Investigate of Parameter Setting in Plastic Injection Molding

Thesis submitted in accordance with the requirements of the Kolej Universiti Teknikal Kebangsaan Malaysia for Bachelor of Manufacturing Engineering (Honours) (Manufacturing Process)

By

Sullyfaizura Mohd Rawi

Faculty of Manufacturing Engineering
June 2006
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DECLARATION

I hereby, declare this thesis entitled “Investigate of Parameter Setting in Plastic Injection Molding” is the results of my own research except as cited in the reference.

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KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

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JUDUL: INVESTIGATE OF PARAMETER SETTING IN PLASTIC INJECTION MOLDING

SESJI PENGAJIAN : 2/2005-2006

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The injection molding process was studied extensively in attempt to create plastic components at the highest quality possible. This project is to investigate of the parameter setting in Plastic Injection Molding. The Arburg Injection Molding was the instrument used for the molding process to produce the “Dog bone Specimen” as a product. Various parameters of the injection molding to s such as Injection pressure, Holding pressure, Temperature of Mold, Temperature of Material, Dosage Volume and Clamping Program as well as other processing parameters such as cooling time were tested. In order to find the optimum parameter settings with the least amount of experiments, the theories of the Design of Experiments (DOE) and 3k Design Factorial were applied. Beside that, measuring the mechanical properties of the polypropylene using the Universal Testing Machine(UTM) to test tensile strength of the material. Maximum value of the tensile strength will be fined based on the testing process.
ABSTRAK

DEDICATION

For Beloved Mother
Wan Sepiah Binti Mohd Noor

For Beloved Sister
Sullyhatimarsila Binti Mohd Rawi

For Beloved brother
Mohd Shapuluddin Bin Mohd Rawi
Mohd Firdaus Bin Mohd Rawi
Mohd Shazruan Bin Mohd Rawi
Mohd Multazam Bin Mohd Rawi
Mohd Nur Aswad Bin Mohd Rawi
Mohamad Faris Jazli Bin Mohd Rawi

My Beloved Niece
Wan Ilya Maisara Binti Wan Mohamad Maizi
Wan Ainul Mardiah Binti Wan Mohamad Maizi

My Beloved Nephew
Wan Huzaitfah Bin Wan Mohamad Maizi
Firstly I would like to thank god for giving this opportunity to me to compete this work. Most importantly to my mums, Mrs. Wan Sepiah Mohd Noor for support me for the whole time period of this project. I want to thank Mrs. Rosidah Jaafar and express my sincere gratitude for being my advisor and helping me with this project from beginning until it's complete. She gave me almost full guideline to conduct this research, provided me with additional data and knowledge. I would also like to thank Mr. Abd Aziz Baharuddin for his advice and to share with me the knowledge he has on this topic. I also would like to thank Mr. Fauzi for there help in the structures lab and helping me to understand and familiar with the injection molding machine. I would like to thank for En Jefferi for his help to design and analysis the result of this project. Last but not least, I would to thank all people that involve either direct or indirect in this research. I appreciate your cooperation and kindness.
# TABLE OF CONTENT

Abstract ........................................................................................................ i
Abstrak ......................................................................................................... ii
Dedication ...................................................................................................... iii
Acknowledgement ........................................................................................ iv
Table of Contents ......................................................................................... v
List of Tables ................................................................................................ x
List of Figures ............................................................................................... xiv
Sign and Symbols .......................................................................................... xvi

## 1.0 CHAPTER 1 INTRODUCTION

1.1 Background ............................................................................................. 1
1.2 Problem of Statement ............................................................................. 2
1.3 Scope of Project ....................................................................................... 3
1.4 Objective of Project ................................................................................ 3

## 2.0 CHAPTER 2 LITERATURES REVIEW

2.1 Introduction of Plastic Injection Molding ................................................ 4
2.2 Element Of The Injection Molding Process .......................................... 5
2.3 Categorizing the Parameter ................................................................. 6
   2.3.1 Temperature ..................................................................................... 7
   2.3.1.1 Temperature Of The Material ...................................................... 7
   2.3.2 Pressure .......................................................................................... 8
   2.3.2.1 Injection Pressure ....................................................................... 8
   2.3.2.2 Holding Pressure ........................................................................ 9
   2.3.2.3 Clamp Pressure .......................................................................... 9
2.3.3 Time
2.3.3.1 Injection Time ......................................................... 10
2.3.3.2 Cooling Time ......................................................... 10
2.3.4 Distance ................................................................. 10

2.4 Understanding Defect .................................................. 13
    2.4.1 Parameter Effect .................................................. 17

