A NEW MATERIAL SUPPLY MECHANISM FOR PLUNGER TYPE INJECTION MOLDING

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Engineering Manufacturing or Bachelor of Manufactuirng Engineering

SUPERVISOR

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STUDENT'S DECLARATION

I declare that this thesis entitled A New Material Supply Mechanism Plunger Type Injection Molding is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree

Signature **: .....**

Name **:** MOHAMAD AL RASSID BIN MOHD BORHANUDIN

Date **:**

To my beloved parents

Mr. Md Borhanudin Bin Md Ishak

Madam Rohaini Bt Othman@Raja Deraman

and

My fellow friends

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ABSTRACT

This project was carried out to develop the new material supply mechanism for plunger type injection molding. The objective of this project is to design a new material supply mechanism that can overcome the limitation on the plunger type injection molding at the same the to improve the function of the current material supply that only act as a material storage. The development process consists of the design process and the validation process. The new design consists of the new function to give more functionality to the current material supply. The new function consists of the mixing mechanism and also the heating element and in additional to that, the valve is also being integrated into the mechanism in order to control the molten plastic from flowing out. The process of selecting a new material supply mechanism are made by selecting the best concept from three concept of a new material supply mechanism using a Pugh concept selection method. Due to the constrain in obtaining the component part, validation process was carried out by using CAE software. The validation process is done by using the CAE software analysis in the temperature flow on the mechanism. The value of the temperature was set to the three variable values to see the different flow of the temperature. Based on the analysis of the temperature flow, it shows that the new material supply mechanism are achieving the objective.

ABSTRAK

Projek ini telah dijalankan untuk membangunkan alat mekanisme pembekal bahan baru untuk pelekap jenis acuan suntikan. Objektif projek ini adalah untuk mereka bentuk alat mekanisme bekalan bahan baru yang boleh mengatasi kelemahan pada pengacuan suntikan jenis pelocok pada masa yang sama untuk meningkatkan fungsi bekalan bahan yang sudah ada yang hanya bertindak sebagai alat penyimpanan bahan. Proses pembangunan terdiri daripada proses reka bentuk dan proses pengesahan.Reka bentuk baru ini terdiri daripada fungsi baru untuk memberi lebih fungsi kepada bekalan bahan semasa.Fungsi baru terdiri daripada mekanisme pencampuran dan juga elemen pemanas dan tambahan kepada itu, injap juga disertakan sekali ke dalam mekanisme untuk mengawal plastik lebur daripada mengalir keluar. Dalam memilih mekanisma terbaru, konsep yang terbaik telah dipilh daripada tiga konsep mengunakan konsep pemilihan Pugh. Disebabkan kekangan dalam mendapatkan bahagian komponen, proses pengesahan telah dijalankan dengan menggunakan perisian CAE. Proses pengesahan dilakukan dengan menggunakan analisis perisian CAE dalam aliran suhu pada mekanisme. Nilai suhu yang telah ditetapkan pada nilai tiga pembolehubah untuk melihat aliran yang berlainan suhu. Berdasarkan analisis aliran suhu, ia menunjukkan bahawa mekanisme baru mencapai objektif.

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LIST OF SYMBOLS

T	-	Torque Per Shaft Design
P_{Motor}	-	Motor Power
N	-	Rotational Speed
F	-	Lateral Impeller Force
D	-	Impeller Diameter
f_n	-	Hydraulic Force Factor
M	-	Shafft Bending Moment
L_x	-	Kength of Shaft to Intermediate Support
L_i	-	Length of Shaft to Impeller
d_s	-	Minimum Shaft Diameter for Shaft Stress
σ_s	-	Allowable Tensile Stress
d_t	-	Minimum Shaft Diameter for Tensile Stress
σ_t	-	Allowable Tensile Stress
d	-	Minimum Shaft Diameter
2D	-	Two Dimensional View
3D	-	Three Dimensional View
RPM	-	Rotational Per Speed
RPS	-	Rotational Per Second
μ	-	Viscosity

D	-	Diameter
g	-	Gravity Accelaration
L	-	Length
K	-	Kelvin
V	-	Velocity
ρ	-	Density
A	-	Area
mm	-	Milimeter
s	-	Second
CAD	-	Computional Added Design
CAM	-	Computer Automated Manufacturing

LIST OF ABBREVIATION

RPM	-	Rotational Per Speed
RPS	-	Rotational Per Second
CAD	-	Computional Added Design
CAM	-	Computer Automated Manufacturing
ABS	-	Acrylonitrile butadiene styrene

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In modern society, manufacturing industry of polymer processing is one of the most important fabricating in industry estimated to polymer product. Injection molding is the most widely used polymer processing operation, because of this operation can produce from the small part to big part. For instance, key holder to large automobile components through to intricate electronic parts into a big amount.

