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Design and Fabrication of Plastic Compressor Machine for Plastic Waste

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Abstract: This project work is on design and fabrication of a plastic compressor machine to compress plastic waste. The objective of this project is to help to reduce plastic waste mostly from domestically usage and turn into a paving brick that can be uses as decoration in a mini garden or walkway. This plastic compressor machine works using a modified old conventional oven to melt shredded plastic waste in a mould and let the melted plastic cooled and turned to a paving brick. The temperature to melt the shredded plastic waste of 450 grams is 250 degrees Celsius in 1 hour. The machine fabricated using recycled materials, which makes it cheap, easy to maintenance and affordable cost.

Keywords: plastic, plastic waste, compressor machine, environment, design, fabrication

1. Introduction

Plastic is one of the most widely used, as it is cheap, usable for daily routine and ease of manufacturing. These days, plastic pollution is increasing which causes environmental pollution. Other than plastic has replace many traditional materials, it also contains numerous compounds that has harmful chemicals and also it takes so much time to disposed naturally. Same problem is also present in our own country, which will create huge problems in future. Waste material from electronics is referred to by a variety of terms including e-waste (or e-wastes) [1] and waste electrical and electronic equipment [2]. The e-waste stream can generally be divided into two sub streams which is a metals-containing wastes (e-metals), and plastics (e-plastics). E-plastics represent a larger fraction of the e-waste stream than e-metals, and there are significantly fewer options for their recycling or reuse. One potential outlet for e-plastics reuse is compression moulding. Currently, e-plastics are available in chopped/ground/shredded granular form with great variance in particle size, color, and polymer composition [3].

Compression moulding was one of the first industrial methods for plastics, with equipment dating back 100 years [4]. The basic process of compression moulding includes of heating a thermoset resin, under severe pressure, within a closed mould cavity until the resin cures through a chemical reaction where smaller molecules link forming high-molecular-weight polymeric chains. Under the pressure, the resin also liquefies and flows, taking the shape of the mould cavity, and then hardens into the desired shape or product. Once sufficiently cooled and strong, the part is removed from the mould and the cycle is complete although the curing reaction continues while cooling to ambient (room) conditions. Technique in process of compression moulding involves three steps of procedures specifically involves preheating samples at specific temperature for certain times to

soften them, compressing preheated samples at the same temperature to match to the mould shape and lastly cooling compressed samples under pressure for intervals to cool the sample [5]. The optimize of temperature suitable for heating the polypropylene plastic (PP) to melt is at 250°C, while the best time to melt of at 250°C is within 15 minutes [6]. Subsequent for machining and finishing are minimal using compression moulding and the labour costs are reduced [7].

2. Materials and Methods

Before the fabrication process begin, the design of the machine being discussed. Three design concepts produced using Autodesk inventor software. The first design concept as shown in figure 1 include a car jack attached to the base as a tool to compress the melted plastic waste.

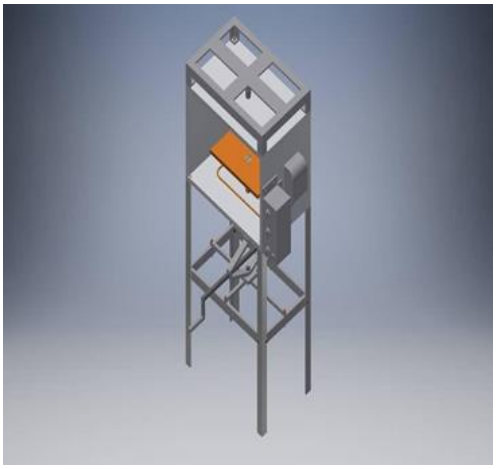

Figure 1. Design Concept 2

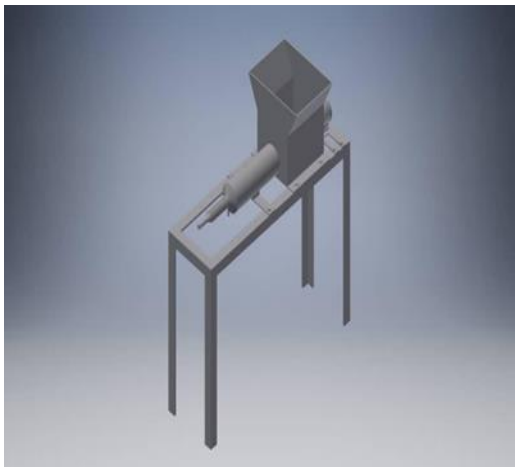

Figure 2. Design Concept 2

The second design concept as shown in figure 2 involve an extrusion process. The melted plastic will be extruded through a small opening and will be collected. The third design concept shown in figure 3 consists of top and down compressor. The hollow steel was choice as a main of material selected to assembly of mini compression moulding for the base of machine.