2.5 Properties of Material .................................................. 17
    2.5.1 Thermoplastic ...................................................... 17
    2.5.2 Polypropylene ..................................................... 19

2.6 Measuring Mechanical Properties of material ....................... 20
    2.6.1 Tensile Test ....................................................... 22
    2.6.2 Universal Testing Machine (UTM) ................................ 23

2.7 Design of Experiment (DOE) ........................................... 25
    2.7.1 The $3^k$ Factorial Design ...................................... 27

3.0 CHAPTER 3 METHODOLOGY

3.1 Research Design
    3.1.1 Design of Experiment (DOE) .................................... 29
    3.1.2 Flow Chart ....................................................... 36

3.2 Research Methodology
    3.2.1 The $3^k$ Factorial Design .................................... 37
    3.2.2 Parameter Selection ............................................. 40
    3.2.3 Experiment Procedures .......................................... 40
        3.3.3 Procedures Of Setting Parameter ............................ 41

3.3 Research Material and Tool
    3.3.1 Material Selection
        3.3.1.1 Polypropylene ............................................ 42
3.3.2 Equipment Selection
   3.3.2.1 Plastic Injection Molding Machine Arburg 420 C........43
   3.3.2.2 Universal Testing Machine (Shimadzu, Ag-100kni).....45

3.4 Research Testing and Analysis
   3.4.1 Tensile test analysis......................................................46

4.0 RESULT AND ANALYSIS

4.1 Introduction.................................................................48
4.2 Experimental Data..........................................................52
4.3 Result
   4.3.1 Result For Category 1..................................................62
   4.3.2 Analysis For Result (Category 1).................................64
   4.3.3 Result For Category 2..................................................65
   4.3.4 Analysis For Result (Category 2).................................67
   4.3.5 Result For Category 3..................................................68
   4.3.6 Analysis For Result (Category 3).................................70
   4.3.7 Result For Category 4..................................................71
   4.3.8 Analysis For Result (Category 4).................................73
   4.3.9 Result For Category 5..................................................74
   4.3.10 Analysis For Result (Category 5).................................76
   4.3.11 Result For Category 6..................................................77
   4.3.12 Analysis For Result (Category 6).................................79
   4.3.13 Result For Category 7..................................................80
   4.3.14 Analysis For Result (Category 7).................................82
   4.3.15 Result For Category 8..................................................83
   4.3.16 Analysis For Result (Category 8).................................85
   4.3.17 Result For Category 9..................................................86
   4.3.18 Analysis For Result (Category 9).................................88
4.4.19: Summary Result Of The Maximum Tensile Strength........89
5.0 DISCUSSION ........................................................................................................94

