The Effect of Injection Time and Backpressure on Product Defects in Water Resevoir Products

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Abstract. Injection molding is a process of making products or components from thermoplastic materials that requires careful control. There are several parameters that affect the quality of the finished product, including injection time and backpressure. This study aims to determine the effect of injection time and backpressure on product defects of water reservoir from GPPS material using Haitian 470 Ton machine. In this study, injection time parameters were tested with times of 3.5, 4 and 4.5 seconds and backpressure of 8 kgf/cm² and 10 kgf/cm². 15 samples were collected for each parameter variation during the tests. n the first test with a backpressure of 8 kgf/cm² with an injection time of 3.5-4.5 seconds no product defects were found. However, in the second test with a backpressure of 10 kgf/cm² with injection times of 4 and 4.5 seconds, visual blackdot defects appeared.

Keywords: Injection Molding, Defect, GPPS.

1 Introduction

1.1 Background

Plastic objects are currently widely used by humans, the use of plastic almost replaces materials made of glass, iron, and wood. This is because making objects from plastic material is very easy and the shape can be designed according to our wishes. One of the processes of making plastic products is to use *injection molding*. *Injection Molding* is the process of making an object from thermoplastic plastic and thermosetting materials [1], this material is in the form of plastic pellets that are inserted into hopper, then heated at a certain temperature until melted, then through the *nozzle*, the plastic is injected into the *mold*. To get good product quality, parameter settings are needed so that there are no defects in excess products. The parameters that affect the *injection molding* process are [2]:

- Temperature: the condition in which plastic material begin to melt.
- Pressure Limit: the air pressure limit used to drive the position to compress the melted plastic material
- Holding Time: the time the material in the heating tube has melted completely.
- Injection Time: the speed of melted plastic coming out of the out the nozzle to fill the empty space on the mold
- Mold temperature : mold temperature before injection of melted plastic material
- Injection speed: the pressure used to hold the recoil of the screw during the charging process.

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- Backpressure: the pressure used to hold the recoil of the screw during the charging process

What is expected in injection molding in general is an increase in product quality, a reduction incycle time , and production costs . In the cycle time the injection process consists of the following stages [3] :

1) Clamping process : the condition when the core and cavity of the mold must be tightly closed on the machine.
2) Injection Process : the plastic in the melted hopper is injected into the mold
3) Process Cooling Time: the time it takes to cool products and molds

Water reservoir (water reservoir) is a product component of an automatic coffee maker (coffee maker). During mass production, there are often defects in this product that are unacceptable to the quality control department, resulting in increased production costs. Some types of product defects that are often found in this product are

- Flashing, excess material on the product
- Sink mark, there is a hollow in the product
- Flow mark, there is a striped pattern on the product
- Bubbles, there are air bubbles in the product
- Weld line, melted on the product.
- Black dot, there are black spots on the product

1.2 Research Objectives

The purpose of this study was to determine the effect of injection time and backpressure on product defects in water reservoir packaging on coffer maker tools with GPPS (general purpose polystherene) material using an injection molding process with a 4700 Ton Haitian machine

1.3 Research Scope

This research was conducted by observing the manufacturing process of water reservoir products made using GPPS material by paying attention to injection time and backpressure parameters when the machine is running for mass production, whether it affects product defect control.

2 Research Methodology

2.1 Data Collection

The data collected in this study includes injection time data, backpressure, and product quality. Injection time variations consist of 3.5 seconds, 4 seconds and 4.5 seconds. And backpressure variations of 8 kgf/cm² and 10 kgf/cm². Data collection is carried out directly by observing the process of making water reservoir products at private manufacturing companies in Batam. The results of this data will be processed and analyzed to be presented in the form of tables and graphs.

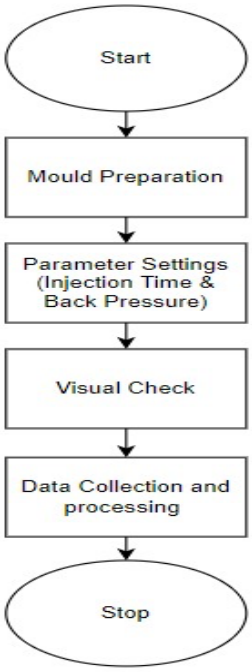


Fig. 1. Research Flowchart

2.1.1 Preparatory Phase

To determine the effect of injection time and backpressure on water reservoir product defects, it is necessary to carry out the preparation stage with literature studies and direct experiments. Literature studies in the form of literature from books and journals related to research that will be carried out when conducting direct experiments in the production area.

2.1.2 Mold Preparation

At this stage the mold to be used for research is prepared. The mold is setup to the machine, then fastened with a clamp so that the mold position remains precise during the injection and ejection process

2.1.3 Parameter Settings

Variations in injection time and backpressure parameters are inputted on the machine. The time used in injection time is 3.5, 4, and 4.5 seconds. The backpressure parameter uses variations of 8 kgf/cm² and 10 kgf/cm².

