

# Comparison of flow analysis between flat and ring plastic parts using moldflow software

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**ABSTRACT** – The flat and ring plastic part were designed using Solidworks software to produce solid parts. Then the solid parts were imported in Autodesk Moldflow Insight (AMI) to analyze warpage deflection, fill time and weldline for both parts. Simulation result shows that the deflection for the flat plastic part is higher than the ring plastic part by 0.1466mm due to the bigger of volume and contact surface area for the flat plastic part. Meanwhile, fill time shows that the ring plastic part is longer 0.0458s then the flat plastic part due to the reduction of flow area. Finally, ring plastic part obviously shows weldline mark at flow front area however no weldline is observed at flat plastic part surface.

## 1. INTRODUCTION

It is important understand the flow of molten material filling the cavity area in an injection moulding process. To driving towards the fast, cost effective and reliable plastic manufacturing, simulation has taken part to achieving those goals [1]. Nowadays the simulation is one important element that must be done in order to get the best settings, parameters and preliminary results in the form of a contour image that show details needed. Recently, the simulation on an injection moulding plastic part has been studied by several researchers. Jian and Chuanyang have investigated the plastic flowing status during the circular plastic part by changing the melting temperature by simulation using MPI software. They find that productivity rate is the highest due to the maximum melting flow rate and the minimum injection time [2]. Xia investigated the flow and warpage simulation of mobile phone injection mould by using Moldflow software and found the application of the technology reduces the mould reworking time and increases the efficiency of the injection mould design [3]. Result from simulation can be compared with visualization where the parameters of machine injection can be optimized using various optimization methods such as using full factorial [4], response surface method and Taguchi method [5].

This project discusses the simulation mechanism of flat shape part and ring shape part that using the Autodesk Moldflow Insight (AMI) as the analyzer by looking at the warpage deflection, fill time difference and weld lines for both shapes.

## 2. METHODOLOGY

Figure 1 shows the simulation flow chart for flat and ring plastic part. To design the flat and ring plastic part, there are considerations that need to be look such as draft angle, part thickness, corner radius and it had been discussed in detail in our previous paper [6]. The solid modeling in CAD part is then imported into the AMI software to be analyzed both flat and ring part. The responses of this project selected are warpage deflection, fill time and weld line. Result responses in AMI for both parts are shown in the form of value and colour contour flow image. Finally, both results are compared which part shows less warpage, short fill time and obvious weldline mark.

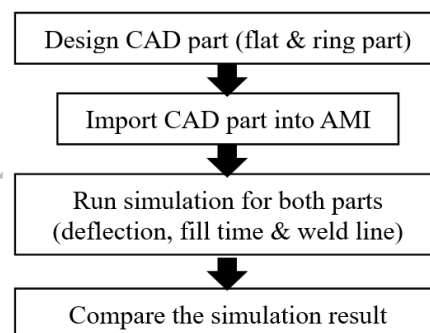


Figure 1 Simulation flow chart.

## 3. RESULT AND DISCUSSION

From the simulation, the results are display in a contour image of material flow filling the shape of the part. The material used in this analysis is polypropylene (PP) and the machine type Arburg alrounder 420c 80 tons. The results for both flat part and ring part are shows and discuss.

### 3.1 Flat part

Figure 2 shows the warpage deflection effect and fill time for the flat part in contour flow image. The maximum deflection for flat part is 0.38mm shows in the red area at the four edges. Meanwhile, the blue area is the areas that having the deflection only of 0.0204mm. Futher in Figure 2(b) the maximum fill time are at the end of the part with having 0.3081s. The flat part shows no weld lines due to its shape.