5.1 Recommendation ...............................................................................................96

6.0 CONCLUSION ......................................................................................................98

REFERENCES ..........................................................................................................99

APPENDICES
A    Gantt Chart PSM 1
B    Gantt Chart PSM 2
C    Experimental Data
D    Reference Parameter
E    Process Plastic Injection Molding
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Specification Are Required In Plastic Injection Molding</td>
<td>11</td>
</tr>
<tr>
<td>2.2</td>
<td>Troubleshooting of Plastic Injection Molding</td>
<td>13</td>
</tr>
<tr>
<td>2.3</td>
<td>Parameter Change versus Property Effect</td>
<td>17</td>
</tr>
<tr>
<td>2.4</td>
<td>Polypropylene At A Glance</td>
<td>20</td>
</tr>
<tr>
<td>2.5</td>
<td>Properties of the Polypropylene</td>
<td>22</td>
</tr>
<tr>
<td>3.1</td>
<td>Factor level</td>
<td>32</td>
</tr>
<tr>
<td>3.2</td>
<td>Parameter setting in plastic injection molding</td>
<td>33</td>
</tr>
<tr>
<td>3.3</td>
<td>Several of parameter selected</td>
<td>33</td>
</tr>
<tr>
<td>3.4</td>
<td>The 3\textsuperscript{rd} design in 9 block based on the Parameter Selected For Low Temperature of Melt</td>
<td>38</td>
</tr>
<tr>
<td>3.5</td>
<td>The 3\textsuperscript{rd} design in 9 block based on the Parameter Selected For Medium Temperature of Melt</td>
<td>39</td>
</tr>
<tr>
<td>3.6</td>
<td>The 3\textsuperscript{rd} design in 9 block based on the Parameter Selected For High Temperature of Melt</td>
<td>39</td>
</tr>
<tr>
<td>3.7</td>
<td>Specification of Plastic Injection Molding ARBURG 420 C</td>
<td>44</td>
</tr>
<tr>
<td>4.1</td>
<td>Parameter Setting Based On The Category</td>
<td>49</td>
</tr>
<tr>
<td>4.2</td>
<td>Data of the Parameter Setting in Category 1 ( Low Temperature Melt, Low Injection Pressure, Low Holding Pressure)</td>
<td>53</td>
</tr>
<tr>
<td>4.3</td>
<td>Data of the Parameter Setting in Category 1 ( Low Temperature Melt, Low Injection Pressure, Medium Holding Pressure)</td>
<td>53</td>
</tr>
<tr>
<td>4.4</td>
<td>Data of the Parameter Setting in Category 1 ( Low Temperature Melt, Low Injection Pressure, High Holding Pressure)</td>
<td>53</td>
</tr>
<tr>
<td>4.5</td>
<td>Data of the Parameter Setting in Category 2 ( Low Temperature Melt, Medium Injection Pressure, Low Holding Pressure)</td>
<td>54</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.6</td>
<td>Data of the Parameter Setting in Category 2 (Low Temperature Melt, Medium Injection Pressure, Medium Holding Pressure)</td>
<td>54</td>
</tr>
<tr>
<td>4.7</td>
<td>Data of the Parameter Setting in Category 2 (Low Temperature Melt, Medium Injection Pressure, High Holding Pressure)</td>
<td>54</td>
</tr>
<tr>
<td>4.8</td>
<td>Data of the Parameter Setting in Category 3 (Low Temperature Melt, High Injection Pressure, Low Holding Pressure)</td>
<td>55</td>
</tr>
<tr>
<td>4.9</td>
<td>Data of the Parameter Setting in Category 3 (Low Temperature Melt, High Injection Pressure, Medium Holding Pressure)</td>
<td>55</td>
</tr>
<tr>
<td>4.10</td>
<td>Data of the Parameter Setting in Category 3 (Low Temperature Melt, High Injection Pressure, High Holding Pressure)</td>
<td>55</td>
</tr>
<tr>
<td>4.11</td>
<td>Data of the Parameter Setting in Category 4 (Medium Temperature Melt, Low Injection Pressure, Low Holding Pressure)</td>
<td>56</td>
</tr>
<tr>
<td>4.12</td>
<td>Data of the Parameter Setting in Category 4 (Medium Temperature Melt, Low Injection Pressure, Medium Holding Pressure)</td>
<td>56</td>
</tr>
<tr>
<td>4.13</td>
<td>Data of the Parameter Setting in Category 4 (Medium Temperature Melt, Low Injection Pressure, High Holding Pressure)</td>
<td>56</td>
</tr>
<tr>
<td>4.14</td>
<td>Data of the Parameter Setting in Category 5 (Medium Temperature Melt, Medium Injection Pressure, Low Holding Pressure)</td>
<td>57</td>
</tr>
<tr>
<td>4.15</td>
<td>Data of the Parameter Setting in Category 5 (Medium Temperature Melt, Medium Injection Pressure, Medium Holding Pressure)</td>
<td>57</td>
</tr>
<tr>
<td>4.16</td>
<td>Data of the Parameter Setting in Category 5 (Medium Temperature Melt, Medium Injection Pressure, High Holding Pressure)</td>
<td>57</td>
</tr>
<tr>
<td>4.17</td>
<td>Data of the Parameter Setting in Category 6 (Medium Temperature Melt, High Injection Pressure, Low Holding Pressure)</td>
<td>58</td>
</tr>
<tr>
<td>4.18</td>
<td>Data of the Parameter Setting in Category 6 (Medium Temperature Melt, High Injection Pressure, Medium Holding Pressure)</td>
<td>58</td>
</tr>
<tr>
<td>4.19</td>
<td>Data of the Parameter Setting in Category 6 (Medium Temperature Melt, High Injection Pressure, High Holding Pressure)</td>
<td>58</td>
</tr>
<tr>
<td>4.20</td>
<td>Data of the Parameter Setting in Category 7 (High Temperature Melt, Low Injection Pressure, Low Holding Pressure)</td>
<td>59</td>
</tr>
</tbody>
</table>
4.21 Data of the Parameter Setting in Category 7 (High Temperature Melt, Low Injection Pressure, Medium Holding Pressure) 59
4.22 Data of the Parameter Setting in Category 7 (High Temperature Melt, Low Injection Pressure, High Holding Pressure) 59
4.23 Data of the Parameter Setting in Category 8 (High Temperature Melt, Medium Injection Pressure, Low Holding Pressure) 60
4.24 Data of the Parameter Setting in Category 8 (High Temperature Melt, Medium Injection Pressure, Medium Holding Pressure) 60
4.25 Data of the Parameter Setting in Category 8 (High Temperature Melt, Medium Injection Pressure, High Holding Pressure) 60
4.26 Data of the Parameter Setting in Category 9 (High Temperature Melt, High Injection Pressure, Low Holding Pressure) 61
4.27 Data of the Parameter Setting in Category 9 (High Temperature Melt, High Injection Pressure, Medium Holding Pressure) 61
4.28 Data of the Parameter Setting in Category 9 (High Temperature Melt, High Injection Pressure, High Holding Pressure) 61
4.29 Result for Category 1 (Low Temperature of Melt, Low Injection Pressure Vs Parameter Holding Pressure) 62
4.30 Result For Average Value of Tensile Strength (Category 1) 63
4.31 Result for Category 2 (Low Temperature of Melt, Medium Injection Pressure Vs Parameter Holding Pressure) 65
4.32 Result For Average Value of Tensile Strength (Category 2) 66
4.33 Result for Category 3 (Low Temperature of Melt, High Injection Pressure Vs Parameter Holding Pressure) 68
4.34 Result For Average Value of Tensile Strength (Category 3) 69
4.35 Result for Category 4 (Medium Temperature of Melt, Low Injection Pressure Vs Parameter Holding Pressure) 71
4.36 Result For Average Value of Tensile Strength (Category 4) 72
4.37 Result for Category 5 (Medium Temperature of Melt, Medium Injection Pressure Vs Parameter Holding Pressure) 74
4.38 Result For Average Value of Tensile Strength (Category 5) 75
Result for Category 6 (Medium Temperature of Melt, High Injection Pressure Vs Parameter Holding Pressure)

