UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Reverse Engineering of A Pharmaceutical Bottlepack Cap By Plastic Injection Mould

Thesis submitted in accordance with the partial requirements of Universiti Teknikal Malaysia Melaka for the Bachelor of Manufacturing Engineering (Manufacturing Design)

By

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

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…….

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DECLARATION

"I hereby declare that this report and its entire contents is my own work unless specific reference and figure are made in the text. This work is submitted in partially fulfillment of the Bachelor in Manufacturing Design and has not been submitted for any other qualification in any other institute.

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ABSTRACT

Reverse engineering is methods that is used in re-produce and re-design an existing product. By using this method, the design of product can be study and improve produce. The purpose of this method to increase the product capability. This project related with redesign and analyzes the mold for a bottlepack cap at Ain Medicare. To produce the mold, measurement must be taken at the product, and from the measurement the product can be draw in the 3D model. The product will be measured by using suitable equipment. The filling simulation process by using moldflowExpress is used to analyze the design. Then, the design of the core and cavity of the product is finalized. The process flow started with identifying the part following with measuring the dimensions at the product and the end was simulating the filling process on the mold by using simulations.

ABSTRAK

“Reverse engineering” adalah merujuk kepada salah satu cara atau kaedah yang biasa digunakan oleh bidang kejuruteraan bagi merekabentuk kembali produk yang telah sedia ada. Melalui kaedah ini, lebih banyak produk dapat dihasilkan. Tujuan kaedah ini dilakukan adalah untuk meningkatkan lagi, keupayaan produk. Projek ini juga dikaitkan dengan penghasilan acuan yang akan digunakan untuk melakukan proses suntikan bagi menghasilkan produk. Acuan yang dihasilkan akan mempengaruhi bentuk produk yang akan dihasilkan. Bagi menghasilkan acuan yang sempurna terlebih dahulu proses pengukuran dijalankan keatas produk yang sedia ada dan daripada ukuran yang diperolehi model produk dalam bentuk 3 dimensi akan dilukis. Pengukuran dijalankan dengan menggunakan alatan yang bersesuaian. Proses disambungkan dengan melakukan proses suntikan bahan mentah kedalam lukisan produk dengan menggunakan MoldflowExpress. Kemudian acuan dan dai dihasilkan. Proses untuk kejuruteraan berbalik ini dengan mengukur produk kemudian melukis produk akhir sekali menganalisis lukisan yang telah dihasilkan.

DEDICATION

Specially dedicated to; my beloved father, Mamat Bin Awang Teh and my mother, Halimah Bt Mamat who are very concern, understanding, patient and supporting. Thanks for everything. To my sisters, brothers and all my friends, I also would like to say thanks. The work and success will never be achieved *without all of you.*

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CHAPTER 1

INTRODUCTION

1.1 Introduction of the Research

The main purpose of this research is to design a new mold by reverse- engineering the existing product. By applying the reverse engineering method, some of the costs like manufacturing costs and assembly costs are can be reduced easily**.** By using some a low cost of CAD/CAM applications and conventional measuring tools the cost designing will reduce. The reverse engineering is used to design the bottlepack cap. Besides that, the other main process to complete the bottlepack cap product is desiging the core and the cavity of the mold. The mold will be used for the injection molding machine in producing the finished product. This study is focused on the methodology and application of reverse engineering in producing the actual methodology product such as bottlepack cap.

1.2 Objective of the Research

The objective of this research is to analyze the aspect of the product requirement during the manufacturing process, the process and methods of reverse engineering and determine the actual data obtained and study the possibilities of producing a similar mold with a similar function by using the moldflowExpress. The first objective is to study the equipment that can be used to measure the product to get usable data, while the

second objective is to apply the equipment and software into the reverse engineering process. The third objective is to know how to make of the core and cavity by using the suitable software, and the function of this part. And the final objectives are to analyze the product and produce the new mold of the bottlepack caps.

1.3 Scope of the Study

The problem statement of this project is how to apply the reverse engineering method to analyze the aspect of the product requirement during the manufacturing process, the process and methods of reverse engineering and determine the actual data obtained and study the possibilities of producing a similar mold with a similar function by using the moldflowExpress. Beside that, to design the product,the equipment and software to be use must be identified.

1. 4 Problem Statement

Ain Medicare is a pharmaceutical company producing product for medical use. One of the products is bottlepack cap. Ain Medicare is producing the mold using one injection molding to support the production if need to outsource to meet the demand.The project is an attempt to support the production at Ain Medicare by produce the mold of the same product to be used on UTeM injection mold machine.

