



EFFECT OF MOLDING PARAMETER ON INJECTION MOLDING

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Abstract

In today's world, Plastic Injection molding process is one of the most widely used processes for producing plastics products. Engineering plastics is the family capable of withstanding high loading for a period of time at elevated temperatures and in adverse environmental conditions. It exhibits a good balance of high tensile strength, shear strength, toughness to use as replacement of metals in many applications. The aim of this paper is to study the effect of various parameters on the plastic part (used in automobiles). A number of experiments has been conducted by changing the main parameters used in injection molding such as Injection pressure, holding pressure, injection speed etc. All these concerned parameters are responsible for giving the required shape to the part with minimum stresses for better life of the product. Based on above parameters, the weight of the part has been varied which will also help in dimensional stability.

Keywords: Plastic Molding process, PP Material, Parameter Effect, Dimensional stability



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I. INTRODUCTION

Today everything is progressing at very rapid pace, so are the manufacturing processes. The plastic injection Molding is the most important process for plastic parts mass production. Among the all plastic products about one fourth are made by injection molding. Selecting the proper process parameters settings is necessary because during production the behavior of the plastic material is highly affected by the process parameters. Consequently, the process parameters govern the quality of the part produced. A sufficient amount of research has been directed towards determining the process parameters settings for the plastic injection molding process. There are number of parameters that affect the properties of plastic product. There are different processing parameters for all different materials. Holding pressure, injection pressure and cooling time are the main processing parameters. Therefore, the setting of process parameters for plastic products has a noticeable influence on their quality and cost. As a raw material plastic is used in plastic injection molding process such as low density polyethylene, nylon, polypropylene, flexible PVC, polystyrene, ABS and machine used for the injection process is the injection molding machine. In plastic injection molding process raw material is melted in the injection molding machine and then forwarded into the mould with the help of reciprocating screw where it cools and solidifies into the final product part.

The reciprocating screw is mounted on gear box in the barrel; barrel contains heaters for heating the raw material. In the injection process raw material is melted by heat and pressure. While forwarding material the material enters the grooves of reciprocating screw. After cooling and solidification final product is obtained.

The work material used in this research is Polypropylene. Polypropylene is a thermoplastic polymer having chemical formula $(C_3H_6)_n$ and chemical name of poly(1-methylethylene). It is a very versatile material; it offers very great combinations of properties such as light weight, strong, high heat resistance as well as stiffness and flexural retention. By these properties polypropylene is easily fabricated. The polypropylene has many variants but the material used is homopolymer polypropylene.

II. EXPERIMENTAL PLANNING

Plastic injection moulding machine is used as a set up for conducting this study. Plastic injection moulding machine classified by driving systems is divided into three types – hydraulic, mechanical and electric. It mainly consists of two main parts – Injection unit and clamping unit.



Weighing machine



Molding machine used for experiment

Most commonly used injection moulding machine is of horizontal plastic injection molding machine. In this, plastic material is usually in the form of powder or pallet, which is being fed from hopper directing the raw material to the injection chamber.

The material is moved forward from the hopper to the injection chamber by cylinder-piston arrangement. Raw material first enters into the barrel and is melted in the injection unit due to external heaters fitted inside the barrel. Molten plastic then injected into the mould cavity through the nozzle and allows it to cool and solidify inside the mould. After this process, the part is removed from the mould cavity.

Material used for this study is Polypropylene (PP). Polypropylene is a linear hydrocarbon polymer, expressed as $(C_3H_6)_n$.

Polypropylene has many variants but the material used in the manufacturing of the bottle cover (product under study) is homopolymer polypropylene of H110MA grade. The electronic weighing machine used for the experiment is of electronic type having the weight limit ranging from 0.01 to 200 gm.

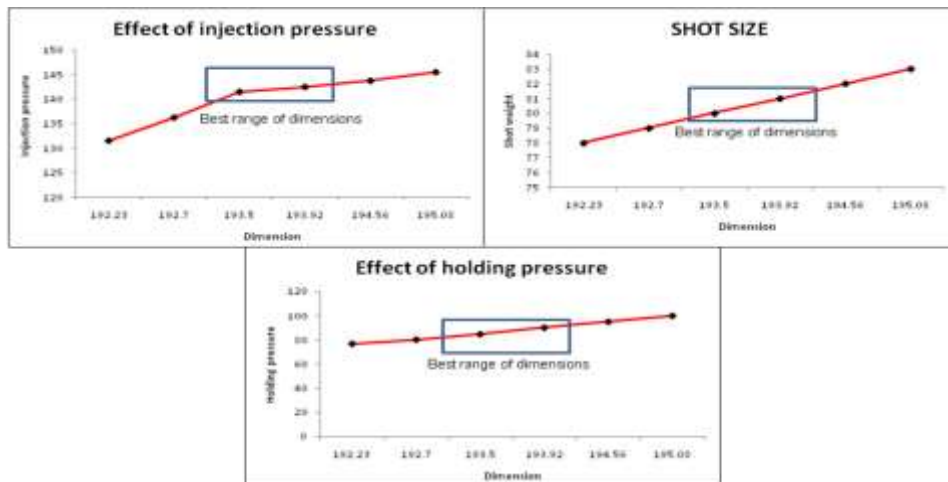
III. RESULTS AND DISCUSSION

Two major parameters e.g. Holding pressure and injection pressure are studied in current work mostly affected the weight of final product.

Dimensional variation response is shown in below graphs when important parameters are varied. For achieving the required dimension best parameters are calculated. & it is very much clear Shot weight, Injection pressure & Holding pressure influences dimensions and make formation of linear effect. So the effective value of melting temperature is 220⁰C.

#Trial based on parameter changes

Parameter	Trial1				Trial2				Trial3				Trial4				Trial5				Trial6			
Injection pressure (MPa)	125	165	135	100	125	165	145	110	125	165	155	120	125	165	155	125	125	165	155	130	125	165	160	132
Injection speed (m/sec)	7	30	15	8	9	30	15	18	9	30	15	8	9	30	15	12	9	30	15	12	9	30	15	12
Injection time (sec)	5				5				5				5				5							
Holding pressure (Mpa)	75		78		80		80		84		85		88		92		94		96		100		100	
Holding time (sec)	1.5		1.5		1.5		1.5		1.5		1.5		1.5		1.5		1.5		1.5		2		2	
Cooling time (sec)	25				25				25				25				25							
Shot size (gram)	78				79				80				81				82				83			
Weight part (gram)	194 gms				196 gms				198 gms				200 gms				202 gms				204 gms			
Considerations for dimension (194 mm)	192.23 mm				192.70 mm				193.50 mm				193.92 mm				194.56 mm				195.08 mm			



CONCLUSION

In above experiment effect of various parameters have been studied which directly or indirectly effect the part dimensions & part aesthetics. Among all factors involved injection speed, injection pressure, holding pressure & shot weight are the prime factors for our required results.

<For Polypropylene (PP) material>

The results show that the best combination of processing parameters for PP in terms of weight are 220 deg C melting temperature, 142 MPa injection pressure (app.) & 85-90 MPa Holding pressure. Study concludes that by optimizing these parameters, we can achieve the best dimensional results considering least possible variation in the mold shape.

Additionally, we can control the weight and cycle time which has direct impact on the cost of the product.

Other parameters of this study are still under research and need more involvement of multidisciplinary science and technology to achieve improvement. Future aspects of this study to carry out further analysis are very wide. Using different analytical approaches will also make an effective outcome, which is also recommended.

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