



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Study the Parameter Optimization in the Injection Molding

Thesis submitted in accordance with the partial requirement of the
Universiti Teknikal Malaysia Melaka for Bachelor of Manufacturing
Engineering (Manufacturing Process and System)

By

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Faculty of Manufacturing Engineering

May 2007



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: STUDY THE PARAMETER OPTIMIZATION IN THE INJECTION MOLDING

SESI PENGAJIAN: 2/2006-2007

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DECLARATION

I hereby, declare this thesis entitled "Study the Parameter Optimization in the Injection Moulding" is the results of my own research expected as cited in the reference.

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Date : 5 May 2007

ABSTRACT

This project describes about the study of the parameter optimization using the design of experiment (DOE) by using the method two factorial designs. DOE using 2k factorial design for obtain the parameter optimum of the plastic container product by using the polypropylene as the material. For achieve optimization that a few objectives have been used on this project reach to find out the optimum parameters of pressure in plastic injection moulding the real situation, to understand the parameters relationship the injection moulding process, to optimum the parameters of injection pressure, holding pressure, back pressure and clamping pressure and to product plastic product without defect. In this study the Arburg-420C injection moulding machine and mould of container are use to find out the parameters involve for producing a product plastic container .The parameters involve injection pressure, holding pressure, back pressure and clamping pressure were I be identified. Then Polypropylene material was be used in this study which they are different in term of viscosity, density and melt flow index. The problem faced which the optimum data parameter was be documented until no defect found at the plastic product. The purpose of this project is to study about the parameters of pressure such as clamping pressure, back pressure, holding pressure and injection pressure that use in the injection moulding process. The optimum parameter is important because they related in produce product without defects such as short moulding, flashing and others. By this project found out the result of product and obtain the optimum parameter and successful produce the good product by knowledge and skill in setting the condition of parameter.

ABSTRAK

Projek ini menjelaskan tentang menentukan parameter optimum dengan menggunakan rekabentuk ujikaji menggunakan kaedah 2k faktorial rekabentuk. Menggunakan rekabentuk 2k faktorial untuk mendapat parameter optimum bagi produk kontena yang menggunakan Polypropylene (PP) sebagai bahan. Untuk mencapai optimum parameter terdapat beberapa objektif yang digunakan untuk mencari optimum parameter yang melibatkan tekanan di dalam proses suntikan pengacuanan, memahami hubungan parameter dengan proses suntikan pengacuanan, untuk mendapat parameter optimum bagi tekanan suntikan, tekanan gengaman, tekanan balikan dan tekanan pegangan dan untuk menghasilkan produk tanpa cacatan. Di dalam kajian ini, menggunakan mesin suntikan jenis Arburg 420C dan acuan kontena. Mengenalpasti parameter yang terlibat seperti suntikan tekanan, gengaman tekanan, balikan tekanan dan pegangan tekanan. Masalah yang dihadapi adalah untuk mendapat data parameter yang optimum sehingga tiada cacatan terhadap produk. Tujuan projek ini untuk mengkaji parameter terlibat seperti suntikan tekanan, gengaman tekanan, balikan tekanan dan pegangan tekanan. Parameter optimum adalah penting bagi menghasilkan produk tanpa cacatan. Daripada projek ini, dengan menghasilkan produk dan mencapai parameter optimum dan berjaya menghasilkan produk ini dengan kemahiran dan pengetahuan tentang menetapkan keadaan parameter.

DEDICATION

For my beloved mother

Hamidah Binti Yusof

Who always been there for me and always prays of me

For my beloved sister

Kamilah Binti Yacob

For my beloved brother

Sakifi Bin Yacob

Azmi Bin Yacob

For my beloved young brother

Mohd Zamri Bin Yacob

For my beloved friend

Ezril Jamaludin

Norhaniza Binti Kamarodzaman

Who has support me

ACKNOWLEDGEMENT

Appreciation is expressed to those who have reviewed and contribution to this project. I am specially alhamdulillah to Allah S.W.T to give all the guidance and also blessing me, to following indebted individuals especially to my supervisor Mr Mohd Amran bin Mohamad Ali, for your kindness advises guidance in developing and producing this work, moral support until my project completed. And I want to thank Mrs.Rosidah Jaafar for being my second advisor. I also would like to thank for Fauzi as technician at casting lab for their helping in using the 420C injection moulding machine. I thank to our lecturer in FKP and technician Mr Fauzi, too numerous to mention, have share their input and contribution on how to make this project more effective as a teaching and learning tool. To all those who have helped, I expressed my sincere thanks. Last, but certainly not be least, continually encouragement and support from my family and friends is deeply and sincerely appreciated.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

PP	-	Polypropylene
DOE	-	Design of Experiment
T	-	Temperature
UTeM	-	Universiti Teknikal Malaysia Melaka
PSM	-	Projek Sarjana Muda
kN	-	Kilo Newton
Mpa	-	Mega Pascal
mm	-	Milimeter
Max	-	Maximum
Min	-	Minimum

CHAPTER 1

INTRODUCTION

1.1 Introduction of the research

Injection moulding can be defined as a process that consists of heating a plastic material to a point at which it becomes soft enough to force into a closed mould, at which point the material cools enough to solidify and form specific product. An injection-moulding machine consists of three basic parts such as the mould plus the clamping and injection units. The clamping unit is what holds the mould under pressure during the injection and cooling. Basically, it holds the two halves of the injection mould together.

