EFFECT OF INJECTION MOULDING PROCESS PARAMETERS ON PLASTIC PART QUALITY IN TRANSPARENT GLASS MOULD

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ABSTRACT
The effect of injection process parameters on plastic part quality such as dimensional shrinkage (DS) and warpage deflection (WD) is studied using visualisation method of transparent glass mould. Injection moulding machine parameters such as injection time, holding time, injection pressure, packing pressure, mould temperature, and melt temperature are selected. The injection machine parameters are set-up to find the effectiveness of the responses that are DS and WD. Gate location at centre, left and right side of product will be taken consideration of polymer flow in machine direction (MD) and transverse direction (TD). To ensure flow pattern can be easily seen, master batch will be mixed with plastic pellet. Further, image from visualization results will be compared with simulation modelling, to get the reasons, how polymer flow in mould cavity affected the DS and WD. The optimization process in simulation will be analyzed using Moldflow software. Selection the best injection parameters will be selected from modelling simulation. Then, simulation analysis of product quality on DS and WD will be performed. Finally, validation will be performed by measured the moulded plastic part using optical profile projector. Our expectation is that DS and WD of plastic part at MD and TD can be reduced through analysis of polymer flow image with the help of experimental and simulation analysis.

KEYWORDS: Injection moulding parameters, plastic part quality, visualization, simulation

1.0 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 do research both in visualization and simulation during flow of molten polymer during injection moulding process [1]. Several researchers have studied the polymer flow using visualization techniques in plastic injection mould. Bociga and Jaruga studied 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 [2]. 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 [3]. In order to drive toward fast, cost effective and reliable plastics manufacturing, integration between injection moulding and software modelling of polymers transformation, computer-aid engineering (CAE) was developed by several researchers have studied of simulation modelling in injection moulding. M. Achudhan et al. analyzed thin wall injection moulded plastics using Moldflow^{TM} software. They found that packing pressure was the most influential parameter on the warpage and shrinkage [4]. Further, W. Xia [5] studied flow filling and warpage of mobile phone using similar software. It was found that the tryout time was saved and the design efficiency of the injection mould was improved. In this project, slanted glass using visualization technique is fixed at centre of mould and image of molten polymer will be taken by digital camera through glass window. Then, Moldflow^{TM} software will be used to simulate the model and flow analysis. Finally, validation on DS and WD of responses will be confirmed by inspection the sample specimen using profile projector.

2.0 PROBLEM STATEMENT

2.1 Problem Statement

Nowadays, many thin plastic parts have been designed to utilize in new production small product such as in new design of small electronic products and engineering parts. However, DS and WD in MD and TD always happen when produced thin plastic part. The DS and WD always happen when wrong

combination of set-up parameters and poor gate location. Therefore, to understand the reasons how the defects occur during injection moulding process, the image of flow pattern of molten polymer flow in mould cavity will be captured through slanted glass.

2.2 The Problem Interesting, Important, And Difficulties

Many plastic companies still using try and error technique to solve quality problems such as DS and WD especially for thin plastic part. During production, they have limited time and usually use their imagination to countermeasure the problems, because impossible to see flow of molten polymer during injection processing since mould made by metal. Therefore, a new technique is proposed using a slanted glass having mirror at the end cavity insert. As compare to the current research which is only observed the flow of polymer at front surface only without looking at top surface of the cavity. Using slanted glass having mirror, it can look flow at top as well as front surface of whole cavity.

2.3 Problem Settlement Approaches

This project studies the use of slanted glass in flow visualization of molten polymer during injection moulding process. Slanted glass is fixed into the mould at three locations; left, right and top side of mould and digital camera will capture the image of polymer flow on top, side and front surface of cavity. Machine parameters; time, pressure and temperature will be set-up to get the effectiveness of the responses on DS and WD. Gate location at centre, left and right side of product will be taken consideration of polymer flow in MD and TD. To ensure flow pattern can be easily seen, master batch will be mixed with plastic pellet. Further, image from visualization results will be compared with simulation modelling by using Moldflow software, to get the reasons, how polymer flow in mould cavity affected the DS and WD. Selection the best injection parameters will be selected from modelling simulation. Then, simulation analysis of product quality on DS and WD will be performed. Finally, validation is performed by measured the moulded plastic part using optical profile projector.

3.0 CONCLUSION

The flow of the molten plastic from the gate into the mould cavity can be observed through slanted glass using digital camera and the image of plastic flow taken can be analysed carefully. Then, analysing images from different location can give more understanding how DS and WD happen during injection process. When pressure, time and temperature are changed, the polymer flow conditions also changes. Different gate positions such as gate is placed at the centre will give significant impact in high DS and WD in MD. However, if gate is located at the left or right of product cavity, it will give significant impact in high DS and WD in TD.

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