

Recycle of Waste Plastic

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Abstract: Recycling the plastic is very important for the universe. The plastic material demand is improving in every day moreover the use of plastics are not beneficial for the human being life cycle also it creates hazards to the nature. Hence in order reduce the new products manufacturing with plastic we can reuse the waste plastic by recycling process. The plastic material takes 450 years to decompose naturally, due to this longer period it creates more environment pollution and it is necessary to recycle the waste plastic

In this project we reproduce the plastic models from the waste plastic materials (High Density Poly Ethylene) by using proper methodology. The HDPE plastic is the stiff plastic used to make milk jugs, detergent and oil bottles, toys, and some plastic bags. HDPE is the most commonly recycled plastic and is considered one of the safest forms of plastic. It is a relatively simple and cost-effective process to recycle HDPE plastic for secondary use. Recycling takes 88% less energy than making plastic from raw materials while helping reducing fossil fuel consumption from which we can reduce the landfill , conserve energy and conserve the environment.

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I. Introduction

The usage of plastic materials are drastically increased in our daily life which leads to wastage of material. The wastage is increased mainly in most populated countries especially in the metropolitan cities. As per the recent survey the around 15.722 kilo tons per day of plastic is discarded in our country. The plastic material is becomes integral part in our day to day life. The plastic usage creates a huge employment in all over world and its manufacturing rate reached around 150 million ton per annum universally.

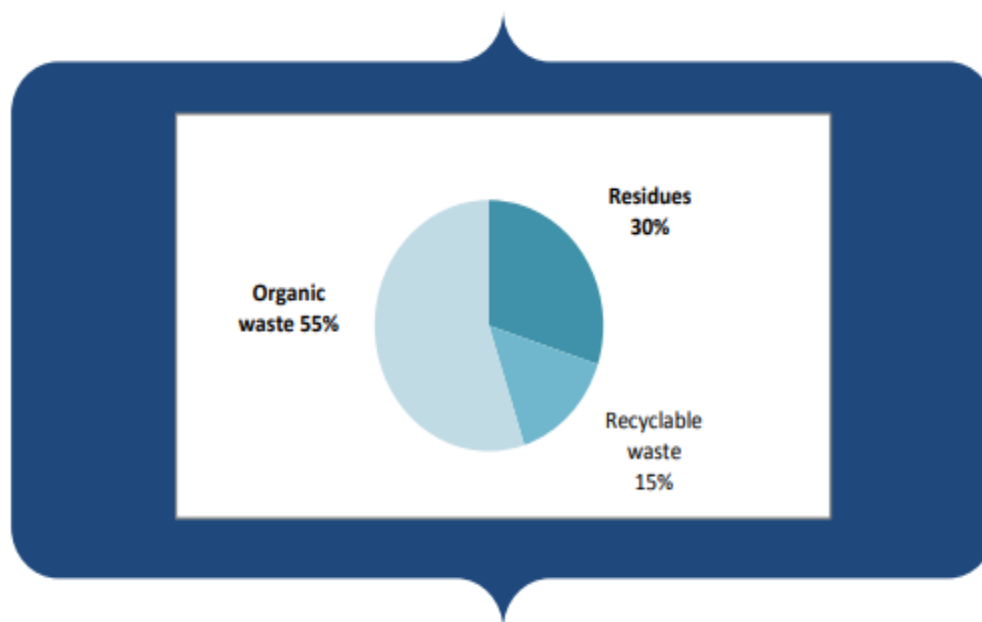


Fig 1: Recycling Potential

It creates a good revenue in our country also around of 8 Million tons are produced in year (2008). The usage of plastics such as restaurant, packing division, transportation, entertainment, domestic application and other several fields it is a necessary material. The increased usage of plastic is also not good for the environment; it creates a bad effect to human life cycle. Typically the plastic materials are reusable when it is recycled but the recycled plastic reuse also possible. The generation of waste material after double recycling is very dangerous to the atmosphere. Even though the need of plastic is reduced, it is growing drastically because it is required from home need to the industry requirements.

II. Methodology

There are two major ways to recycle plastic:

- (1) Mechanical recycling ("chop and wash"), where the plastic is washed, ground into powders and melted.
- (2) Chemical recycling, where the plastic is broken down into monomers. Before recycling, most plastics are sorted according to their resin type.