2.1.4 Visual Checking

During the ejection process, goods that come out of the machine are subject to visual checking, in order to find out whether the item is a rejected item. If there is a reject, the parameter

settings at injection time and backpressure are re-done in order to get items that pass the visual check and can be packaged..

2.1.5 Data Collection and Processing

At this stage, observation and calculation of the number of items with visual defects are carried out into a data set so that conclusions can be found.

2.2 Material

In general, plastic pellets are materials composed of long chain molecules also called polymers. The material used in this study is included in thermoplastic polymers. Table 1 shows the materials used and Figure 2 is a picture of the materials used [4].

Table 1. Material Specifications

Specification	Detail
Family Name	Polystherene
Trade Name	Styrolution PS 147F
Manufacturer	INEOS
Familu Obbreviation	General Purpose Polystyrene (GPPS)
Temperature in Machine	180^{o}C-260^{o}C
Melt Volume Rate	6.5 cm^{3}/10min
Tensile Strength at yield	50 Mpa

Fig. 2. Material GPPS

2.3 Equipment

The machine used in the production of water reservoir products is a Haitian machine with a clamping force of470 kN with specification shown at Table 2.

Table 2. Machine Specifications

Specification	Detail
Merk	Haitian
Rate Power	60kW
Clamping Mechanism	Toggle Mechanism
Clamping Force	4700 kN
Screw Model	∅70mm

Fig. 3. Haitian Engine 4700 kN

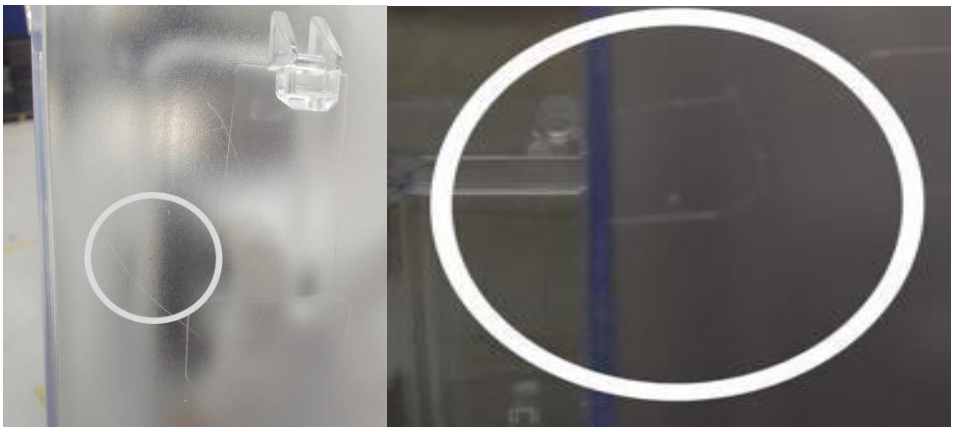
3 Data Analysis

To find whether there are product defects in the product defect test objects of a production cycle, a variation test is carried out for each parameter and visual checking . In this test is carried out by taking 15 test samples for each variation of the parameters tested. Table 3 shows the variation of each parameter and research data the number of product defects.

Tabel 3. Research Data

Backpressure	*Injection time*	Product Defects
8 kgf/cm²	3.5 s	-
	4 s	-
	4.5 s	-
10 kgf/cm²	3.5 s	-
	4 s	1
	4.5 s	2

In this study, test samples were obtained at 8 kgf / cm² backpressure with injection time variations did not obtain product defects, while at 10 kgf / cm² backpressure variations and 4 s &; 4.5 s injection time product defects were found . This is due to the changed injection time and backpressure parameters in a short time and higher pressure. Product defects in the backpressure variation of 10 kgf / cm² found 3 test objects with visual product defects, namely when the injection time reached 4 seconds, where defects were found in the form of flowmark and at injection time 4.5 s found 2 test specimen results with blackdot visual defects . Figure 4 shows blackdot defects in products with a backpressure parameter of 10 kgf/cm² and an injection time of 4.5 s.



(a) (b)

Fig. 4. (a) Blackdot defect in backpressure variation products 10 kgf/cm²
(b) injection time4.5 s

4 Conclusion

This study is to determine the effect of injection time and back pressure on product defects in water reservoir packaging. In setting parameters using a backpressure of 8 kgf/cm² and injection time of 3.5.4, and 4.5 seconds no product defects were found at the time of conduct research. By using the backpressure parameter setting of 10 kgf/cm² with an injection time of 3.5 seconds also found no product defects during the test, product defects appeared when using the backpressure parameter setting of 10 kgf/cm² with injection time of 4 and 4.5 seconds. Product defects that appear in the form of flowmarks and blackdot. This study is to determine the effect of injection time and back pressure.

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