# THICKNESS MEASUREMENT AND BURSTING STRENGTH ANALYSIS OF GEOTEXTILES FROM LDPE PLASTIC WASTE

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**ABSTRACT:** This paper research is present the thickness measurement and bursting strength analysis of geotextiles from Low-Density Polyethylene (LDPE) plastic waste. LDPE plastic waste from plastic bag were cut into 270 mm width x 400 mm length to ensure the dimension fitted into hot press machine. The samples were prepared at different layer of LDPE plastic waste of 4 layers, 6 layers, 8 layers, 10 layers and 12 layers to produce geotextiles. The samples were heated using hot press machine at temperatures of 120°C and 140°C, respectively. It is revealed the 10 layer of LDPE plastic waste with temperature of 120 °C is the optimum thickness suitable for geotextiles application at 0.29 ± 0.05 mm. Bursting strength test analysis for 10 layer of LDPE plastic waste is 7.71 kgf shows the bonding LDPE thin film layer immediately heated up to the temperature on the surface area that provide good adhesion with an intermediate layer continuous laminating of the LDPE layer.

**Keywords:** *geotextile, LDPE plastic waste, bag waste*

## 1. INTRODUCTION

Nowadays, plastic development and use is growing, leading to increased plastic pollution and environmental problems [1]. Around 8 million tonnes of plastic waste discharges from coastal nations into the oceans every year. It would be the same scenery as five garbage bags full of trash on every foot of the coastline around the world. Plastic production increasing from 2.3 million tonnes in 1950 to 448 million tonnes by 2015. It is estimated to double by 2050 [2]. Low Density Polyethylene, LDPE is most used materials in the world [3]. Technically sophisticated, lightweight, and cheap plastics are suited to a wide range of applications. The problem with plastics the end-of-life management of products made from it [3]. Improving waste management and recycling systems will minimise pollution. Recycling creates ways to minimise oil consumption, carbon dioxide emissions and the volume of waste that needs to be disposed. By transforming the plastic bag waste into geotextile is one of the best solutions.

Geotextile is a synthetic textile permeable material which enhances the soil characteristics. It can separate, absorb, stabilize, secure, and drain when used in conjunction with soils. Geotextiles is a product for a wide variety of development operations, including bridges, docks, waste disposal, irrigation, and other civil ventures [3]. Geotextiles are used in civil construction projects for soil filling to enhance soil characteristics. Geotextiles make destitute soil steadier, permitting for building in regions that would something else be unacceptable for numerous foundation works, such as bridges, harbours, landfills, water system frameworks and other gracious wanders, geotextiles are reasonable materials [4]. Therefore, researchers nowadays use plastic bag waste in their studies to minimize the use of non-renewable sources and aim to achieve eco-friendly product. In this research, LDPE plastic waste from bag plastics was proposed to produce geotextiles applications.

## 2. METHODOLOGY

In this project, LDPE is the main raw material. The Low-Density Polyethylene (LDPE) plastic waste from plastic bag were provided from household shop at Pekan Pagoh, Johor. LDPE plastic waste from plastic bag were cut into 270 mm width x 400 mm length as shown in Figure 1 to ensure the dimension fitted into hot press machine. The samples were prepared at different layer of LDPE plastic waste of 4 layers, 6 layers, 8 layers, 10 layers and 12 layers to produce geotextiles. The samples were heated using hot press machine at temperatures of 120°C and 140°C, respectively. The different layer of LDPE plastic waste and temperatures for heating process the samples using hot plate machine was tabulated in Table 1.

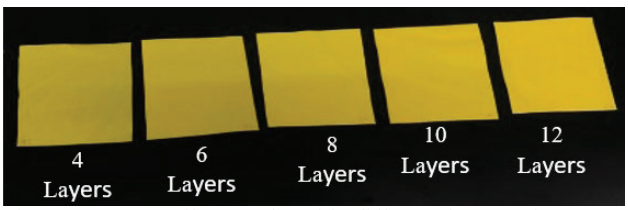


Figure 1: Geotextile sample with different layers of LDPE plastic; (a) 4 Layers, (b) 6 Layers, (c) 8 Layers, (d) 10 Layers and (e) 12 Layers

Table 1: Heat transfer temperature and duration time for each sample.

| LDPE Layers | Heat Transfer Temperature (°C) | |
|---|---|---|
| | 120 | 140 |
| | Heat Transfer Timer (s) | |
| 4 Layers | 40 | 30 |
| 6 Layers | 44 | 34 |
| 8 Layers | 48 | 38 |
| 10 Layers | 52 | 42 |
| 12 Layers | 56 | 46 |

## 3. RESULTS AND DISCUSSIONS

### 3.1 THICKNESS MEASUREMENT

The thickness measurement was conducted according to ASTM D5199 – standard test method for measuring the nominal thickness of geosynthetics. The thickness of geotextile was determined by observe the distance between two parallel surfaces confining the test material under a specified pressure after 5 seconds. In Figure 2, there are increasing of thickness measurement of geotextile sample at different layer of samples. It is revealed that the temperature of 140°C geotextiles sample are thicker than the sample of 120°C. It is highlight ed the more numbers of LDPE plastic bag waste layers, the thicker thickness of the geotextile samples. It is also revealed the 10 layer of LDPE plastic waste with temperature of 120 °C is the optimum thickness suitable for geotextiles application at 0.29 ± 0.05 mm. The range of geotextile thickness is in the range of 0.2 to 0.3 mm [4].