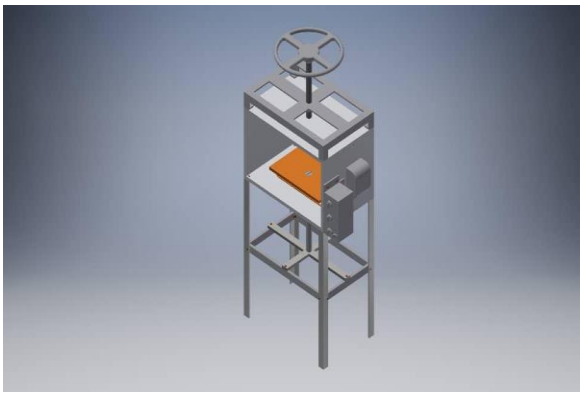

Figure 3. Design Concept 3

Before making the decision for final design, the three designs were compared. The advantages and disadvantages of the three proposed designs listed in Table 1.

Table 1. Advantages and disadvantages of the proposed design concepts.

Structure	Advantages	Disadvantages
Design Concept 1	Ease of handling	Time consuming
Design Concept 2	Easy to collect melted plastic	Expose to mechanical hazard
Design Concept 3	Easy to compress	Hard to monitor the process

The fabrication process including cutting the materials into the designated shape, welding and functional testing. Based on product design, the hollow steel was a cut and connected to oven as an equipment of to ensure that there is application of heat for the sole purpose of acquiring the required shape of the mould cavity with high dimensional accuracy. For the base product, hollow iron is welded to another part to assembly with supported car jack for the purpose to compress the mould after the resin was melt.

3. Results and Discussion

The three design concepts were compared to choose the best design for this project. Table 2 shows the design selection matrix, which resulted the first design concept, has the highest score of 52. Hence, the first design concept selected as the final design for this project.

Table 2. Design selection matrix

Structure	Ideas		
	Design concept	Design Concept 2	Design Concept 3
Design	9	5	4
Cost	10	6	5
Safety	8	8	7
Availability	8	7	5
Ergonomics	8	8	7
Size	9	5	7
Total Score	**52**	**39**	**35**

The 4 different temperatures which is 180, 200, 220 and 250◎ celcius is set to determine the melting point of the 450 grams shredded plastic waste. After setting the time of 1 hour, the observation on the shredded plastic is recorded. At temperature of 250◎ celcius, the shredded plastic waste is melted. The results is shown in figure 4.

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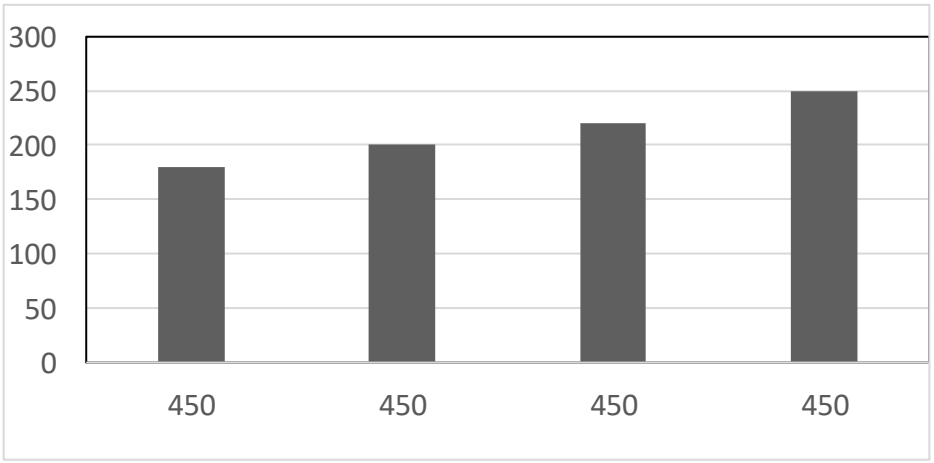

Figure 4. Graph of temperature testing vs constant weight(450g)

The fabricated plastic compressor machine is shown in figure 5. The plastic bottle is shredded and put into an aluminum cake mould and compressed by using a hydraulic car jack.

Figure 5. The fabricated Plastic Compressor Machine

Testing for the function of the machine shows the possible temperature to melt the shredded plastic waste of 450 grams at temperature of 250^0 Celsius in 1 hr. Fabrication of the machine using recycled materials make it cheaper and easier in maintenance.

4. Conclusions

The plastic compressor machine built by using recycled parts and materials. It is easy to fabricate, easy to handle and low-cost fabrication. The machine can process 450 grams of shredded plastic waste in 1 hour and turn it into a colourful solid paving brick. The produced paving brick as proposed. It can be concluded that this plastic compressor machine can help reducing plastic waste by processing it into some decorative items. The machine shows a good function and easier in maintenance.

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