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Analysis of Plastic Flow inside the Three Plate Mould

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By

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JUDUL: **ANALYSIS OF PLASTIC FLOW INSIDE THE THREE PLATE MOULD**

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I hereby, declare this thesis entitled “Analysis of Plastic Flow inside the Three Plate Mould” is the result of my own research
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ABSTRACT

The purpose of this project is to analyze the behavior of the plastic flow inside the three plate mould by using Moldex software. This research project was done by calculating the optimum size of feeding systems, including sprue, runner and gate. Besides that, the research focused on identifying the suitable location of gate, runner system and sprue system. Other than that, this research was to understand the parameters involved in flow simulation type of the plastic material, type of mould and type of injection moulding machine. In order to complete this research, hand phone housing for Nokia 2210 model was chosen as the 3D model. The 3D modeling of hand phone housing was prepared using Solidwork software. Then, transferred to Rhinocerous software. After the 3D modeling was exported, Rhinocerous software was used to do the meshing process on the part surface and then continue to design the runner, gate and sprue. After that, plastic flow analysis of Nokia 2210 mould was done using Moldex software. As result, various defects have been identified on Nokia 2210 such as short shot, weld line and air trap.

ABSTRAK

Kajian projek ini bertujuan untuk mengkaji kelakuan aliran plastik di dalam acuan tiga plat dengan menggunakan perisian Moldex. Kajian ini dilakukan dengan mengira saiz yang optimum terhadap spru, pelari dan get. Lokasi bagi sistem get, sistem pelari dan sistem spru juga dikenalpasti. Seterusnya, kajian ini diteruskan dengan memahami semua parameter yang terlibat dalam simulasi aliran, jenis bahan plastik berkenaan dengan acuan dan jenis pengacuan suntikan. Untuk menyempurnakan kajian ini, perumah telefon bimbit Nokia, siri 2210 dipilih sebagai model 3D. Penyelidikan ini bermula dengan melukis model 3D perumah telefon bimbit yang dipilih dengan menggunakan perisian Solidwork. Dari perisian Solidwork, lukisan model dipindahkan ke perisian Rhinocerus untuk proses seterusnya. Dengan menggunakan perisian Rhinocerus, proses penjaringan pada permukaan model dilakukan seterusnya,rekabentuk pelari, get dan spru dihasilkan dengan mengambilkira saiz dan kedudukan yang sesuai dengan acuan tiga plat. Setelah semua proses merekabentuk sistem pada acuan selesai, fail dipindahkan ke perisian yang seterusnya, iaitu perisian Moldex. Dalam perisian Moldex, pemilihan bahan plastik yang sesuai dilakukan dan parameter-parameter yang tertentu ditentukan sehingga mencapai tahap optimum. Setelah analisa dijalankan, keputusan mendapati terdapat beberapa kerosakan dikenalpasti, seperti plastik tidak lengkap, garis kimpal dan air yang terperangkap.

DEDICATION

To my beloved parents:

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LIST OF ABBREVIATIONS

PSM	= Projek Sarjana Muda
ABS	= Acrylonitrile Butadiene Styrene
PMMA	= Polymethyl Methacrylate (acrylic)
PP	= Polypropylene
PE	= Polyethylene
LDPE	= Low Density Polypropylene
HDPE	= High Density Polyethylene
MFI	= Melt flow index
EDM	= Electric-discharge-machined
C	= Carbon
H	= Hydrogen
N	= Nitrogen
Cl	= Chlorine
S	= Sulfur

CHAPTER 1

1.0 INTRODUCTION

1.1 Background

Plastic materials are the most important material in the world. The history of plastics goes back more than 100 years. However, compared to other materials, plastics are relatively modern. Their usage over the past century has enabled society to make huge technological advances to take us towards the new millennium. Plastics are usually used in agriculture, appliances, clothing, construction, electronics, furniture, packaging, transportation and numerous other areas. Almost in every human life activity, directly or indirectly involves in the products that made from plastics materials. [17]

There are many process can be used to produce the plastic product such as injection moulding process, extrusion process, blow moulding process, compression, and rotating process. The most popular process is injection moulding process. In the past, many people do not have any detail information about plastic injection technology. It was known by only a handful of expert. This process can produce high mass production and complicated shape of product. Injection moulding is the process of forcing melted plastic in to a mould cavity. Once the plastic has cooled, the part can be ejected. It is useful when the parts are too complex or cost prohibitive to machine. With this process, many parts can be made at the same time, out of the same mould. In injection process, mould is needed which it can be attached to the injection machine to produce plastic part. [16]

Mould is a tool to produce plastic part. To get one mould, involves various stages from design stage where the mould needs to be designed using Computer Aided Design Software and then machine the raw materials to become mould parts and finally, assemble the mould parts to become one complete set of mould.