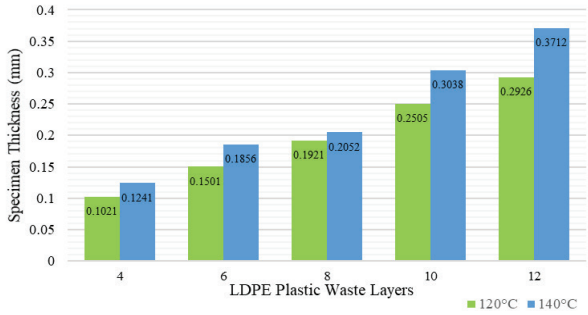


Figure 2: Thickness measurement by geotextile sample at different LDPE plastic waste layers

### 3.2 BURSTING STRENGTH TEST ANALYSIS

The Figure 3 shows the burst strength for each layer of LDPE plastic bag waste. The burst strength increases with layers of LDPE plastic bag waste. The increasing in graph shows that the more the LDPE plastic bag waste layer, the more layer presence within unit square are of the geotextile [5]. Bursting strength test analysis for 10 layer of LDPE plastic waste is 7.71 kgf shows the bonding LDPE thin film layer immediately heated up to the temperature on the surface area that provide good adhesion with an intermediate layer continuous laminating of the LDPE layer. Therefore, more layer reacts efficiently against the bursting force than the lower number of layers of LDPE plastic bag waste. Increasing the number of inter-face bonding layer will give a reinforcing effect and resulting in a tougher product [6].

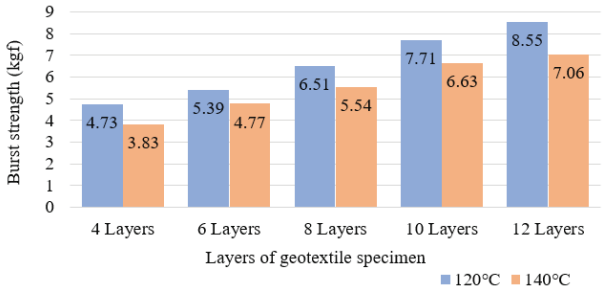


Figure 3: Burst strength by geotextile sample layers

## 4. CONCLUSION

In conclusion, the optimum layer of 10 layers LDPE plastic waste with temperatures of 120°C heat transfer process is potential to be use as geotextile applications. It is also suitable mesurement thickness for geotextile application at 0.29 ±. 0.05mm. The utilization of plastic bag waste for application in geotextile product would decrease the environment problem of plastic bag waste and able to sustain sustainble product from producing waste material for geotextile.

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## REFERENCES

[1] Henry, B., Laitala, K. and Klepp, I.G. (2019). Microfibres from Apparel and Hime Textiles: Prospects for Including Microplastics in Environmental Sustainability Assessment, vot.652, pp.483-494.

[2] Parker, L. (2020). Planet of Plastic? We Made Plastic. We Depend On It. Now We're Drowning In It. Retrieved at 'https://www.nationalgeographic.com'

[3] Esmaeili, A., Pourbabaee, A.A., Alikhani, H.A., Shabani, F. and Esmaeili, E. (2013). Biodegradation of Low-Density Polyethylene (LDPE) by Mixed Culture of Lysinibacillus Xylanilyticus and Aaspergillus Niger In Soil. Plos One, vol. 8(9), pp. 1-15.

[4] Wu, H., Yao, C., Li, C. Miao, M., Zhong, Y., La, Y. and Liu, T. (2020). Review of Application and Innovation of Geotextiles in Geotechnical Engineering. Materials. MDPI. Bil.13, pp.1-10

[5] Ogundare, D.A., Familusi, A.O., Osunkunle, A.B. and Olusami, J.O. (2018). Utilization of Geotextile for Soil Stabilization. American Journal of Engineering Research, vol.7(8), pp. 224-231.

[6] Wang, Q., Lu, R., Kong, Y., Zhang, C., Xie, F., Zheng, T., Chen, Z., Tang, L. and Wang, H. (2015). Experimental Study of Tensile Properties of the Steel-Plastic Geogrids. The Open Materials Science Journal, vol.9, pp.146-151.