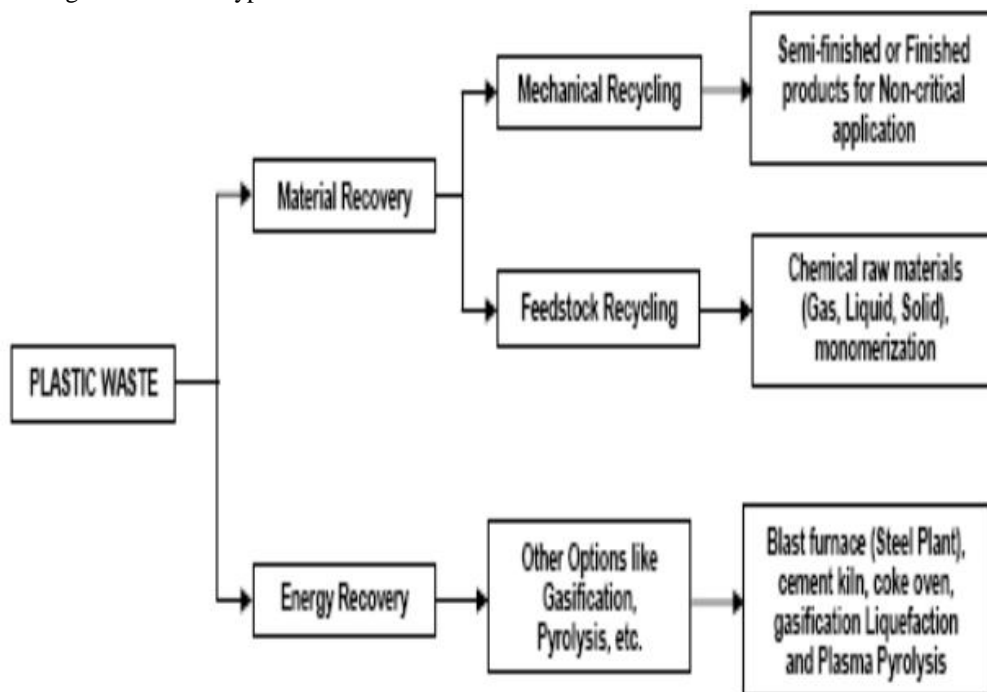


Fig 2: Recycling Process Layout

Chosen Mechanical recycle method the produce new products from waste plastic

Step1: Collection of waste plastic: First step we are collected the waste plastic from the waste yard which is already cut into small pieces.

Step2: Sorting of plastic into categorize: Sorting of plastic done by their specific numbers assigned for plastics, from which we are selected HDPE which is numbered by 2 and it is Thermo plastic material which we can easily recycled.

Step3: Washing to remove impurities: After sorting plastics, it is necessary to remove dirt, labels, and particles, glue and additional chemicals form plastic so that it should not affect the process and doesn't produce poisons gases during processing.

Step4: Heating and finishing: After washing plastic piece are taken in the aluminium try and heated in the muffle furnace at 250°C for 45 minutes. We should heat the plastic up to softening stage, in between the heating try has been taken outside from the furnace and squeeze it properly to remove the air entrapment between the plastic pieces then kept again in the furnace. Softened plastic has been given different shapes with the help of dies by pressing in the UTM machine. The load applied for pressing is 12600N. Finally extra projections has been removed and given final finish to all components by hand grinding machine.

Why we are maintained the temperature 250⁰C because further heating of plastic will produces fumes which are not good to environment and human being. It is dangerous to inhale that poisonous gases.

Step5: Products and Comparing the values with other material: prepared the two samples and tested compression test, the average values are as follows:

Table 1: The Typical Thermoplastic and Thermosetting resins

S. No.	Thermo plastic	S. No.	Thermoset Plastic
1	Polyethylene Tetrphthalate (PET)	1	Bakelite
2	Polypropylene (PP)	2	Epoxy
3	Poly Vinyl Acetate (PVA)	3	Melamine
4	Poly Vinyl Chloride (PVC)	4	Polyester
5	Polystyrene	5	Polyurethane
6	Low Density Polyethylene (LDPE)	6	Urea-Formaldehyde
7	High Density Polyethylene (HDPE)		

