



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN AND ANALYSIS THE OPTIMUM SPRUE SIZE FOR
SINGLE CAVITY PLASTIC NAME CARD HOLDER INJECTION
MOLDING**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) (Hons.)

by

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ABSTRAK

Plastik ialah salah satu produk yang selalu digunakan dalam kehidupan harian disebabkan oleh ciri-ciri plastik seperti mudah untuk dibentuk, murah, dan ringan. Pengacuan suntikan plastik ialah satu process untuk menghasilkan satu produk dari bahan plastik. Pengoptimuman saiz sprue dalam process pengacuan plastic memainkan peranan penting di bahagian-bahagian pembuatan plastic untuk meningkatkan produktiviti proses. Pada masa yang sama ia tidak akan menjejaskan kualiti produk akhir. Kualiti yang buruk akan mentakrifkan sebagai satu kesan yang buruk kepada kos yang tinggi dalam industri dan masa untuk pengeluaran. Perisian Moldflow Plastics ialah salah satu pengisian digunakan untuk mensimulasi pemegang kad nama plastik mewakili paling berkesan secara menyeluruh terhadap alat alat untuk menyerupai, mengkaji, mengoptimumkan, dan mengesahkan bahagian dan bentuk acuan. Ia memberi maklumat terperinci tentang kaedah pemprosesan. Ia kini telah menjadi salah satu syarat untuk mengesahkan reka bentuk dan mengurangkan proaea pengulangan semula dalam kaedah cuba dan ralat manual pengilangan. Dalam masa yang sama, masa tunggu juga dapat dikurangkan secara drastik. Keputusan simulasi ini boleh meningkatkan kualiti produk dengan memilih bahan baik dan saiz sprue yang diterima berdasarkan ciri-ciri yang dihasilkan melalui keputusan analisa lokasi gate dan analisa pengisian. Keputusan ini sangat membantu dalam penghasilan produk pemegang kad nama plastik

ABSTRACT

Plastics is one of the common material used in daily life because of the behavior of plastic such as easy to be formed, cheap, and light. Injection molding is a method for making a product for plastic material. Optimization of sprue size in injection molding plays a vital role in manufacturing of plastic parts to improve the productivity of the process. At the same time it should not affect the quality of the final product. The bad quality will define as a bad impact to industry high cost and time for production. Moldflow Plastics software is one of the tools used in simulation of plastic name card holder to represent the most comprehensive suite of definitive tools for simulating, analyzing, optimizing, and validating plastic part and mould designs. It gives detailed information about the processing conditions. It has now become a prerequisite to validate the design and reduce the iteration involved in trials and error method of manufacturing tools. The lead time is also drastically reduced. This paper interprets the result done on gate analysis, fill analysis using Moldflow software. The result of this simulation could improve quality of product by choosing the excellent material with acceptable sprue size based on the characteristic that have been resulted from the gate location and filling analysis. It is very help in the development of new product plastic name card holder.

DEDICATION

Special thanks to my supervisor and my friends,

For my beloved mom, Normawati binti Shahri and all my family members who always give their support, encouragement and good advice to me.

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LIST OF ABBREVIATIONS

ABS	-	Acrylonitrile Butadiene Styrene
CAD	-	Computer Aided Drawing
EDM	-	Electrical Discharge Machining
FEA	-	Finite Element Analysis
HDPE	-	High Density Polyethylene
LDPE	-	Low Density Polyethylene
MPI	-	Mould flow Plastic Insight
PC	-	Polycarbonate
PE	-	Polyethylene
PP	-	Polypropylene
UV	-	Ultraviolet

CHAPTER 1

INTRODUCTION

This chapter consists for selected title for this research project. The problem statements are discovering from preliminary study for the introduction of the research. The objective is determined from the problem statement. This research only covers as stated in the scope.

1.1 Introduction

Plastic is a material that can create numerous shapes that can be utilized by human as a part of routine life [6]. All of plastic products are produced from various types of operation or process [6]. Plastic name card is one of the plastic parts that made by using plastic injection moulding machine.

Injection molding is a cyclic process for producing identical articles from a mold, the most commonly used manufacturing process for the manufacture of plastic parts [9]. The main purpose of injection moulding process is to reproduce the desired geometry of the final plastic part by transforming molten plastic into its final shape and dimensional

details [3]. While the main advantage of this process is the capacity of repetitively fabricating parts having complex geometries at high production rates [9].

Different types of materials will produce different types of injection moulding product depends on the customer need such as plastics, elastomer and rubber. Plastics are divided into two distinct groups that is thermoplastics and thermosets [6]. For this project, there are four types of material that are polycarbonate, polypropylene, polyethene and Acrylonitrile Butadiene Styrene are choose to analyse by using injection moulding process.

A mould must be well designed to produce good quality parts with excellent dimensional tolerance [19]. Sprue is one of the parts that need to be considered in designing of mold to get a better quality of a product. Quite often designing molds has to deal high complexity, which necessitates exhaustive simulative analysis, deliberate modifications and multifarious trails interactively and iteratively, owing to these uncertainty is obvious [13].

There are several commercial flow analysis software packages that can be used to design the mould [19]. CAD tool is one of a common technique at present, it is a useful system which integrates advanced design and manufacture as well as high productivity techniques [16]. The overall aim of this project will focus on the analysis of the sprue size, plastic name card holder by using injection moulding process with different types of materials.

