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Estimation of Plastic Tiles Tensile Strength

Suhaila Sahat[1]*, Ahmad Alif Aiman Ahmad Hashim[1], Muhammad Amirul Haqim Nasrudin[1], Anas Akmal Azhar[1]

[1]Civil Engineering Department,
Universiti Tun Hussein Onn Malaysia Jalan Panchor, Pagoh, 84600, MALAYSIA

*Corresponding Author Designation

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Abstract: Plastic is mainly used for our daily life. Due to their low cost, ease of manufacture, they are mostly used for packaging, furniture and toys. It is more than a century since plastic was invented and nowadays, plastic waste is one of the causes sources of pollution. Therefore, countries all over the world took wise decision in planning for sustainable environment such as 3R campaign to reduce, reuse and recycle. In our project we recycle plastic bag and make it as a tile. Tile is a thin object usually square or rectangular in shape. The objective of this project is to determine tensile strength of plastic tiles to estimate percentage of recycle plastic bag in producing plastic tile. This research used 100 % plastic bag as main material in the tile. There is no other additional material added. This plastic tile is made by heating process using oven heater at 220 ℃ and then it is compressed by cool press machine to shape it. We used 60 pieces plastic bags to fabricate a tile. However, the estimation of plastic bags used to fabricate a thousand of tiles is 60,000 pieces. The data and result collected for this project were satisfying because it can sustain load up to 1.5 kN for one pieces of tile compared with standard tile the load is 1.1kN(250pound). From the result it slightly recommend that this plastic tile is suitable to be use for construction industry.

Keywords: Plastic, Reuse Waste, Tile, Tensile

1. Introduction

Plastics is an organic polymer that available in certain resin form or some form obtained from the basic polymerized resin [1][2][3]. Polymer defined as something made up of many units Polymer are molecules that rely on each other. The chains made of carbon, hydrogen, oxygen and/or silicon atom. By polymerization, the chains are made [4]. Plastics can be classified into two types which are thermosets and thermoplastics. Thermosets is a polymer that cannot be restored when heated. They are capable in their durability and strength [4][5][6]. Thus, it is primarily used for automobiles and construction applications. For thermoplastics, it is a polymer in which the molecules attracted together by weak bonds, creating plastics that soften when heated and return to original condition at room temperature [4][7]. Plastics require a small amount of cost and a little energy to produce it. Plastics also are lightweight and biocompatible. Thus, this makes an ideal to use plastics as disposable devices.

Corresponding author: suhailasa@uthm.edu.my

Plastics is an innovative material for use in many sectors such as medical and constructions. Within a year, over 300 million metric tons of plastics have been produced [8].

Statistic has proved that, Malaysia is the 8th large producer of mismanaged plastic wastes in the world [9]. Furthermore, Malaysian used 3 billion plastic bag per year [9]. Malaysia is well known as a country with middle high income and growing rapidly based on economy but this growth is not matched with effectiveness of managing our wastes. It is stated that Malaysia's has a large plastic disposal and recycling problem, where 55% of our plastics waste are mismanaged [10]. In 2010, Malaysia produced almost 1 million tons of mismanaged plastic waste which is around 0.14 to 0.37 million tons may enter the oceans [11]. There are tons of plastics that has been produced from our country in uncontrollable ways and our country failed to manage this problem.

There are four major types for disposal of plastics; landfilling, incineration, recycling and biodegradable [8][12][13]. All plastics can be disposed in landfilling but it is required space and the chemical components and energy contained in plastics articles typically is lost in this disposal route. Incineration, gives some energy from plastics production but it is produced unhealthy environmental. Plastics can be recycled, and some of the material used to make plastics can be recovered. However, this method is not fully used, due to difficulties with the collection and arrangement of plastic waste. Last but not least, biodegradable, prevent to damage environmental pollution for long term effect [8]. In this case, there is no such short way to dispose plastics from earth in a short time.