Result For Average Value of Tensile Strength (Category 6)

Result for Category 7 (High Temperature of Melt, Low Injection Pressure Vs Parameter Holding Pressure)

Result For Average Value of Tensile Strength (Category 7)

Result for Category 8 (High Temperature of Melt, Medium Injection Pressure Vs Parameter Holding Pressure)

Result For Average Value of Tensile Strength (Category 8)

Result for Category 9 (High Temperature of Melt, High Injection Pressure Vs Parameter Holding Pressure)

Result For Average Value of Tensile Strength (Category 9)

Summary of Maximum Tensile Strength Value of the Parameter Setting

The Value of Parameter Setting in Plastic Injection Molding for Specimen 37
## LIST OF FIGURE

2.1 Element Of Plastic Injection Molding  
2.2 Categories Of Parameter  
2.3 General Representation Of Commodity Thermoplastics  
2.4 Structure Of Polypropylene  
2.4 Test specimen under axial tension load.  
2.6 Treatment Combinations In A $3^k$ Design  

3.1 Flow Chart For Topic Project  
3.2 Plastic Injection Molding Machine Arburg 420 C  
3.3 Universal Testing Machine (Shimadzu, Ag-100kn)  
3.4 Tensile Strength Testing Determines Break And Yield Points Plastic Material  

4.1 Graph for Tensile Strength (Category 1) Vs No. of Experiment  
4.2 Graph for Average Tensile Strength (Category 1) Vs Parameter of Holding Pressure  
4.3 Graph for Tensile Strength (Category 2) Vs No. of Experiment  
4.4 Graph for Average Tensile Strength (Category 2) Vs Parameter of Holding Pressure  
4.5 Graph for Tensile Strength (Category 3) Vs No. of Experiment  
4.6 Graph for Average Tensile Strength (Category 3) Vs Parameter of Holding Pressure  
4.7 Graph for Tensile Strength (Category 4) Vs No. of Experiment  
4.8 Graph for Average Tensile Strength (Category 4) Vs Parameter of Holding Pressure  
4.9 Graph for Tensile Strength (Category 5) Vs No. of Experiment  
4.10 Graph for Average Tensile Strength (Category 5) Vs Parameter of Holding Pressure
4.11 Graph for Tensile Strength (Category 6) Vs No. of Experiment 78
4.12 Graph for Average Tensile Strength (Category 6) Vs Parameter of Holding Pressure 78
4.13 Graph for Tensile Strength (Category 7) Vs No. of Experiment 81
4.14 Graph for Average Tensile Strength (Category 7) Vs Parameter of Holding Pressure 81
4.15 Graph for Tensile Strength (Category 8) Vs No. of Experiment 84
4.16 Graph for Average Tensile Strength (Category 8) Vs Parameter of Holding Pressure 84
4.17 Graph for Tensile Strength (Category 9) Vs No. of Experiment 87
4.18 Graph for Average Tensile Strength (Category 9) Vs Parameter of Holding Pressure 87
4.19 Graph For Maximum Tensile Strength MPa Vs No of experiment 90

