

DESIGN PRINTING EQUIPMENT WASTE OF PLASTICS SCALE HOUSEHOLD WITH MOLDING INJECTION METHODE

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Abstract. Molding equipment waste plastic former household scale aims to determine the optimum temperature melting of the quality of products produced on the result of the plastic molding tool. Waste plastics molding tool is designed as a whole, using a stainless steel material for its design and material brass lever for parts heater. This methods tool works injection molding using a heater as a means of recycle plastic to produce versatile products. Parameters were tested in these experiments is that violence against melting temperature for the product of sample HDPE (High Density Polyethylene) and samples of products PP (Polypropylene). From the data obtained can be seen that the optimum temperature is good for sample HDPE (High Density Polyethylene) is 340°C, with the injection time of 3.9 minutes, while for sample PP (Polypropylene) is at a temperature of 290°C with injection time of 3.1 minutes. To test the hardness of products, product PP (Polypropylene) is better than the product samples HDPE (High Density Polyethylene).

Keywords: Plastic, Injection Molding, PP, HDPE

I. INTRODUCTION

Plastic is an ingredient artificial inorganic consist of chemical substances quite dangerous for the environment [5]. Waste of plastic is difficult to outlined naturally. To decipher plastic waste itself need more or less 80 years in order to degrade perfectly. Hence use plastic can be said unfriendly or conservative for the environment when used without using the rules. While in the daily life, especially any of us in Indonesia, the use of plastic we can find in almost all the activity of our lives. When we realize, we can do more for this is by using return (reuse) plastic bags kept at home. Thus indirectly we have reduced waste plastic that can be wasted after use (reduce). Or even better if we can recycling plastic into something more use full. The utilization of waste plastic is to reduce the disposal of plastic minimum and to a certain extent save resources and reduce dependence raw materials import. The utilization of waste plastic can be done by using return (reuse) and recycling (recycle). In Indonesia, the utilization of waste plastic in scale households are generally to the use with the different purposes, for example the paint made of plastic used for the pot or

bucket. Plastic is material we often find in daily life. Technological progress and industry made activities of the production of plastic increase. Almost all product using plastic either as packing or starter. Material plastic mostly used because they have excess in it is light, transparent, waterproof, and are relatively cheap and affordable by all the community. All excellence this make plastic popular and much used almost every aspect of human life. As a result, numbers the production of plastic that will to be trash that also continue to rise. Lack of awareness of waste and the level of consumption the community as well as other activities who rush into cause of trash kept accumulate at the dump water. Trash commonly found that are bottles, detergents, and plastic bags, the trash generally still can recycled to be any valuable product. The plastic type are plastic having violence and the high density that in recycling needed instrument a mold capable of melting plastic bag. Four types of waste plastics are popular and in demand that is Linear Low Density Polyethylene (LLDPE), Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE) and Polypropylene (PP) [3].

Came the idea how to enable local communities to recycle plastic waste independently into a useful

product or selling value, so that the amount of plastic waste out of the house can be reduced in number and can directly increase revenue is needed tool design plastic molding small capacity that is appropriate for the purpose household industry. In addition, the power consumed this tool does not exceed the capacity of domestic power that is less than 900 or 1300 watts. The purpose of this study is designing and making the plastic molding equipment recycling household scale with injection molding method for molding plastic recycling type of polypropylene (PP) and high density polyethylene (HDPE), then obtain the melting temperature optimum product results from the molding tool plastic molding by analyzing the physical form of the endurance test of friction.

II. LITERATURE

A. Plastic

Plastics are long-chain polymers bind atoms to one another. Polymers derived from the Latin poly (many) and merous (part), in which the element is comprised of many (usually hundreds) repeating unit, block building called mer, showing unit repetitive small, equal to the term unitcell used in connection with the structure crystals of metal [4]. Polymer long-chain molecules, also called as macromolecules or large molecule, which is formed by polymerization, by linking and cross-linking of different monomers.

