

Waste management of Plastics using Waste Clothes and Converting it into Insulation Panel

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ABSTRACT-

Waste management intended to the treatment of all types of waste products such as medical, biomedical, municipal, household, organic etc. In everywhere plastic waste is the main element which effects environment and biodiversity. Bike tire, insulation panel, constructional bricks, paper notebooks, decorative objects etc are the by-products waste material. Waste management involves different techniques such as mechanical, chemical, thermal, landfill and recycling. Design of “An Insulation Panel” by combining small particles of clothes and plastics. By their combination, produce a high value aided composite material. Waste clothes (such as cotton , polyester , viscose or rayon , silk and wool etc) and plastics (such as bottle bodies and caps shopping bags ,thin layers of packaging , confectionary wrappers , condiment sachets etc.) are blended for production of composite panels. The results indicate that the developed textile – based composite panels are applicable as commercial support materials and offer improved thermal and acoustic insulation properties. Final product as insulation panel has higher thermal resistance, lower thermal conductivity, hygienic and resistant, better acoustic attribute, prevention against moisture and mold, comfortable and easy to use.

Keywords: Plastics, cloth, waste, insulation panel.

1. INTRODUCTION

Every year, an estimated 11.2 billion tonnes of solid waste is collected worldwide [1]. In 2020 the world was estimated to generate 2.24 billions tonnes of solid waste, amounting to a footprint of 0.79kg per person per day [2]. Solid waste management is one of the biggest challenges to both small and large cities for different countries. This is mainly due to improper management of waste materials producing by people. Increasing generation with uncontrolled production of solid waste burdens on the municipal budget.

Due to modernization , plastics are being used as an essential material in almost every products . Because of this , a huge amount of its waste also gets produced in every modern industry And it’s becoming a great threat for earth’s environment. Also due to exponential growth of population textile wastes (cotton, velvet, linen etc) are also increasing , and it’s becoming a great problem for many countries. Approximately 7793 ktons, or 8.5% of global textile waste, is accumulated in India every year [3]. Specifically cotton is used in every textile industry as its main material , so it’s waste is causing lots of problem to both environment and industry .In a field study conducted, the amount of waste generated in the consumption of 167,850 kg cotton was given as 19,086 kg, which indicates that at least 11% of the raw material was separated as waste [4].

The different processes or techniques of waste management can reduced the effect on the environment, human health, and so on. In the manufacturing industry we can use waste plastic and waste cloths as a sustainable source of raw materials. Using this two as a raw material, composite panels can be made more efficiently and with less cost of production. These insulators can be used in house walls for providing good heat insulation during winter. As this insulator is made from waste materials, the production prices will be lower so we can keep the product price very affordable.

1.1 Features of insulation panel

- Non-polluting in nature – Not involving any type of combustion process during processing of the product.

- Easy to install – Due to simplest construction of the components of the project.
- Cost effective – Manufacturing cost ignored. Processing cost reduced because there is only gravitational action acts on the system, no pumps, pressure controlling systems used
- This system produced a very good acoustic insulator in processing simple way.

1.2. Material Selection

- Primary data collection: Primary data collection is the process of collecting data and information through surveys, interviews or experiments.

For this paper ,there were not using any type of primary data collection methods due to short time period for executing this paper.

- Secondary data collection: In secondary data collection method, information and different data is collected from different sources excluding primary source. Example: Information collected from journal papers, online website and government departments.

In this paper the process of collecting data fully depends on the method of secondary data Collection .From the journal paper taking

- The idea of proper execution of the project such as different process execution and the different method implementation to get required desired output. How to direct in a definite direction for better result includes for definite progress applying definite way in proper direction.
- Idea of carrying operation one after another includes sequences of operations to processing the model in a way that results greater efficiency.
- How to select an area for materials selection.

From online website we get brief description of individual operation of the project.

For increasing amount of plastics and clothes waste is the biggest problem in worldwide. So we are going to attempt our first step to making insulation panel from plastic and cloth waste to decreasing its amount.

Table-1:Plastic waste generation in different states of India

SL No.	States	Generation of plastic waste (Tonnes per annum)
1	Andhra Pradesh	386.85
2	Arunachal Pradesh	2,721.17
3	Assam	24,970.88
4	Bihar	4,134.631
5	Chhattisgarh	3,2850
6	Goa	26,086.3
7	Gujarat	4,08,201.08
8	Haryana	1,47,733.511
9	Himachal Pradesh	13,683
10	Jharkhand	43,332.308
11	Karnataka	2,96,380
12	Kerala	1,31,400
13	Madhya Pradesh	1,21,079
14	Manipur	8,292.8
15	Meghalaya	5,043
16	Mizoram	7,908.6
17	Nagaland	565
18	Odisha	45,339
19	Punjab	92,890.17
20	Rajasthan	51,965.5
21	Sikkim	69.02
22	Tamil Nadu	4,31,472
23	Telangana	2,33,654
24	Tripura	32.1
25	Uttarakhand	25,203.03
26	Uttarpradesh	1,61,147.5
27	Weste Bengal	3,00,236.12
28	Maharashtra	4,43,724
29	Jammu and Kashmir	74,826.33