In injection molding, polymer pellets are fed into a heated cylinder (usually a screw extruder), the solid polymer is plasticized inside the cylinder. Thus the molten polymer is injected into a mold cavity, and finally the molten polymer inside the cavity is solidified by cooling the mold. The molded article conforming to the shape of the molded wall is usually the final part and requires no further work. Modern injection molding machines often have a microprocessor controller and many monitoring instruments (temperature, pressure, position, etc.). This is to ensure the quality of the products at the most economical processing conditions.

Injection molding can produce a lot of material from almost all thermoplastic and some thermosets materials as shown in the figure 1.1. Injection molding is widely use in polymer processing, before of many advantages.

The advantage of the injection molding is, to allow for the high production output rates. The product can be made in close tolerances on small intricate part. It is also can be used more than one material at the same time when utilizing co-injection molding There is typically very little post production work required because the part usually have a very finished look upon ejection and the scrap may be reground to be used. Therefore there is very little waste can be used in full automation with injection molding.

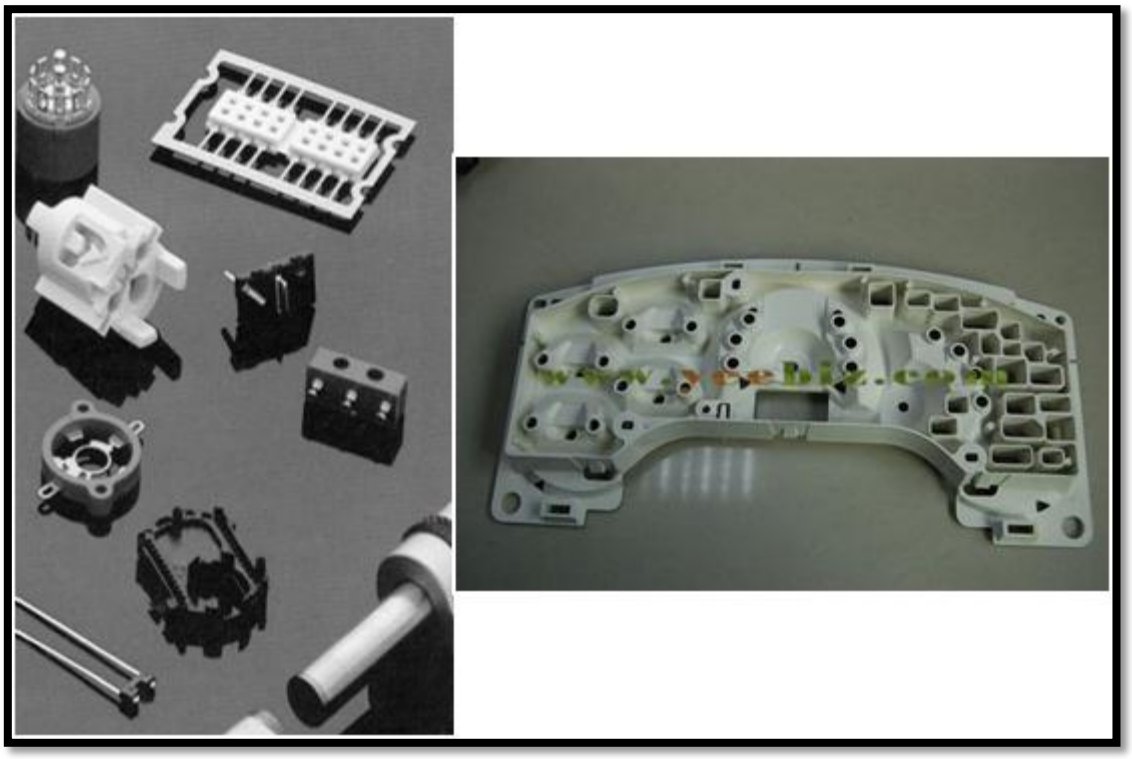

Figure 1.1: Plastic product

Source : Kalpakjian and Schmid (2001)

For the injection molding process, when it consider about the cost of the equipment, the production rate and also the tooling cost. It shows that injection molding is one of the most expensive processes to use. However this can be used in high production compare to other and can produce the intricate part in high volume. This table shows comparative costs and production volumes for processing of plastic. Table 2 shows that the economic

production quantities for various molding methods, although injection molding have very high in investment but it can be very economic in production rate.

Table 1.1: Comparative costs and production volumes for processing of plastic.
(Source : Kalpakjian and Schmid (2001))

	Equipment capital cost	Production rate	Tooling cost	Typical production volume, number of parts
				10 10^2 10^3 10^4 10^5 10^6 10^7
Machining	Medium	Medium	Low	
Compression molding	High	Medium	High	
Transfer molding	High	Medium	High	
Injection molding	High	High	High	
Extrusion	Medium	High	Low	*
Rotational molding	Low	Low	Low	
Blow molding	Medium	Medium	Medium	
Thermoforming	Low	Low	Low	
Casting	Low	Very low	Low	
Forging	High	Low	Medium	
Foam molding	High	Medium	Medium	

*Continuous process.