TABLE I
SPECIFIC GRAVITY OF VARIOUS TYPES OF PLASTICS

Resin	Specific Gravity (g/cm ³)
Polypropylen (PP)	0.85-0.90
LDPE	0.91-0.93
HDPE	0.93-0.96
Polystirene (PS)	1.05-1.08
ABS	0.99-1.10
PVC	1.15-1.65
Asetil Selulosa	1.23-1.34
Poliamida	1.09-1.14
Poly Carbonate	1.20
Poly Acetal	1.38

Sources: <https://lordbroken.wordpress.com>

TABLE II
THE MELTING TEMPERATURE THERMOPLASTIC PROCESSES
Processing Temperature Rate

Material	°C	°F
ABS	180 – 240	356 – 464
Acetal	185 – 225	365 – 437
Acrylic	180 – 250	356 – 482
Nylon	260 – 290	500 – 554

Poly Carbonat	280 – 310	536 – 590
LDPE	160 – 240	320 – 464
HDPE	200 – 280	392 – 536
PP	200 – 300	392 – 572
PS	180 – 260	356 – 500
PVC	160 - 180	320 – 365

Sources: <https://lordbroken.wordpress.com>

B. Mold Machine Injection of Plastic

Mold is a tool used to form part in accordance with design we want (form and dimension) [8]. Other definition, mold is a cavity has a particular form (design) to make a product for a rapid in a step and cheap [4]. The price of making mold is very expensive, usually making mold done to a mass production and large industry.

Construction based substance of mold consisting of hardened steel, pre-hardened steel, aluminium and beryllium copper alloy. But, election material mold as a board outline are on a matter of economics considering age discharging mold, that usually showed by shot [10].

C. Injection Molding

The principles of injection molding in plastic material comprising a softening stage in a heated cylinder and then injected into a mold that is colder, so the plastic harden [4]. Containers that have been molded ejected from the mold by a tool, compressed air or other tools. This technique is expensive and less economical. This process is very suitable for thermoplastic material, due to the heating, the material will become soft. And conversely, will harden again when cooled. These changes are only physicals, not chemical changes, which mean that the process of softening and hardening again can be repeated at any time, making it possible to recycle the thermoplastic material according to the needs.

III. RESEARCH METHODS

A. Design Tools Mold Waste Plastic Injection Molding

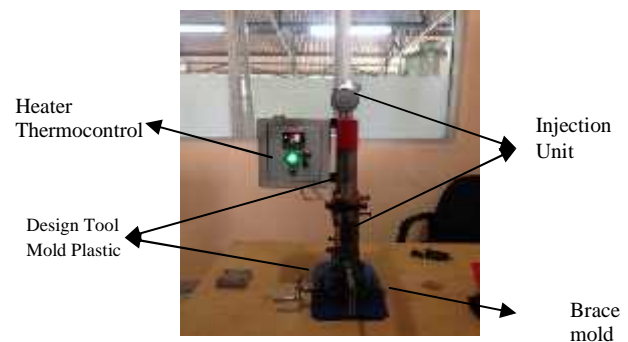


Fig 1. Design Tool Mold Waste Plastic Injection Molding

B. Materials and Equipment

Materials used in the injection molding process is : Polypropylene (PP), High Density Polyethylene (HDPE). Materials used in the design of injection molding tools is iron plat 15 mm, Heaters (Heating Element), Thermocouples, Control temperature, As nozzle, Box Panel, As threaded screw, Uring As Stang nozzle, Uring vise, Plate Clamp vise, Bolts 17, Home Box Heating Element, Cable, Welding, Eye Grenda Cut, Glass Woll, Stang vise, Plat Desk Tool and Block Heaters Plastic, The nozzle, A set of Injection Molding Tool, A set of 1 piece Swipe Security Tool and Analytical Balance.

C. Experimental Procedure

Manufacture of Plastic Molding Plastic Injection Molding Tool Operational way of injection molding plastic molding tools are as follows:

1. Tool prepared waste plastics molding on the table with a height of 50-65 cm, it is in order to provide comfort to the operator at the time of injection process.
2. Plastic raw materials to be used are prepared as injection process, in this study the plastic used is household waste plastics PP and HDPE types that previously had been cut into small pieces first in order to get into the barrel.
3. The heating system at thermocontrol turned on and set the temperature corresponding to the melting point of the plastic to be used.
4. Once the heating system reaches the specified temperature, then is input PP and HDPE plastics that have been cut into small pieces before into the barrel.
5. Plastic that has been inserted into the barrel would decline the temperature of which is predetermined, the process at least takes between 16-54 seconds to return to a predetermined temperature.
6. The next step is to mold placed on the mold clamp and tighten it by turning the threaded rod clamp gripping the mold so that mold.
7. Waste kinds of plastic household PP and HDPE injected into the mold.
8. The last step is remove from the mold clamp molds and refrigerate for 10 seconds, then remove the product from the mold.