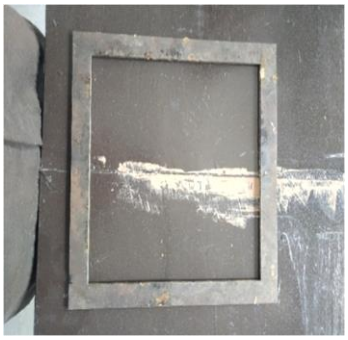
However, plastics existence brings harm to environment in many ways. Report about effects of environmental pollution with plastics material have been famous in the last few years [14][15][16][17][18]. One of the effects is it can disturb animal ecosystems and also may threaten the life of animals. It is lead to drowning for the marine mammals and turtles to breathing at surface due to entanglement in fishnets or plastic foil restricts their mobility [14][19][20][21]. Plastics also may lead to choking when they block the respiratory system indirectly, it causing animal death and threatening animal habitats due to the use of uncontrolled plastics. Thus, we use plastics as substitution material for manufacturing tiles to minimize this problem. We choose tiles for our product because we want to produce an invention tiles for the future, to minimize the waste plastic bags and save the animal habitats from the extinct.

2. Materials and Methods

Main objectives in this study was focused on fabricating tile 100 % from recycled plastic bags without any additional material. Oven heater was used as one of our tools to melt the plastic bags with 220 ℃ (**Figure 1- a**). The process started with plastic bags was heated in the oven for 5 minutes and using metal bowl . For each 5 minutes, 5 plastics were melted and the amount of time that used to shrink all the plastic bags were 60 minutes to melt all the plastic bags.

After that, melted plastic was pulled out from the metal bowl using gloves (**Figure 1- b**) and left to cold for several minutes to avoid the steel mold attached to the cool press machine (**Figure 1- c**). And then, the mold was pressed by cool press machine for 10 minutes with pressure of 110 kg/cm^2 and plastic tile is made (**Figure 1- d**). Tensile strength test (**Figure 1- e**) were perform using 3 specimens of plastic plate made from melted recycle plastic bag with same dimension which is 120x20 mm with its thickness of 5 mm (**Figure 1- f**).

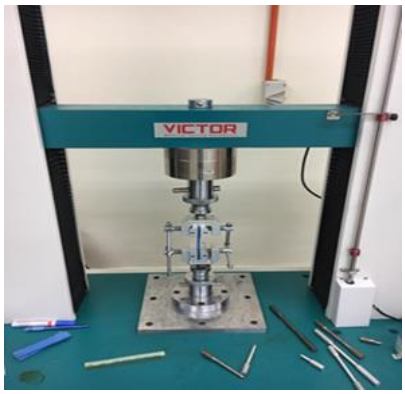
(a)



(b)

(c)

(d)



(e)

(f)

Figure 1: Plastic til fabrictaion prosess and specimen testing, (a) Molding process, (b) Formwork to make a tile, (c) Cool press machine, (d) Plastic tile, (e) Tensile strength test, and (f) Plastic plate

3. Results and Discussion

A plastic tile was made from 60 recycled plastic bags with size of 235x235 mm and the thickness is 5mm with the weight is $3.3x10^{-3}$ kN shown in **Table 1**. The duration of fabricating a tile were 1 hour 10 minutes. It is aasume that; If a thousand pieces of plastic tiles were made, the require amounts of plastic bags is about 60,000 pieces with its weight of 3,300 N and the estimation duration to construct it into tiles is about 48 days 14 hours and 40 minutes. In this case, this product leads to the invention of tiles for the future and it is also can reduce the mismanaged plastic wastes in our country by producing more tiles that made plastic.