It is very important to get good appearance, such as no welding line, sink mark, accurate dimension, flatness, and the most important capable to assemble to other parts. Some plastic parts are produced using injection machine have various problems such as welding line, sink mark and etc., due to various factors, such as wrong gate location, wrong size of gate, wrong size of runner, wrong length of runner, wrong location of water hole and other factors that effect the quality of plastic parts.[10]

In the past few years, many mould makers have used trial and error method to produce mould where they were usually very high skill people to assist on design stages. Sometime to produce one set of mould had taken long time due to the modification and repairing at mould to get good plastic part.

The defects of plastic part can be reduced by flow analysis on the plastic part at the design stage which plastics parts will be analyzed using flow analysis software. This analysis usually looks at the various parameter such as flow front, flow rate, temperature different, shrinkage distribution, air trap, optimum window condition and etc. [10]

1.2 Objectives

The objectives of this project are:

1. To analyze the behaviors of plastic flow inside the 3-plate mould.
2. To calculate the optimum size of sprue, runner and gate.
3. To identify the suitable location of gate, runner and sprue.
4. To understand the parameters involved in flow simulation.
5. To understand the type of plastics material, mould and injection machine.

1.3 Scope

In this study the type of 3-plate mould is used to analyze the flow behaviors of plastic using Moldex software. The 3D product will be drawn using solid work software. In order to analyze the plastic behavior, the optimum sizes of feeding systems were calculated and the location of the feeding systems was identified. After that the 3D product will be transferred to Rhinoceros software as post processor. Moldex software will be used to analyze the flow of plastic. Data from the result will be compiled and study the result.

1.4 Problem Statements

At the present time, mould makers are still using try and error method to locate the location of feeding system such as gate, runner and sprue inside the plastic injection mould. They need experienced people who capable to decide the size and location of feeding system especially in 3 plate mould.

With simulation software the behaviors of flow of plastic inside the cavity mould can be predicted. In 3-plate mould the feeding system can be decided using different approach such as centre gate, off-centre gate and multiple gate systems. The size and location of gate, runner and sprue play importance role for producing good quality plastic product. If wrong method used when choose the feeding system size and location, it will affect the product quality such as welding line, air trap and etc.

The Moldex software as a simulation software is used to ensure the best choice location and size of feeding system such as gate, runner and sprue. This because of the defect of plastic product can be eliminated before fabrication actual mould.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Introduction

This section discussed about analysis plastic flow inside the 3-plate mould. In this chapter, the theory in the field of plastics technology is described. In the area of plastic technology, studies focuses on a few different aspects namely are three-plate mould, plastic materials, injection flow rate and etc.

2.2 Plastic material

A plastic is a material that can change its shape; so many things can be made of plastic. The head of the Monsanto Plastics Research says that, "Plastics are materials that, while being processed, can be pushed into almost any desired shape and then retain that shape. [17]

There are many types of plastic. Some can be shaped only when they are freshly made; then they become hard afterwards. Others can be changed by heating them up or even by melting them.

Most plastics are man-made; they do not occur in nature. They are often made from oil that comes out of the ground. The process of making plastics is usually quite complicated

The term "plastics" encompasses organic materials, such as the elements carbon (C), hydrogen (H), nitrogen (N), chlorine (Cl) and sulfur (S), which has properties similar to those naturally grown in organic materials such as wood, horn and rosin. Organic materials are based on polymers, which are produced by the conversion of natural products or by syththesis from primary chemicals coming from oil, natural gas or coal. [17]

It designs in many different formulas for different purpose including for moulding. Approximately 18000 different materials are available for moulding. Majority of available materials are blends of previously developed material. Malaysia exports of plastics and plastics product were valued at RM9.38 (US$ 2.47) billion in 2003, the bulk of which went to the key markets of some country like Singapore, China and Hong Kong.[10]

2.2.1 Thermoplastics

Basically, plastic materials are divided generally into two groups namely thermoplastic and thermoset, based on their characteristic after the processing stage. The behavior of thermoplastics depends on other variables as well as their structure and their composition [8]. Thermoplastic materials is softened by the application of heat, hardened when cooled and fixed the shape of the moulding which may be quite rigid or flexible according to the type of plastic used. It can remould again and can recycle. This is because, there are no chemical changes takes places.