

Waste Thermocol to Adhesive for Better Environment

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Abstract— Plastic waste causes serious health and ecological problems like breeding places for mosquito's, being eaten by cattle and wild animals to endanger their lives, where it lays it stop vegetation from growing, create obstructs in drain and piping, etc. Now total consumption of plastic has reached to 100 million tons, and this has caused significant depletion of natural resources such as petroleum and natural gas. Plastics make up almost 13 percent of the municipal solid waste stream, a dramatic increase from 1960, when plastics were less than one percent of the waste stream. 32 million tons of plastic waste was generated in 2011, representing 12.7 percent of total MSW. Annually approximately 500 billion plastic bags are used worldwide. More than one million bags are used every minute. A work is carried out to convert waste thermocol to useful product i.e. Adhesive.

Keywords— Environment, plastic waste, recycling of plastic waste, management of plastic waste, waste thermocol.

I. INTRODUCTION

Waste, or rubbish, trash, junk, garbage, depending on the type of material or the regional terminology, is an unwanted or undesired material or substance. It may consist of the unwanted materials left over from a manufacturing process (industrial, commercial) or from community and household activities. The material may be discarded or accumulated, stored, or treated (physically, chemically, or biologically), prior to being discarded or recycled. It is also used to describe something we use inefficiently or inappropriately.

Plastic is a synthetic material that is made by polymerizing molecules of monomer, materials that are derived from coal, petroleum or natural gas.

Proper way of plastic waste handling is recycling. Recycling of plastic is desirable because it avoids their accumulation in landfills. Basically there are four different ways of recycling of waste plastic and they are, primary recycling, secondary recycling, tertiary recycling (fuel and chemical recovery) and quaternary recycling (energy recovery). Combinations of these are well known and are used to some extent.^[1]

II. CLASSIFICATION OF PLASTIC WASTE

Throughout the region, the principal sources of solid waste are residential households and the agricultural, commercial, construction, industrial and institutional sectors. A breakdown of plastic waste types and sources is provided in Table I.

TABLE I
CLASSIFICATION OF PLASTIC WASTE^[2]

Plastic Identification Code	Type of Plastic Waste	Plastic Waste Classification and their Common Applications
1	PET	Polyethylene Terephthalate E.g. Bottles, Films
2	HDPE	High density Polyethylene E.g. Packaging, Detergent, Shopping Bags
3	PVC	Polyvinyl Chloride E.g. Water pipes, Curtains, Credit card, Packaging films, Water Films
4	LDPE	Low density Polyethylene E.g. Plastic bags, Wire cloth
5	PP	Polypropylene E.g. Plastic bag and toy
6	PS	Polystyrene E.g. Disposable cups and plates, Fast food boxes
7	Other	Acrylonitrile butadiene styrene, High impact polystyrene, General purpose polystyrene, Polyamide, Polycarbonate, etc.

III. EFFECT OF PLASTIC ON ENVIRONMENT AND ON HUMAN HEALTH

Plastic wastes can break down and release toxins that harm the environment, animals and the general public, according to the International Plastics Task Force.

Certain chemicals such as biphenyl A can cause some serious health concerns, according to an article on plastic bottles by Beth Daley of the Boston Globe. Even low doses of biphenyl may cause developmental problems in children. Some other problems associated with plastic waste are as follows:

- Littering of the landfills: Plastic garbage becomes unhygienic and ugly,
- Littering of plastics: Plastic bags causes blocking of the cities, municipalities sewerage systems, leads to spreading of water borne diseases,
- Death of animals: Due to improper disposal of plastic food bags that are eaten by animals,
- Soil fertility is also affected due to plastic material: Soil fertility also decreases due to manure remaining in the soil for years without natural degradation,
- The manufacturers of plastic materials are polluting the environment: Disposing of the plastic waste and chemicals used in the process of manufacturing plastic material.^[3, 4]

Plastic particles in the oceans attract toxins. These enter the food chain; we are at the top of that food chain. And plastics and their additives aren't just around us, they are inside virtually every one of us- present in our blood and urine in measurable amounts, ingested with the food we eat, the water we drink and from other sources.

Two broad classes of plastic-related chemicals are of critical concern for human health-biphenyl-A or BPA, and additives used in the synthesis of plastics, which are known as phthalates. For example:

- BPA: It is a common synthetic chemical found in plastics, food can linings, beverage can linings, and other consumer products, which interferes with human hormones,
- Phthalates: It is a chemical used to soften plastics, to carry fragrance and scent, and used in other everyday products, have been linked to birth defects and are harmful to reproductive system.^[5, 6, 7, 8, 9]

IV. PLASTIC RECYCLING PROCESS

Recycling of plastics is desirable because it avoids their accumulation in landfills. While plastics constitute only about 8 percent by weight or 20 percent by volume of municipal solid waste, their low density and slowness to decompose makes them a visible pollutant of public concern. It is evident that the success of recycling is limited by the development of successful strategies for collection and separation. Recycling of scrap plastics by manufacturers has been highly successful and has proven economical, but recovering discarded plastics from consumers is more difficult.^[3, 10, 11, 12, 13]

Following are the main plastic recycling processes:

A. Plastic Process Scrap Recycling

Currently most plastic recycling bin of the developed countries are of 'process scrap' from industry, i.e. polymers left over from the production of plastics. This is relatively simple and economical to recycle, as there is a regular and reliable source and the material is relatively uncontaminated. This is usually described as reprocessing rather than recycling.^[3]

B. Post-use Plastic Recycling

Post-use plastic can be described as plastic material arising from products that have undergone a first full service life prior to being recovered. Households are the biggest source of plastic waste, but recycling household plastics presents a number of challenges. One of these related to collection.^[3]

