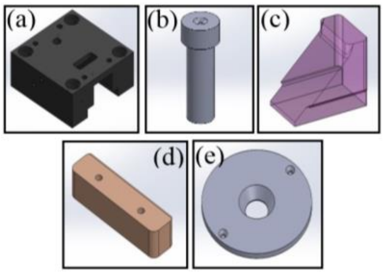

Figure 3 (a) Cavity plate (b) Sprue (c) Slanted glass (d) Slot (e) locating ring

### *4.1 Moveable Mould Design*

Figure 4 shows parts in the assembly of moveable part of slanted glass injection mould. Core plate is the main part where the insert is fixed at the middle of it. The insert decide the shape of the finish product. During the injection process happen, the molten material flow through sprue at the cavity plate. It then flow through the runner and gate at the insert and after that flow inside the cavity space. While the material is filling up the cavity space, digital camera no.1, no. 2 and no. 3 captured the flow material through the slanted glass and the side glass.

## 5. CONCLUSIONS

The design of slanted glass mould using two-plate of injection mould is designed carefully. Flow of the molten plastic from the gate into the mould cavity can be observed through slanted glass; front and side glass using digital camera and the image of plastic flow taken can be analyzed through the visualization and compared with modeling simulation. The slanted glass injection mould is designed carefully because in actual fabrication of mould need high investment and any error of mould design should be avoided before actual plastic injection is machined and fabricated.

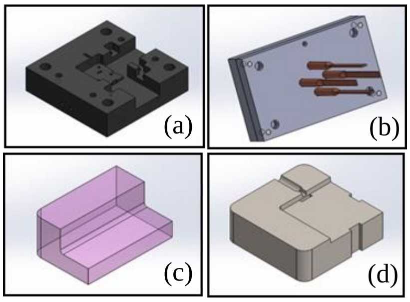

Figure 4 (a) core plate (b) ejector pins and ejector plates (c) side glass (d) insert

## 6. ACKNOWLEDGEMENT

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