COMPARISON OF TWO AND THREE PLATE MOLDS PLASTIC INJECTION MOLDING FOR MOLD DESIGN SELECTION

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This report is proposed to fulfilled some of the requirements to be honor with Bachelor of Mechanical Engineering (Structure and Material)

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"I verify that this report is my own work except for the citation and quotation that the source has been clarify for each one of them"

Signature :……..

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Date :……..

To my beloved family for their encouragement and support especially, and for their understanding in the way I am.

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ABSTRACT

The purpose of this project is to study and discuss the comparison between two plate and three plate molds which is used in plastic injection molding. A selected part was analyzed in order to built the mold. The project started from design the part of WF Neck joint in the SolidWorks software and finally used the Moldflow Plastic Adviser software for flow analysis in single and multi cavity. Two plate mold is more cost effective and simple mold design compared to three plate mold. In comparison three plate mold produce better quality product and complex part design. However, this need to be studied for different design of mold. In the „Moldflow Plastic Adviser" which system will be identify and eliminate cosmetic issues such as sink marks, weld lines and air traps. The best gate location and the orientation of the plastic was found in the study.

ABSTRAK

Kajian ini adalah bertujuan untuk mengkaji perbandingan diantara dua plet dan tiga plet acuan bagi „plastic injection molding". Dua plet acuan mencirikan satu produk yang kualitinya rendah berbanding tiga plet acuan yang berkualiti tinggi tetapi harganya jauh lebih murah berbanding tiga plet acuan. Selain itu, proses pembuatan bagi dua plet acuan ini lebih rendah dan memerlukan kemahiran daripada individu. Kualiti produk bagi pemilihan acuan ini melibatkan tahap acuan dari segi pengaliran cecair dan tegangan kekuatannya untuk membentuk produk dalam keadaan baik tanpa kecacatan permukaannya. Penggunaan simulasi Moldflow Plastic Adviser (MPA) ini dapat mempertingkatkan kualiti sesuatu produk itu dengan tahap maksimum yang mengikut prosedur untuk kualiti tinggi merangkumi segala aspek. Simulasi MPA ini secara tidak langsung dapat mengurangkan kos perbelanjaan dalam proses penghasilan produk dengan menganalisis awal bagi menghasilkan produk bermutu tinggi dengan kos yang rendah. Dalam simulasi MPA ini dapat mempertingkatkan keberkesanan bahan acuan bagi produk pengikat kipas dinding.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Background

The plastic injection molding process engaged the injection of a plastic material melt into a closed mold, at point the plastic cools and solidifies to form a specific product. The action that takes place is much like a three phase process comprising filling, packing and cooling phase. In its simplest form, is like the operation of a plunger needle that a barrel contains heated plastic that is injected by used of a plunger or auger device into a closed mold that contains a machined, reverse image of the desire product. While this may seem simple, the process actually involves many individual activities and parameters that must be tightly controlled to produce a high-quality product at a reasonable cost. The primary advantage of this process is that many functions and features can be incorporated into the product design. This process will minimize, or eliminate, the amount of secondary work required to produce the same product in other ways or using other materials. Its popularity is typified by the numerous products produced in this way at present time (Brydson, 1999).

Mold is the production tooling used to produce plastic parts in molding. The plastic product begins life in the mold. The mold produces the final shape of the product before it is ejected out into the world to perform its intended function. In addition, the process is fast, usually requiring less than one minute for a complete

product. The multiple cavity images can be placed in the mold, many products can be produced at the same time. This makes the cost of an individual part much lower than if it was molded alone. In theory, the mold can be designed and built to create a totally finished product, including painted surfaces, assembled units form individual components and molded-in metal inserts (Crackwell, 1993).

The beginning of simulation software has made a major impact in the industry where in the past, much was unknown about the injection process itself. Indeed, it was known by only a handful of experts. To the resourceful user, simulations can produce a variety of results on ail aspects of injection process. Traditional trial runs on the factory floor can be replaced by less costly computer simulations. The performance adviser adds the ability to simulate the packing phase of the injection molding process to both part and mold. Use Moldflow Plastic Adviser results to minimize undesirable part shrinkage as well as to assess whether a part is likely to warp or deform beyond acceptable levels.

1.2 Objective

The purpose of this work are:

i) To compare two and three plate molds in plastic injection molding process in form of design and product quality.

ii) To select the best mold design in term of good product quality.

1.3 Scope

The scopes of this study are:

i) Discover the differences between two and three plates for plastic injection molding.
ii) The design analysis solution using a software „Moldflow Plastic Adviser".
iii) To improve product quality and to identify eliminate sink marks, weld lines and air traps.

1.4 Problem Statement.

The task was to selected the comparison two and three plate mold that can be reducing the cost of the injection molding process and good product quality. The paper study of flow analysis in mold using computer software analysis. The project was a design modification of an existing product, not a totally new design from scratch.

1.5 Outline of Research.

The research outlines are as follows:

1.5.1 Literature review.

The principle and theories of the plastic injection molding. Then the comparison of two and three plates of mold for were reviews from various sources such as journals, books, previews reports and the world wide website. Summary of the literatures was presented in Chapter 2.