5.1 The example for the specimen before with the gripping zone 94
5.2 Part cooling in mold 96
LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

ASTM - American National Standard
ASTM D 638 - Standard Test Method For Tensile Properties Of Plastic
ASTM D 3641-97 - Standard Practice For Injection Molding Test Specimen Of Thermoplastic Molding And Extrusion Materials
ASTM D 4549 - specification for polystyrene Molding and Extrusion Material (PS)
ASTM D 4101 - specification for polypropylene plastic injection an Extrusion Material (PP)

do - Diameter
DOE - Design of Experiment
L0 - Length
PP - Polypropylene
UTM - Universal Testing Machine
MPa - Mega Pascal
mm - Millimeter
kN - Kilo Newton
kg - kilogram
Max - Maximum
Min - Minimum
CHAPTER 1

INTRODUCTION
CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

Injection molding is a practical technique used in manufacturing for mass producing plastics parts quickly and inexpensively. As plastic parts have become more popular and critical in modern engineering applications, demand for quality has increased. The principle of injection molding is very simple. Injection molding is a process in which a plastic material is heated until it becomes soft enough to force into a closed mold at which point the material cools to solidify and from a specific product. The action that takes place is much like the filling of jelly donut. A hypodermic style cylinder and nozzle inject the heated plastic into an opening creates in closer container(mold). The material is allowed to harden, a finished part is ejected and the cycle is represents as often as necessary to produce the total number of pieces required.

This project conduct to investigate and optimize of setting parameter in plastic injection molding. For the injection molding process, the parameters include ram speed, injection pressure, barrel and nozzle temperature, mold temperature, mold clamp force, dwell time, cooling time, and material properties. However, for this study only five parameters (temperature of melt, injection pressure, holding pressure, dosage volume and clamping program) were varied while the rest were held constant. 3k factorial design, a formal method of the Design of Experiments (DOE) was applied to test these parameters in an efficient manner, using the least amount of experiments and therefore saving resources and time. The material will be use in this project polypropylene. We choose this material because this material have a
different properties and parameter for other material. So, finally we will find also the accurate result for polypropylene and we can conclude of the quality of product. We also will be do the tensile test of the product produced and analysis the result of the test using the UTM. Processing conditions have very strong influences on properties and performance of parts and products. Changes in processing conditions can lead to improvements or degradation of accuracy, shape, surface finish, fracture resistance and many other part properties and characteristics. One of the major activities of manufacturing engineering is the assessment of the effects of changing process parameter values on part characteristics. The primary use of process models is to predict these effects. Often process models are inadequate for this task, usually because the process is very complex or because accurate material behavior descriptions at processing conditions are unavailable. So the defect of from the result will produce should be analyze and try to improve the quality of the product. Outcome of the defect will be define to produce the better parameter.

1.2 PROBLEM STATEMENT

Nowadays, quite a variety of different technique are employed in the forming polymeric material. Injection molding is the most common method for method for forming plastic polymer. Injection molding is the most widely used molding process for thermoplastics. Injection molding is economical only for large production quantities. Thus, the product of produced using injection molding have are troubleshooting. Most of the defect of the product have a come from not proper parameter setting in plastic injection molding. Beside that, in this project also have to optimize the parameter of the injection and determine the accurate value of the parameter. Before this, the parameter is manually setting and don't have the accurate value. The other side, the problem is to minimize of the defect of the injection molding. A through understanding of the molding process will be help determine the causes.
1.2 OBJECTIVE OF PROJECT

Objective of this project is:
1. To optimize of the parameter in plastic injection molding.
2. To determine the maximum tensile strength value of polypropylene.

1.4 SCOPE OF THE PROJECT

This project to investigate the parameter setting in plastic injection molding, so for the started to optimize the parameter, the sequence of the process is:

i. Material selection for polypropylene. Pure polypropylene have been used in to investigate the parameter setting in injection molding

ii. Produce the specimen using Plastic injection Molding. The parameter should be setting based on the parameter selection.

iii. Tensile test for the produced specimen using Universal Testing Machine (UTM) to find maximum tensile strength of value for each specimen based on different parameter setting.

iv. Analyze the result and find the optimum result for this investigation for parameter setting of Plastic Injection Molding.