1.5 Research Organization

To make a research, first we should have the research organization. The function of the research organization is to arrange of the research, and to ensure it is carried out smoothly. In chapter one, it describes briefly about the introduction, objective,

application, scopes of study, problem statements, project organization, conclusion and the main focus and also the method that are going to be use to complete this research. In chapter two, it explains about the literature review of the reverse engineering, plastic injection mold, the equipment and the software that are used in reverse engineering. Besides that, this research also includes about the literature review of the original bottlepack cap product that has been produced by Ain Medicare Sdn.Bhd. This chapter also explains about the sources that related to the reverse engineering, plastic injection and the making of core and cavity. Chapter three is the methodology, which shows how the process of reverse engineering and plastics injection mold has being applied according to the equipments and methods used. It is also summarized some of the processes and applications that have been applied in reverse engineering. By taking some of the examples and guidance from other researches, then it can be studied and applied in this research.

Most of the organization facilities are theoretically claimed to have the facilities to follow in the development of mold making. Reverse engineering is known as an important element in product development. By combining reverse engineering and mold making techniques, the facilities can be utilized and tested on its capabilities of producing the mold by applying a combination of CAD capabilities, measurements tools and all resources available.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In this chapter explain about historical and the meaning of the reverse engineering and the application of the reverse engineering. Reverse engineering is important to produce the new pattern of the product by using reverse engineering equipment. In this chapter also explain about the software will be using to design the product. Beside that, it also include about the mold making and the application of plastic injection mold. At the last of this chapter, all the literature review about the reverse engineering, software is used to produce the product. Lastly the step to produce mold making can be studied. In the end of this research, it can summarize about the application of the reverse engineering in the manufacturing field.

2.2 Reverse Engineering

This is the main purpose that will be study. From the reverse engineering process, to produce the new pattern of the product it must apply the injection molding process the injection molding process is use to produce the bottle pack cap by making the core and cavity of the product before this. To making the reverse engineering product, it must follow the first step until the last step in the reverse engineering process

Reverse engineering process is a unique technique that uses the existing entity information to produce a new entity that has some of same properties of the existing entity.:(Saedon, J., Che Abdullah,S, Ismail,A R and Yahaya M A ,2006)

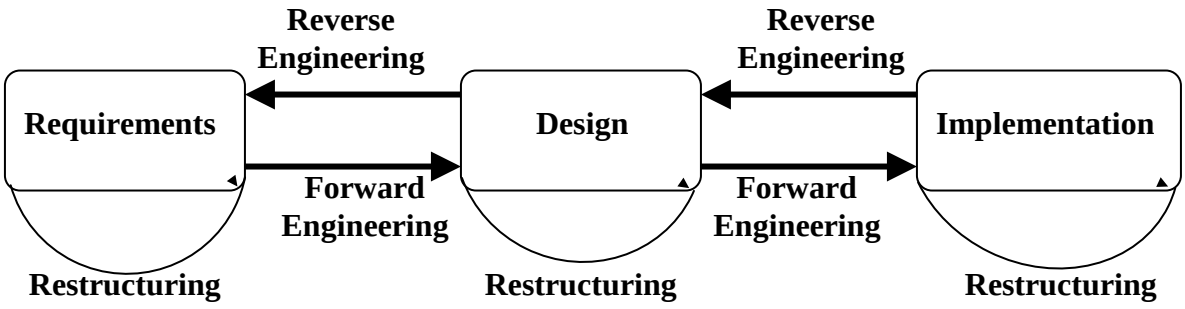

Figure 2.1 : Relationship between the re-engineering term.; (Gannod,G.C ,2000)

Reverse engineering defined as the process of duplicating an existing component, subassembly, or product, without the aid of drawings, documentation, or computer model is known as reverse engineering.

Reverse engineering can be viewed as the process of analyzing a system to:

1. Identify the system's components and their interrelationships
2. Create representations of the system in another form or a higher level of abstraction
3. Create the physical representation of that system

Reverse engineering is very common in such diverse fields as software engineering, entertainment, automotive, consumer products, microchips, chemicals, electronics, and mechanical designs.

Another reason for reverse engineering is to compress product development times. In the intensely competitive global market, manufacturers are constantly seeking new ways to shorten lead-times to market a new product. Rapid product development (RPD) refers to

recently developed technologies and techniques that assist manufacturers and designers in meeting the demands of reduced product development time. For example, injection-molding companies must drastically reduce the tool and die development times. By using reverse engineering, a three-dimensional product or model can be quickly captured in digital form, re-modelled, and exported for rapid prototyping/tooling or rapid manufacturing.

Following are reasons for reverse engineering a part or product:

1. The original manufacturer of a product no longer produces a product
2. There is inadequate documentation of the original design
3. The original manufacturer no longer exists, but a customer needs the product
4. The original design documentation has been lost or never existed
5. Some bad features of a product need to be designed out. For example, excessive wear might indicate where a product should be improved
6. To strengthen the good features of a product based on long-term usage of the product
7. To analyze the good and bad features of competitors' product
8. To explore new avenues to improve product performance and features
9. To gain competitive benchmarking methods to understand competitor's products and develop better products
10. The original CAD model is not sufficient to support modifications or current manufacturing methods
11. The original supplier is unable or unwilling to provide additional parts
12. The original equipment manufacturers are either unwilling or unable to supply replacement parts, or demand inflated costs for sole-source parts
13. To update obsolete materials or antiquated manufacturing processes with more current, less-expensive technologies

It can be said that reverse engineering begins with the product and works through the design process in the opposite direction to arrive at a product definition statement (PDS).