There are so many parameters in the injection moulding process that must be controlled to ensure the proper manufacture of a product. All fall into four major categories. These are temperature, pressure, time and distance. The softening or melting of the plastic is achieved by causing the individual molecules within the plastic material to go into motion. This is accomplished by applying heat. There are four heating zones in a moulding machine heating cylinder such as nozzle, front, center and rear. Injection pressure is used to fill the mould to its primary capacity (95%) with molten plastic.

Clamp pressure is used to keep the mould closed against the injection pressure of the incoming molten plastic. Total cycle time of injection moulding process consists of totaling the individual time require for a variety of activities including injection time, cooling time and machine closing and opening time. Material property values can be

altered significantly by adjusting moulding parameters. It has horizontal and vertical moulding machine.

In this case, use the ARBURG 420C horizontal moulding machine because the horizontal moulding is the most common method of injection moulding. Therefore, large number of experienced personnel is available and gravity assists ejected parts to fall freely from the mould. For the advantage using the Injection moulding which it can be used to form a wide variety of products. Complexity is virtually unlimited sizes may range from very small to very large, and excellent control of tolerances is also possible.

Most polymers may be injection moulded, including thermoplastics fiber reinforces thermoplastics, thermosetting plastics and elastomers. The another advantage of injection moulding are high production rates, high tolerances are repeatable, wide range of materials can be used, low labor costs, minimal scrap losses and little need to finish parts after moulding. The disadvantages of injection moulding expensive equipment investment, running costs may be high and parts must be designed with moulding consideration.

1.2 Objectives of the research

This project is an attempt to approach the subject of injection moulding in analytical parameters. The objectives of this project are:

- i. To find out the optimum parameters of pressure in plastic injection moulding the real situation.
- ii. To understand the parameters relationship the injection moulding process.
- iii. To optimum the parameters of injection pressure, holding pressure, back pressure and clamping pressure.
- iv. To produce plastic product without any defect.

1.3 Purpose of the study

The purpose of this study is to develop and consideration the type of parameters involves in the injection moulding process for produce a plastic container product. Requirement to study and analyze the parameters by know the purpose application of the parameters in producing the part of the mould for injection moulding.

1.4 Project scope

In this study the Arburg-420C injection moulding machine and mould of container are use to find out the parameters involve for producing a product plastic container .The parameters involve injection pressure, holding pressure, back pressure and clamping pressure will be identified. Then Polypropylene material will be used in this study which they are different in term of viscosity, density and mould flow index. The optimum data parameter will be documented until no defect found at the plastic product.

1.5 Problem statements

The problem faced by many injection companies is the setting data for injection machine did not available if no accurate data available, the mould setter need more time to setting up mould at injection machine. For this study pressure, temperature and time parameters involved in producing product container will be documented and record. This because of the time of setting up for one mould takes longer time. The optimum parameter is importance because they relate to product defect such as short shot, sink mark and flashing. For example, if too high injection pressure the product plastic will out flashing or if too low injection pressure the product plastic can get short shot.

1.6 Advantage of the precise parameter in produce product of injection moulding

By the knowledgement and skill in the injection moulding condition can improve the product quality and reduce the part reject. There are many advantages of the precise parameters for produce a product of injection moulding such as below:

- i. Can reduce manufacture cost by apply the precise parameter.
- ii. From the research can improve the level productivity plastic process industry.
- iii. Overcome the defects problem occur on the product.

1.7 Application of the research

This study has many applications mainly in produce a proper product. By understanding the element of the parameters relationship with the injection moulding which can use this path as a guide to select the correct value of parameter during the manufacture process. By implementing the correct parameter at the sector of industrial can decrease time and manufacturing cost. By develop the important concept in parameter of injection moulding can make confidently to produce a product by own skill.

1.8 Thesis structure

Chapter 1 describes about the introduction of the projects which explain the background of studies, objective, scope, statement of problem and rational of the project. The next chapter, the study focus on the literature reviews as station to collect more information that base on the project requirement for the project progress.

Chapter 2 consists the literature of studies about the material, machine and others. It also describes about the main step for produce the container product which is consideration the study include the type of categories of parameters, properties of material and the theory about the injection moulding machine describe about the element of in the injection moulding machine, machine operation, mould, mould process and thing to know about the injection moulding and the method can be use to produce product by apply the concept two level factor for design of experiment in this project. And also study about the troubleshooting in the injection moulding as preparation before do the experiment. The next chapter, the study focuses on the methodology for the project progress.

Chapter 3, the methodology describes about the method to be use for this project by apply the Design of Experiment (DOE) for produce the container product. In the methodology describe about the manner and procedure experiment of the injection molding operation. For this project application can enhance the knowledge about machining process that focuses to the injection moulding machine. The next chapter focuses on the procedure experiment.

Chapter 4 describes about the method and procedure for do the experiment by using the injection moulding process. It shows the flow of steps to handle the injection moulding machine operation and for produce the container product. In the next chapter, the study focuses on the result and data analysis.

Chapter 5 is very important because it determine the actual data from do the experiment. The analysis of data result brings out and performs to decrease the defect by adjusting and setting the parameters. The results show the real condition of the product base on the five categories of parameters setting. The reason of the data analysis is to know the range value of the parameters for produce the good surface finish container product. In the next chapter, the study focuses on the discussion of the results.

Chapter 6 describes about the discussion that explains about the results analysis and types of defect observe the major and minor of the defects. Also observe about processing condition resulting in defects and good Calculate the overall cycle time and preview the problems face during in this project. In the next chapter, the study focuses on the conclusion and recommendation.

Chapter 7 contains the conclusion of the analysis and product with the recommendation for future in producing good product. Beside that, the appendix and reference are locate in the behind of the thesis