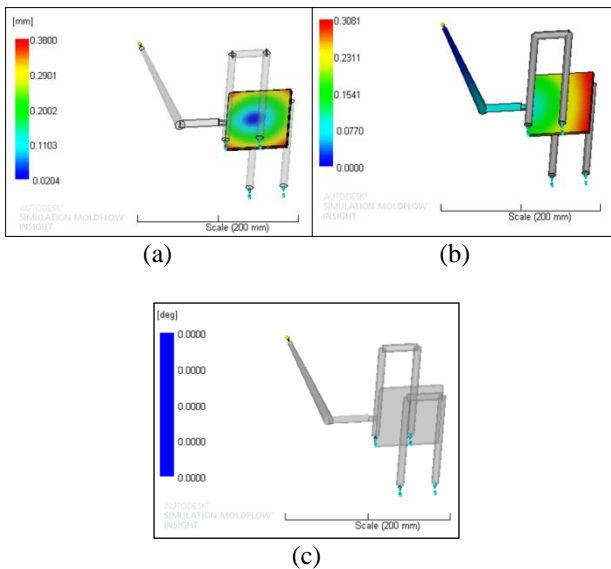


Figure 2 Flat plastic part; (a) warpage deflection of 0.3596mm (b) fill time in 0.3081s and (c) no sign of weldline.

### 3.2 Ring part

Figure 3 shows the warpage deflection, fill time and weld line for the ring part in contour flow image.

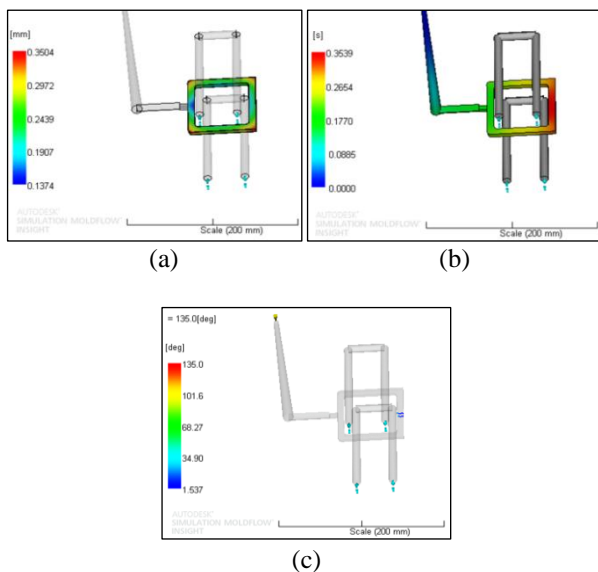


Figure 3 Ring plastic part; (a) warpage deflection of 0.213mm (b) Fill time of 0.3539s and (c) shows sign of weldline.

The maximum deflection for ring part is 0.3504mm shows in the red area at the far away edges. The blue area is the areas that having the minimum deflection of 0.1374mm. While in Figure 3(b) the maximum fill time is at the end of the part with having 0.3539s. Further, Figure 3(c) the ring part shows weld line at the meeting area at the end of the ring part.

From the simulation result, it shows that the maximum warpage deflection for flat part as compare to the ring part is 0.1466mm due to the shape of the flat part that consist more material and the contact surface area with the mould is bigger thus the heat dissipation from the part to the mould is slower than the ring part.

However, the fill time for the ring part is slower than the fill time of the flat part by 0.0458s because of the flow area that is smaller for the material to fill until the end of the part. The weld lines are formed in the ring part because of two flow fronts meets heads on. They give the part of the area local weakness because they act as stress concentrations. Although the weld lines cannot be eliminated, this flow analysis can show the location and the mould can either be redesign to position weld lines in the least sensitive area.

## 4. CONCLUSION

The comparison of simulation analysis for both flat and ring plastic part by using AMI is performed. The warpage deflection, fill time and weld lines for flat and ring plastic part are observed carefully by contour image result. It can be concluded that flat part shows more warpage deflection but lower fill time as compare to ring part. Further, flat part shows no weldline but obvious weldline for ring part. Thus, result shows that volume and shape are crucial factors for materials characteristics of plastic part.

## ACKNOWLEDGEMENT

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