In doing so, it uncovers as much information as possible about the design ideas that were used to produce a particular product.

2.3 Bottlepack Cap

Bottlepack cap is one of the product is produce at Ain Medicare Sdn Bhd. The function of the bottlepack cap is to cover the Intravenous Solution bottle. The bottlepack cap product produces by using the injection molding machine. Each time during operation the machine will produce eight caps. The injection molding at the Ain Medicare used 4 plate mold of core and cavity.

Figure 2.2 : Bottlepack cap

2.4 Plastic Injection Mold

Plastic injection molding is one of the processes to produce the plastic product. This process is most typically used for thermoplastic materials which may be successively melted, reshaped and cooled. Before making the new product from plastic injection molding, the prepared of the core and cavity is important. It is because, to make the new product from the injection molding process, it must have the core and cavity of the product. The core and cavity function is to make the shape of the product when the

injection molding injects the material (polypropylene) into the core and cavity. This versatile process allows us to produce high quality, simple or complex components on a fully automated basis at high speed with materials that have changed the face of manufacturing technology.

Plastic injection moulding is a manufacturing technique for making parts from thermoplastic material. Molten plastic is injected at high pressure into a mold, which is the inverse of the desired shape. The mold is made by a moldmaker (or toolmaker) from metal, usually either steel or aluminium, and precision-machined to form the features of the desired part. Injection moulding is very widely used for manufacturing a variety of parts, from the smallest component to entire body panels of cars. It is the most common method of production, with some commonly made items including bottle caps and outdoor furniture. There are the four major categories must be consider during the plastic injection molding process. There are temperature, pressure, time, and distance.;(Bryce,D.M ,1997)

This patent is drawn to an injection molding apparatus for producing a tube closed at one end wherein the normally unsupported end of the core located in the cavity during the injection of the molten material to fill the space between the core and cavity wall, which supporting means is automatically removed from operation during the forming of the closed end of the tube. This support means is a plug extending through the end of the core into a recess in the bottom of the cavity where the closed end of the tube is to be formed. The plug is spring pressed into said recess and is forced out of the recess by a slid able bushing at the top of the cavity which is moved against the force of the spring by the molten material when it fills the uppermost open end portion of the cavity, thereby permitting the closed end of the tube to be formed.;(Boothroyd, G, Dewhurst, P and Knight, W ,2002)

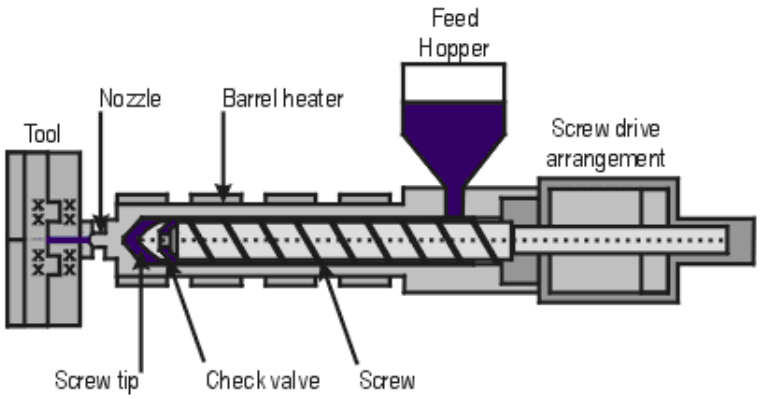

Figure 2.3 : Injection molding system Boothroyd, G, Dewhurst, P and Knight, W (2002)

An injection molding system consists of the machine and mold for converting, processing and forming raw thermoplastic material, usually in the form of pallets, into a part of desired shape and configuration. Figure shows a schematic view of a typical injection molding system. The major components of an injection molding system are the injection unit, the clamp unit, and the mold : (Boothroyd, G, Dewhurst, P and Knight, W 2002)

2.5 Mold

Considerable thought is put into the design of molded parts and their moulds, to ensure that the parts will not be trapped in the mould, that the moulds can be completely filled before the molten resin solidifies, to compensate for material shrinkage, and to minimize imperfections in the parts, which can occur due to peculiarities of the process.

Moulds separate into at least two halves (called the core and the cavity) to permit the part to be extracted; in general the shape of a part must be such that it will not be locked into the mould. For example, sides of objects typically cannot be parallel with the direction of draw (the direction in which the core and cavity separate from each other). They are angled slightly; examination of most household objects made from plastic will