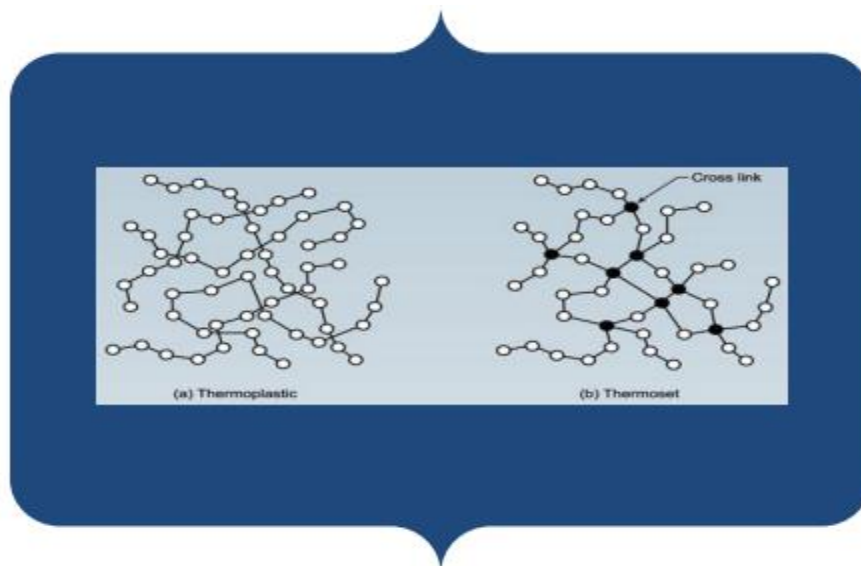


Fig 3: Structure of (a) Thermoplastic (b) Thermosets

III. Products

The recycling process we are adopted mechanical method as mentioned in above process. The final result that is different models is prepared with specific dimensions. The list of models as follows,

- 1) **Table top:** Sample size of 18 * 18 cm, of 330 grams of plastic pieces to make this model.
- 2) **Trolley wheel:** Sample size of 14cm outer diameter and 5cm inner diameter, width 3.6cm, required 460 grams of plastic pieces.
- 3) **Exam pad / chopping board:** Sample size: 25 * 18 cm, having 300grams of weight.
- 4) **Solid patterns: Sample size:** 14cm diameter, width 1.5cm, 230grams of plastic pieces required to prepare this pattern
- 5) **Tiles for flat form:** Sample Size of 24cm from corner to corner, 12cm one side, width 10cm from 600grms of plastic pieces for one hexagonal tile.