1.2 Objective

- 1) To identify and design the optimum sprue size for single cavity plastic name card holder with different type of materials.
- 2) To analyse the optimum sprue size plastic name card holder when forces acting on the product by using Moldflow software

1.3 Problem Statement

Design of molding tool is an important issue to produce the high quality of product [19]. In the injection moulding process, there are several specification guidelines and references to design the mold. For traditional injection moulding, only people who have a lot experience and knowledge in injection moulding process will come out to decide sizes and location of feeding system especially in a different material. A parameter setting and feeding system such as gate, runner and sprue inside the plastic injection moulding are located a mold maker using trial and error method [6].

When the mold maker cannot perform the job with good method in designing a mold, they will take much time to think and make an experiment. Conventional practice also involves an iteration of modification on the existing mold until the molded part is within specification [19]. This process will waste more time and have higher cost of the production [6]. These situations happen because sprue design dependent on the volume of cavity that relate to product materials.

In plastic manufacturing industry not all those products produced according to the standards as they wish for, those products do not follow the standards in categorized as a disabled product [1]. Many types of defect may occur when the sprue size and parameter of the mold not perform in a smooth operation such as splay, film of flash, warpage or bend, sink mark and short mold. Conventional approach in mold design for injection moulding is based on allowances for post mould shrinkage of the part [19].

1.4 Scope

The scope of this research is to design and analysis the optimum sprue size for single cavity mold, plastic name card holder by using an injection moulding process with six different types of materials that is Polycarbonate (PC), Polypropylene (PP), Polyethylene (PE), Acrylonitrile Butadiene Styrene (ABS), Low Density Polyethylene (LDPE) and High Density Polyethylene (HDPE). The design and analysis of plastic name card holder, the mold and sprue design will illustrate and design by using CAD tools which is CATIA software while for the analysis of the product used a Autodesk Moldflow analysis.

CHAPTER 2

LITERATURE REVIEW

This chapter will preliminary thesis study of the optimum sprue size of plastic name card in injection moulding process. This chapter start explains about the injection moulding that relate with the machine, process, material and a mold. to design a mold, size a sprue and a gating need to consider. CAD tools are one of the options to get the better of design results.

2.1 Introduction of Injection Molding

Injection moulding is a universal in manufacturing a variety of plastic parts for smallest components to entire plastic product [6]. Injection moulding process represents the most critical, appealing, attractive and efficient process technologies for manufacturing plastic parts [4]. This process are very complicated system to comprised with a lot of components that are dominated too many cycles of temperatures and stresses [2]. In most cases, finishing operations are not necessary. This makes injection moulding, suitable for mass producing article [4]. There are many injection moulded parts can be found in daily life. This process is used to produce thin walled plastic parts for a wide variety of applications, one of the commonest being plastic housings. Plastic

housing is a thin walled plastic that requires many ribs and bosses on the interior. Plastic moulding product also can be used by human in routine life, such as the plastic name card holder, plastic tubes, buckets, toothbrushes, plastic toys and also many medical devices including valves and syringes [6].



Figure 2.1: Injection Moulding

(Source: <http://www.jayconsystems.com/jaycon-blog/what-is-injection-molding>)

2.1.1 Advantages & Disadvantages

The injection moulding process is the part can be formed in a complex shape and fine details [2]. By using this process, the finished part will have short product cycles with excellent surface finish and have good dimensional accuracy. Besides that, it has a high production rate and low labor cost. Finally, to reduce cost, the scrap can be recycled as long as the path does not involve in secondary process such as printing, spraying or others. Costs can be reduced further by the integration of components, while there is the potential for weight savings over metal counterparts [7].

While the disadvantage of this process are injection moulding part very limited to thin walled part and the parts must be designed with the moulding consideration. In

terms of cost, these processes have high tooling and equipment cost, expensive equipment investment and the running cost may be high. Other than that, this process contributes a long lead time as long as possible.

2.2 Injection Moulding Machine

An injection moulding machine can classify into a plasticating or injection unit, clamping unit, control system and tempering devices for the mold. This machine also called as a universal machine onto which various molds for making parts which different geometries can be mounted within certain limits. [4]

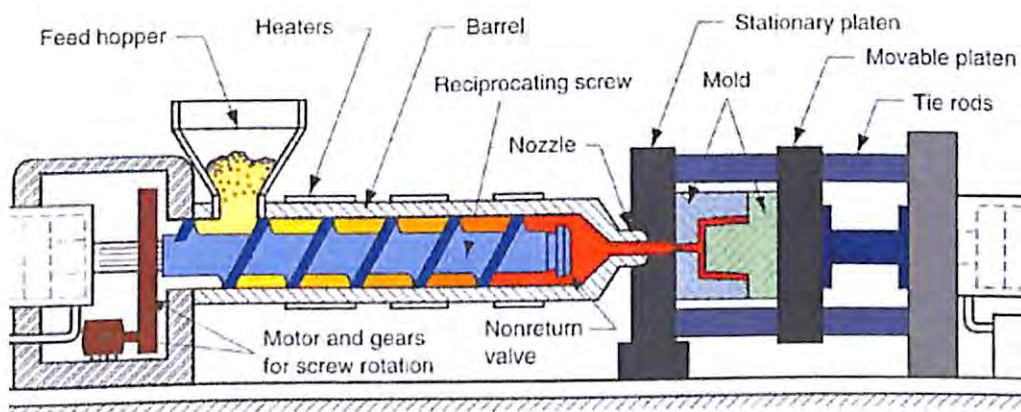


Figure 2.2: Injection Moulding Machine

(Source: <http://mould-technology.blogspot.com/>)

2.2.1 Injection unit

Injection unit used to heat and melt the plastic pellets or granules when entering from the hopper into a heating chamber [6]. Furthermore, it also can be used to inject the melt into the cavity and also to build up the pressure to provide the moulding with additional pressure during cooling process. There are important unit in injection unit such as hopper, screw, nozzle and heater bands.