IV. RESULTS AND DISCUSSION

A. Results

1. Testing Tools Molding Plastic Injection Molding Produced

Here's a table that contains the results of stress tests hardness plastic products using injection molding plastic molding tools. Results of analysis of the frictional resistance of used types of PP (Polypropylene) and HDPE (High Density Polyethylene) can be seen in TableIII.

TABEL III
RESULTS OF ANALYSIS OF THE FRICTIONAL RESISTANCE

No	Sample	Temperature °C	Time (minute)	Hardness Test (kgf)
1. 2. 3.	HDPE (<i>High Density Polyethylene</i>)	340	3,9	34
1. 2. 3.	PP (<i>Polypropylene</i>)	290	3,1	30

B. Discussion

1. A Mold Plastic with Injection Molding

Injection molding operate as in needles, where the melting of plastic injected into mold closed that be inside the machine, so that the melt full fill the space that is at mold according form of the intended product[1].The process cycle for injection molding consist of four stage [4] namely; *clamping*, before *injection* material into mold, two part of mold must be closed on a machine; *injection*, plastic liquid injected into mold and full fill the space according a form of the indented product; *cooling* is a process of cooling the material plastic after injection process; *ejection*, when mold opened, a mechanism used to ejection system is to stimulate a part of plastic of a mold. In making a mold plastic, the injection molding there were several analysis undertaken in order to get a mold able to produce the product of plastic use full with good quality.

2. Analysis Power Heater

Large power heater hanging from a kind of material, mass object that is to be heated and time that want to taken in reached a certain temperature. To determine large of power heater used formulation of producer heater. From calculation was obtained resource needed to heating the heater until reach temperatures 340°C and 290°C is 252 watt, where by temperature is able to melt HDPE (*High Density Polyethylene*) and PP (*Polypropylene*). Power heater was obtained through the way thatcount area of tube heater used. Calculation power heater affect the quality

of product produced, because for melt sample HDPE (*High Density Polyethylene*) that good, must be reach the optimum temperature [6].

3. Analysis Melting Time

The time it takes heater to reach melt temperature in sample HDPE (*High Density Polyethylene*) is 3.9 minutes, while the time it takes for injection sample PP (*polypropylene*) reached 2.4 minutes. Melting time HDPE longer when compared to polymer PP, it was because the nature of HDPE more hard and rigid and chain of polymer longer hence melting time will be more long [7]. Time injection affect quality of product produced, because the longer time so sample out from the nozzle will be more melting so easy to molding [6].

4. Analysis Hardness the Product

On this research analysis hardness against a product produced such product sample HDPE (*High Density Polyethylene*) and PP (*Polypropylene*). Test the hardness aims to determining the quality of plastic. If plastic has hardness high so plastic will be more difficult melted, therefore time required will be longer. Results of sample have been obtained tested by put the sample into the press tool, then turn on the press tool and wait for 30 second. After that, sample has tested will shaped plates.

The results of hardness in the sample HDPE (*High Density Polyethylene*) dan PP (*Polypropylene*) obtained by 34 kgf/cm², while for sample PP (*Polypropylene*) as much as 30 kgf/cm². Sample with the hardness low is better than sample with the hardness high. In this testing, sample PP (*Polypropylene*) better than sample HDPE (*High Density Polyethylene*), this is because density of HDPE is higher (0.951 g/cm³) when compared with density of PP that is 0.8814 gr/cm³ [2]. HDPE having degrees of crystallinity low in branching and has power between molecule very high and strength tensile [3].

5. Analysis of Melt Temperature

After did the hardness test, then analyzed that temperature affect the product produced, due the product can be seen that sample PP (*Polypropylene*) have degree of hardness high compared sample HDPE (*High Density Polyethylene*). Melt temperature of HDPE (*High Density Polyethylene*) more high compared with PP (*Polypropylene*), because during temperature 290°C sample PP (*Polypropylene*) done with form liquid, so that can quickly and easy to molded. While for sample HDPE (*High Density Polyethylene*) when temperature 340°C product still form gel that required more time, it was because of the nature of crystallinity HDPE will decrease due of the heating [11].

CONCLUSION

From a series of studies that have been done by a few conclusions from the study about the design of injection molding plastic molding tool, namely: From the results of research using the method of injection molding the most favorable conditions, namely the temperature of HDPE is higher than the temperature of PP, because when the temperature of 340°C sample the PP is a liquid with the injection time of 3.9 minutes so that it can quickly and easily mold while for samples HDPE when the temperature 290°C with injection time of 3.1 minutes, because the product is still shaped gel so it takes a longer time until the sample is liquid and can be molded.

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