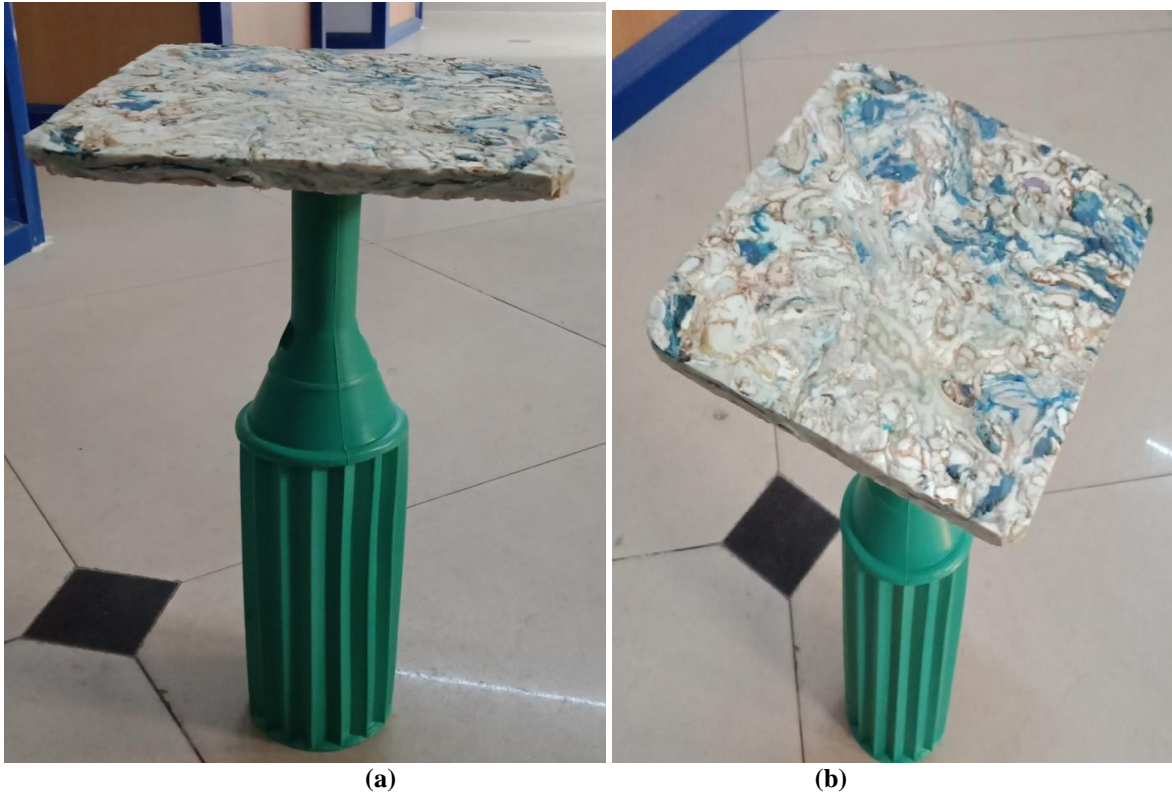


Fig 4 (a) (b): Table Top



Fig 5: Trolley Wheel



Fig 6: Exam Pad / Chopping Board



Fig 7: Solid Patterns



Fig 8: Tiles For Flat Form

IV. Testing Results

Tested Sample

Sample Size: Diameter is 43 mm Height 50mm



Fig 8: Tested Sample

Table 2: Compression Strength and Load

Sl.no.	Factors	HDPE(Recycle)	HDPE(Actual)	Wood	Remarks
1	Compression Strength	15.315 N/mm ²	20 N/mm ²	3 to 15 N/mm ² (Parallel grains) 8 to 12 N/mm ² (Perpendicular grains)	Values are nearer to Wood
2	Density	898.8 Kg/m ³	930 to 970 Kg/m ³	805 – 960 Kg/m ³	Values are good compare to wood
3	Load	12600 N	-	13200N	Comparatively withstand the load as same as wood

V. Conclusion

Plastic recycling is very important and must be taken seriously. Plastics make up a huge amount of solid waste and take centuries to break down in landfill or the ocean. Therefore, all recyclable plastics should be recycled to reduce landfall, conserve energy and conserve the environment. We can also prepare following components by using waste thermoplastic 1) Bricks 2) Pens 3) Planter pots 4) Pulley 5) Plastic patterns and many. Hence this is more concern with environment issues using of plastic to be reduced and start producing new products with waste plastic and it is very good thought to become a **Entrepreneur** by starting recycle units with less investment cost and it is very simple process.

References

- [1]. Plastic Business Data and Charts, Verband Kunststoffzeugende Industrie e. V. (VKE), Germany. published 16.04.2004 (downloadable from <http://vke.de>)
- [2]. Meech, C. G. (2006) Science Progress, 89 (1), 1 – 59.
- [3]. Zweifel, H. (2001) Plastics Additives Handbook, Fifth Edition, Carl Hanser Verlag, Germany. 4. Michaeli, M. (1995) Plastics Processing: An Introduction, Carl Hanser Verlag, Germany.
- [4]. La Mantia, F. P. (1997) Role of Additives in the Recycling of Polymers, IUPAC, 38th Microsymposium on Recycling of Polymers, Prague, July 1997.
- [5]. Brandrup, J., Bittner, M., Menges, G. and Michaeli, W. (1996) Recycling and Recovery of plastics, Carl Hanser Verlag, Germany.
- [6]. Pascoe, R. D. (2000) Sorting of Waste Plastic for Recycling, Rapra Review Reports, 11, 4.
- [7]. Rauwendaal, C. (1994) Polymer Extrusion, 3rd Edition, Carl Hanser Verlag, Germany.
- [8]. ASTM D5033-00, (2000) Standard Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics, 2000.
- [9]. BASF AG, (1996) Plastics Recycling-Activities of BASF, Technical Information for Experts, Ludwigshafen, 1996, pp. 6, 7/3/97 Nr 08/96 e

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