1.5.2 Methodology

The methodology were divided into two phase which are the two plate and three plates of plastic injection molding. Then the comparison of this part such as the design, cost, product quality will be selected. The methodology of this task were described in Chapter 3. The methodology of this study has been summarised in the flow chart (Figure 1.1) below

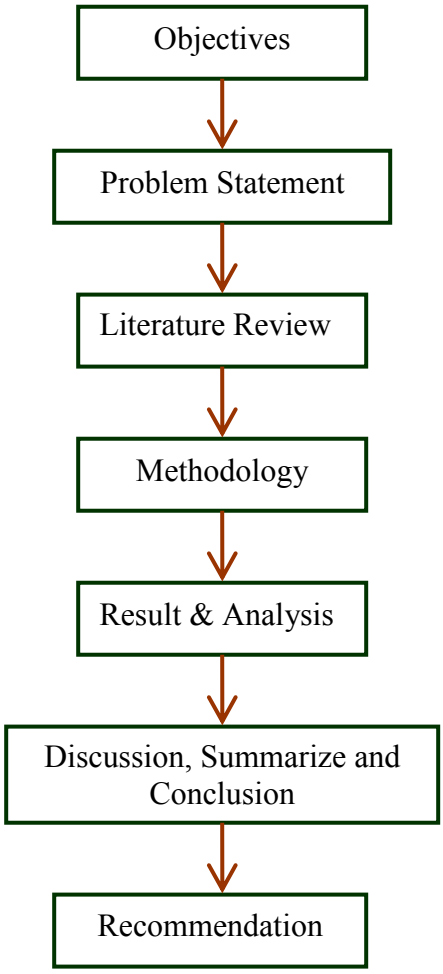

Figure 1.1 Flow Chart Methodology

1.5.3 Project Analysis.

The information that collected from the research were presented by using statistical analysis. The details were also analyzed to obtain the effect of cost and quality product by using statistical software analysis. Then select a new design and the comparisons for each plates were done and the results were discussed in chapter 4.

1.5.4 Discussion.

All results that obtained in the research of this study were compiled and discussed in chapter 5. Finally, the conclusion and recommendation for future research were presented in Chapter 6 and Chapter 7.

CHAPTER 2

LITERATURE REVIEW

2.1 Plastic Injection Molding

The plastic injection molding is a process that consists of semi-inject the molten polymer in a closed mold under pressure and cold, through a small hole called a gate. Molten plastic is injected at high pressure into a mold, which is the inverse of the product's shape. In that mold material solidifies starting to crystallize polymer semi. The final part is obtained by opening the mold and remove the cavity of the molded part.

According to Knights (1997), In 1868 John Wesley Hyatt became the first to inject hot celluloid into a mold, producing billiard balls. He and his brother Isaiah patented an injection molding machine that used a plunger in 1872 and the process remained more or less the same until 1946, when James Hendry built the first screw injection molding machine, revolutionizing the plastics industry. Roughly 95% of all molding machines now use screws to efficiently heat, mix, and inject plastic into molds.

The injection molding is a very popular technique for the manufacture of different articles and provides low cost at moderate to large quantities. Plastic molding is an extremely versatile process for producing a wide range of simple or complex plastic parts with a good finish.

2.1.1 Injection Molding Materials

The huge majority of injection molding is applied to thermoplastic polymers. The polymers being softened by heat and hardening on cooling even after repeated cycling. In general, most of thermoplastic materials offer high impact strength, good corrosion resistance, and easy processing with good flow characteristics for molding complex designs (Boothroyd 1994).

The thermoplastic separated into two class that namely crystalline and amorphous. Crystalline polymers have an ordered molecules arrangement with a sharp melting point which its reflect most incident light and generally appear opaque. They also undergo a high shrinkage or reduction in volume during solidification. Crystalline polymers usually are more resistance to organic solvents and have good fatigue and wear-resistance properties. Besides, this polymers also are denser and have better mechanical properties than amorphous polymers.

Acrylonitrile Butadiene Styrene (ABS) is among the most popular and versatile of the resins in the styrene family .Its availability, strength, and limited shrinkage all help make it widely used as the default choice for most plastic products. The ABS is an amorphous polymer with good impact strength and excellent appearance. It is easy to process and is widely used for product has poor chemical resistance.

Tensile Strength	: 5000-7500 psi
Flexural Modulus	:270,000-380,000 psi
Impact Strength	:3.0-7.5 ft-lb/in notched izod
Maximum Temp.	:200 F short duration, 140 F long term
Brand Names	:Cycolac (GE) Lustran (Monsanto)

Table 2.1: Acrylonitrile Butadiene Styrene (ABS) Specification
(Kenneth Budinski 2005)

Thermoplastic	Yield strength (MN/m^2)	Elastic modulus (MN/m^2)	Heat deflection temperature (° C)	Cost ($/kg)
High-density polyethylene	23	925	42	0.90
High-impact polystyrene	20	1,900	77	1.12
Acrylonitrile-butadiene-styrene(ABS)	41	2,100	99	2.93
Acetal (homopolymer)	66	2,800	115	3.01
Polyamide (6/6 nylon)	70	2,800	93	4.00
Polycarbonate	64	2,300	130	4.36
Polycarbonate (30% glass)	90	5,500	143	5.54
Modified polyphenylene oxide (PPO)	58	2,200	123	2.75
Modified PPO (30% glass)	58	3,800	134	4.84
Polypropylene (40% talc)	32	3,300	88	1.17
Polyester teraphthalate (30% glass)	158	11,000	227	3.74

Table 2.2: Thermoplastic Polymers Specification (Boothroyd et al. 1994)

2.2 Molds

Mold is the common term used to describe the production tooling used to produce plastic parts in molding. The injection mold is the element of the injection molding system that receives the molten plastic from the injection unit, forms the shape of the desired plastic part, provides the necessary cooling to solidify the part and ejects the part. The choice of material to build a mold from is primarily one of economics, steel molds generally cost more to construct, but their longer lifespan will offset the higher initial cost over a higher number of parts made before wearing out.