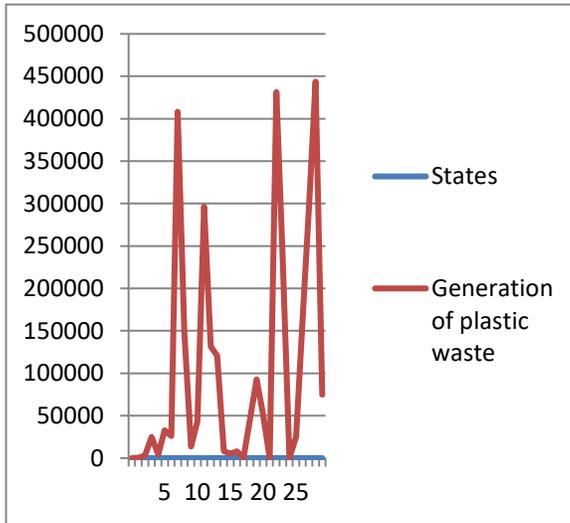


Fig 1: Line diagram of different states of plastic waste

Globally, approximately 75% of textile waste is disposed of in landfills, 25% is reused or recycled, and less than 1% of all textile is recycled back into clothing [7,8]. In this respect, advancing reuse and recycling technologies for textile waste in diverting waste from landfill is crucial [9].

China and the European Union (EU) are the two leading regions for clothing and textile exports [10]. The worldwide volume production of textile fibers in 1975 was about 23.9 million metric tons (MMT), in 2017 it reached 98.5 MMT [11], and it increased further to about 111 MMT in 2019 [8]. For many years, cotton fiber demand dominated polyester; however, in 2002, polyester demand surpassed cotton fiber and has continued to grow at a faster rate than cotton fiber [12]. Polyester and cotton are the most common fibers used worldwide [12,13]. Moreover, the global fiber consumption in 2017 consists of 60% synthetic fibers or polyester/cotton blend (polycotton) and 40% cellulosic, which is the typical example of most textiles [14]. In Canada, an estimated 500,000 tons of apparel waste is disposed of annually [15]. The EU textile industry generates approximately 16 MT of waste annually.

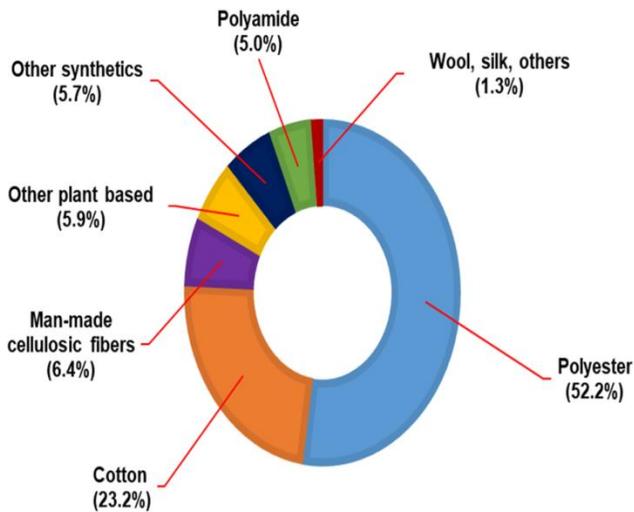


Fig 2: Global fiber production share in 2019

2. METHODOLOGY

For making insulation panel gathering wastage from municipal budge, hostels and rural areas. After that two processes are followed for produce final product as insulation panel.

A. Separation: From different sources collecting waste as combination of e-waste, medical waste, solid waste, degradable and non degradable waste. All of these are firstly separated in two sections, first is plastic and cloths section and in second section remaining products are placed. In the second stage, separation of plastic from cloths done from the first section of the wastage.

B. Shredding and binding: After separation cloths and plastics are shredded in small particles as much as possible. And shredding processes is continued for more than two rounds because it is not possible to get required sizes of shredded particles in two rounds. By increasing speeds in rpm of the shredder machine very small shredded particles obtained. In binding process both shredded particles are blend in one section. Mixing it well as per requirements, for obtaining different characteristics and properties of final product.