Table 1: Estimation of plastic bags to fabricate into tiles

Criteria	Number of Tiles			
Amount of plastic tile (pcs)	1	10	100	1000
Amount of recycled plastic bags use to fabricate tile (pcs)	60	600	6,000	60,000
Weight (kN)	$3.30x10^{-3}$	$3.30x10^{-2}$	0.33	3.30
Duration to fabricate into tile	1 hour 10 minutes	11 hours 40 minutes	4 days 20 hours 40 minutes	48 days 14 hours 40 minutes

Table 2: Result from tensile strength test

No.	Force@ Peak (N)	Tensile stress (MPa)	Elongation@ Peak(mm)	Elong. @ peak(%)	Yield Strength Rp0.2(MPa)
1	1108.15	11.08	8.12	7.378	6.37
2	1510.22	15.1	9.82	8.927	10.98
3	1019.89	10.2	5.23	4.757	6.26
Minimum	1019.89	10.2	5.23	4.76	6.26
Mean	1212.75	12.13	7.72	7.02	7.87

No.	Upper Yield Strength(MPa)	GaugeLength@ Break(mm)
1	7.53	11
2	12	14
3	7.53	9
Minimum	7.53	9
Mean	9.02	11.33

Table 1 was simplified from data in **Figure 2**, the maximum load that can be covered by this specimen is 1,510.22 N and its tensile stress is reach to 15 MPa (**Table 2**). Besides, the maximum elongation is 9.82 mm which is 8.93% of the peak elongation. Thus, this product is satisfying because it can sustain load up to 1.5 kN for one pieces of tile compared with standard tile the load is 1.1kN (250 pound) [22].

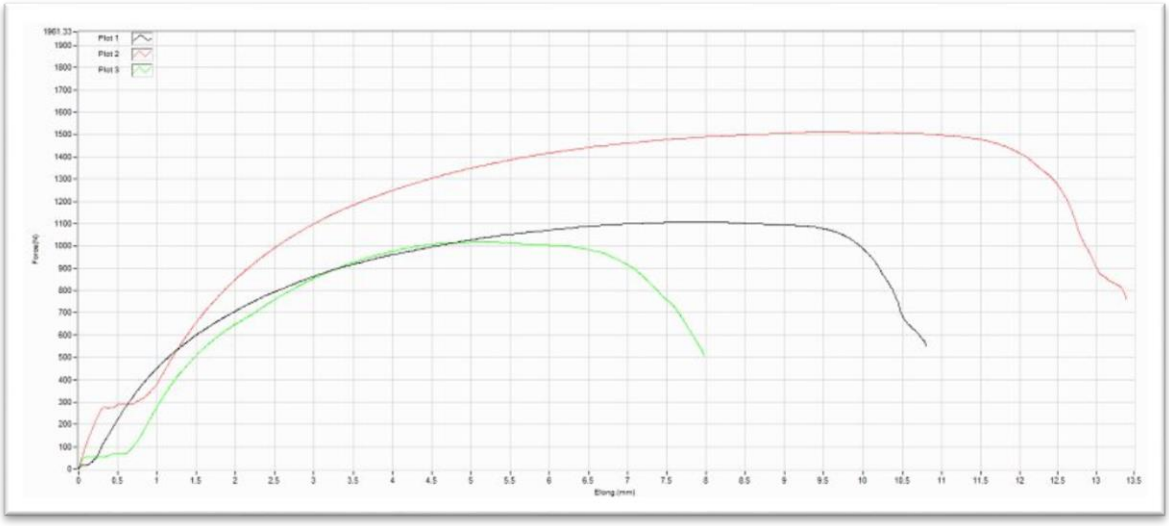


Figure 2: Force (N) versus elongation (mm) from the plastic tile

4. Conclusion

For the conclusion, tiles that are made from plastic are very suitable for nowadays. It is because the process to make the plastic tiles is simple and low-cost. By using plastic as its material, we can reuse the plastic and reduce the waste of plastic in daily life. Besides, our action can help to reduce the pollution and make our environment become clean. If we compare the plastic tiles and the normal tiles, we can see the significant difference in the hardness and the strength of the tiles. It is recommended the plastic should be shredded before being shrink. It is because to ensure the plastic perfectly shrink and the bond of the plastic molecule stronger.

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