1.2 BACKGROUND

Injection molding machine is one of the most significant and rational forming methods existing for processing plastic materials. A major part in this development has been by the forward-thinking machinery industry. It has been quick to seize on innovations and incorporate them into plastic molded products. The most recent examples are the all-electric and hybrid injection molding machine. A major focus continues to be on finding more rational means of processing the endless new plastics that are developed and also produce more cost-efficient products. A simplified general layout for an injection molding machine is shown in Figure 1.2. It can be classified into two units that are clamping unit and injection units.

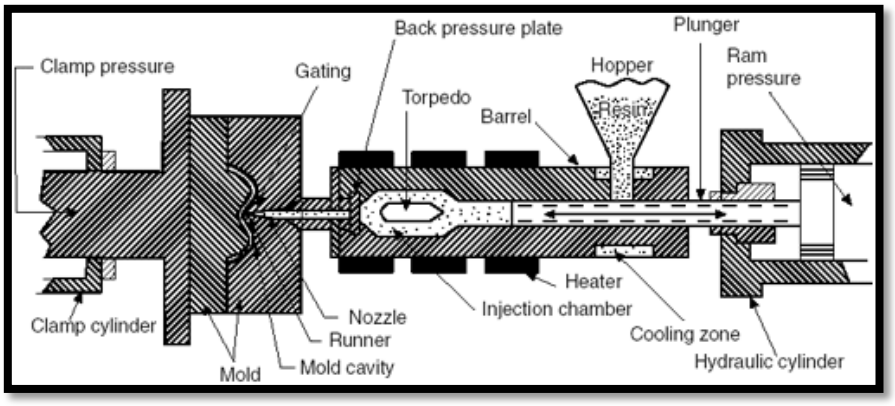

Figure 1.2: Cross-section of typical plunger injection molding machine.
(Source : Manas Chanda and Salil K.Roy (2009))

Injection unit contains hopper and plasticizing unit. Granular plastic material will be fed through hopper to the hot barrel. The plastic material is gradually melted and injected through the nozzle to the injection mold. Functions of the injection unit are (R J Crawford, 1998):

(i) Movement of the barrel to bring the nozzle in contact with sprue bush of the mold.
(ii) Generation and maintain of pressure between the nozzle and the sprue bush during injection of molten plastic material.
(iii) Rotation of screw during feed stage.
(iv) Arial motion of screw during the injection stage.

1.3 PROBLEM STATEMENT

Injection molding have been widely use in polymer processing in high volume because of its characteristic that economic when produce large quantity of the product. To ensure that the entire product that produces is in good condition, there are a few parameters that need to be look when running the machine, the purpose is to obtain good condition of the product when produce a large quantity is impossible without the proper supervises. The important to overcome the problem in injection molding is because of every defect

considered a loss for the company. The less defect that produce, the higher profit for the company. This is into specific molding problems, below are some possible solutions may be used as an aid in producing quality molded parts. 65 percent of product rejections are directly related to Injection Molding profiles, and that up to 20 percent can be from the Mold. Because of this project are about to develop the new mechanism for the material supply, so the problem are more emphasize to the material supply problem for the plunger type injection molding. Table 1.2 shows the comparison of the disadvantages of the plunger type and reciprocating screw.

TABLE 1.2: The comparison between disadvantage of plunger and reciprocating type

PLUNGER TYPE INJECTION MOLDING	RECIPROCATING TYPE INJECTION MOLDING
1. Do not provide uniform melt homogeneity.	1. Significant amount of screw rotation during injection indicates a worn barrel and check valve. This allows a backflow of melt over the ring, causing the screw fights to counter rotate
2. Plastic melted unevenly	2. Defective, streaked, splayed, or non-uniform parts due to poor melt quality resulting from worn components.
3. Plastic closer to the heated walls simply had a higher temperature than the plastic further away	3. Inconsistent shot size
4. Difficult to meter accurately the shot size. Since metering is on a volume basic, any variation in the density of the material will alter the shot weight.	

Based on the comparison on the Table 1.2, the problem that can be found and can be used for this project is the material are not melt unevenly and not completely in the solvent phase during mixing and heating process before transfer into barrel or injection molding for plunger type injection molding. This project is more focusing on the plunger type injection molding because, due to the high demand of the plastic product, the limitation of the plunger type injection molding making the screw type injection molding more preferable to the commercial used. If the limitation of plunger type injection molding can be eliminated. Then consider the cost of each type of machine, plunger type are more preferable than screw type in term of cost and suitable to use to produce small product.

1.4 OBJECTIVES

For this project, the main objectives are:

i. To analysis the material supply concept mechanism for plunger type injection molding.
ii. To design the suitable mechanism for material supply mechanism for plunger type injection molding.
iii. To study the mechanism for material supply mechanism for plunger type injection molding.

1.5 SCOPE OF THE STUDY

For this project, the scopes of the study are:

i. Making literature review for this project.
ii. Brainstorm the idea for the new concept of material supply mechanism for plunger type injection molding.
iii. Invent the new design of hopper for plunger type injection molding machine
iv. To improve the function of the hopper for plunger type injection molding machine.