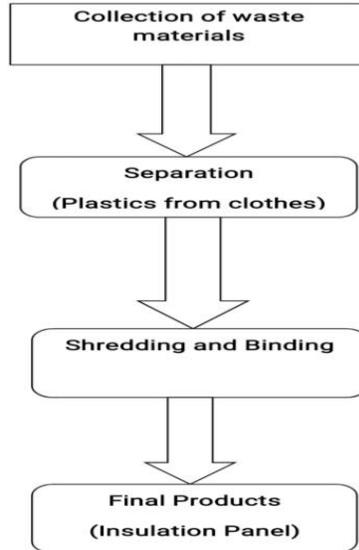


Fig 3: Different process of making insulation panel

3. RESULTS AND DISCUSSION

A good insulation panel has definite characteristics and properties. These properties are gained by incurring different testing procedures. For different properties separate testing is done in proper testing device or machine.

Properties of insulation panels are

A. Acoustics (sound insulation ratings): The 'Rw' value is the sound insulation rating for airborne sound. This rating can range from as low as Rw 10-15 up to values of Rw 75 and greater. [6]

B. Tensile strength: In a good insulation panel the average of tensile strength values is between 10 to 25 psi. The averages of tensile strength of the board with the density of 200, 300 and 400kg/m³ are 4.49, 13.24 and 14.78 psi respectively.[6]

C. Thermal conductivity: Thermal conductivity is directly related to the board density, where the higher board density, the higher thermal conductivity. The thermal insulation board with density of 200-400kg/m³ had the thermal conductivity ranging from 0.0438-0.0606 W/mK [6]

D. Moisture content: The moisture content trends to increasing of board density. According to the standard of TIS. 876-2547, the average of moisture content values must be range from 4 to 13%. [6]

4. CONCLUSION

This research paper will provide a great message for others to designing and manufacturing products by using wastage to make more commercial by-products. We have taken the raw materials from solid waste which helps in getting raw materials in available way and reduce purchasing and carrying cost of the product.

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6. REFERENCES

[1] <https://www.unep.org/exploretopics/resource-efficiency/what-wedo/cities/solid-waste-management#:~:text=Every%20year%2C%20an%20estimated%2011.2,solid%20waste%20are%20collected%20worldwide>

[2]<https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>

[3]<https://texfash.com/column/the-report-on-indias-textile-waste-needs-a-closer-look-and-an-update>

[4]<https://www.sciencedirect.com/science/article/abs/pii/S0959652621013512#:~:text=In%20a%20field%20study%20conducted,and%20de%20Francisco%2C%202016>

[5] Plastic waste management rules (As per Rule '17(4)' of PWM Rules, 2018). *Central pollution control Board Ministry of Environment, Forest and climate change, Govt. of India Parvesh Bhawan, East Arjun Nagar Delhi-110032.*

[6] Luamkanchanaphan T., Chotikaprakhan S. and Jarusombati S. (2013). *A study of Physical, Mechanical and thermal Properties for thermal insulation from Narrow-leaved Cattail Fibers.*

[7] Ellen MacArthur Foundation. A New Textiles Economy: Redesigning Fashion's Future. 2017. Available online: <https://www.ellenmacarthurfoundation.org/publications> (accessed on 10 January 2021).

[8] Textile Exchange. Preferred Fiber & Materials, Market Report. 2020. Available online: https://textileexchange.org/wp-content/uploads/2020/06/Textile-Exchange_Preferred-Fiber-Material-Market-Report_2020.pdf (accessed on 10 January 2021).

[9] Labayen I. Yuan Q. (2022). *A Review on Textile Recycling Practices and Challenges* [10] WTO (World Trade Organization). World Trade Statistical Review. 2018. Available online: https://www.wto.org/english/res_e/statis_e/wts2018_e/wts2018_e.pdf (accessed on 6 December 2019).

[11] Statista. Production Volume of Textile Fibers Worldwide 1975–2017. 2018. Available online: <https://www.statista.com/statistics/263154/worldwide-production-volume-of-textile-fibers-since-1975/> (accessed on 6 December 2019)

[12] Textile World. Man-Made Fibers Continue to Grow. 2015. Available online: <https://www.textileworld.com/textile-world/fiberworld/2015/02/man-made-fibers-continue-to-grow/> (accessed on 6 December 2019).

[13] HIS Markit. Natural and Man-Made Fibers Overview. 2015. Available online: <https://ihsmarkit.com/products/fibers-chemical-economics-handbook.html> (accessed on 6 December 2019).

[14] GFA & BCG (Global Fashion Agenda and the Boston Consulting Group). Pulse of the Fashion Industry. 2017. Available online: <https://www.globalfashionagenda.com/publications/#pulseofthefashionindustryreport> (accessed on 22 November 2018).

[15] Storry, K.; McKenzie, A. Unravelling the Problem of Apparel Waste in the Greater Vancouver Area. 2018. Available online <https://businessinsurrey.com/wpcontent/uploads/2018/05/UnravellingtheProblemofApparelWasteintheGreaterVancouverAreaMarch2018.pdf> (accessed on 10 March 2019).