C. Mechanical Recycling

Mechanical recycling of plastics refers to processes which involve the melting, shredding or granulation of waste plastics. Plastics must be sorted prior to mechanical recycling. Mostly, sorting is done manually. Recently, technology is being introduced to sort plastics automatically, using various techniques such as X-ray fluorescence, infrared and near infrared spectroscopy, electrostatics and flotation. Following sorting, the plastic is either melted down directly and moulded into a new shape, or melted down after being shredded into flakes and then processed into granules called re-granulate.^[3]

D. Chemical or Feedstock Recycling

Feedstock recycling describes a range of plastic recovery techniques to make plastics, which break down polymers into their constituent monomers, which in turn can be used again in refineries, or petrochemical and chemical production. A range of feedstock recycling technologies is currently being explored. These include

- (i) Pyrolysis,
- (ii) Hydrogenation,
- (iii) Gasification and
- (iv) Thermal cracking

Feedstock recycling has a greater flexibility over composition and is more tolerant to impurities than mechanical recycling, although it is capital intensive and requires very large quantities of used plastic for reprocessing to be economically viable.^[3]

V. ADVANTAGES OF REUSE AND RECYCLE OF PLASTICS

It has been observed, to reduce bad effects of waste plastics, it is better to recycle and re-utilize waste plastics in environment-friendly manners. As per statistics, about 80% of post-consumer plastic waste is sent to landfill, 8% is incinerated and only 7% is recycled. In addition to reducing the amount of plastics waste requiring disposal, recycling and reuse of plastic can have several other advantages, such as^[3, 10, 11, 12, 13, 14]

- Conservation of non-renewable fossil fuels – Plastic production uses 8% of the world’s oil production, 4% as feedstock and 4% during manufacture,
- Reduced consumption of energy,
- Reduced amounts of solid waste going to landfill,
- Reduced emissions of carbon dioxide (CO₂), nitrogen-oxides (NO_x) and sulphur-dioxide (SO₂).

VI. WASTE THERMOCOL AND ITS MANAGEMENT

Thermocol is a type of polystyrene used for packaging. After use it is thrown away as “waste plastic”.

Effect on Human Health

- The burning of polystyrene polymers such as foam cups, meat trays, egg containers, yogurt and deli containers releases styrene. Styrene gas can readily be absorbed through the skin and lungs,
- At high levels styrene vapour can damage the eyes and mucous membranes,
- It can increase the risk of heart disease; aggravate respiratory ailments such as asthma and emphysema, and cause rashes, nausea or headaches, damages in the nervous system, kidney or liver, in the development system.^[7, 14]

VII. OBJECTIVE

To prepare adhesives from waste thermocol.

VIII. METHODOLOGY ADOPTED

The experiment is carried at normal room temperature and pressure. Various types of solvent as well as solvent blends are selected for preparation.

- Take 50 ml of petrol or selected solvent using a burette in a clean and dry glass beaker,
- Now take the thermocol which has been cut into small pieces and add slowly to petrol or solvent in the beaker,
- Stir continuously and keep on adding thermocol into the beaker,
- After a while no more thermocol dissolves in the petrol or solvent,
- Stop adding thermocol and allow it to stand for a few minutes.^[15]

The beaker containing petrol or solvent now has a thick and coagulated mass in it. This is the resultant adhesive.

IX. RESULT AND DISCUSSION

The quantity of waste thermocol used with different solvent and nature of product solvent mass is tabulated as follows:

TABLE III
COMPARATIVE DATA OF VARIOUS SOLVENT FOR ADHESIVE PREPARATION

Sr. No.	Name of Solvent (Quantity: 50 ml)	Maximum Quantity of Waste Thermocol Used	Nature of Mixture
1	Petrol	16.3086 gm	Homogeneous, viscous liquid with sticky nature
2	Acetone	24.5052 gm	Homogeneous, viscous liquid with less sticky nature
3	Toluene	24.3082 gm	Homogeneous, viscous liquid with sticky nature
4	Acetone + Petrol (45:5 ml)	21.6806 gm	Homogeneous, viscous liquid with less sticky nature
5	Acetone + Petrol (40:10 ml)	24.2406 gm	Homogeneous, viscous liquid with medium sticky nature
6	Acetone + Petrol (35:15 ml)	24.2491 gm	Homogeneous, viscous liquid with medium sticky nature
7	Acetone + Petrol (30:20 ml)	24.3409 gm	Homogeneous, viscous liquid with medium sticky nature
8	Acetone + Petrol (25:25 ml)	22.7624 gm	Homogeneous, viscous liquid with medium sticky nature

The stickiness test is carried out with paper envelopes with various types of synthesis adhesive. From above experiment, it is observed that some solvent form good quality of adhesive, these solvents are petrol and toluene.

Some solvents form medium sticky adhesive, these are mixture of acetone and petrol. Whereas some solvent form very less sticky adhesive that one was acetone.

X. CONCLUSION

Plastic is now an integral part of the everyday activity of human life and one cannot rule out the disadvantages of plastic but the disadvantages can be reduced to some extent if certain tips to deal with plastic waste are followed. Thermocol is basically polystyrene $[\text{CH}(\text{C}_6\text{H}_5\text{CH}_2)]_n$ by structure. From experiment it is observed that petrol and toluene is able to give good quality of adhesive than that of other solvents. It is simple and required only beaker, glass rod and balance. Hence this technique is economical. Again in this no additive, catalyst or any intermediate substance are used, during processing no any gaseous or residual product is formed. Hence this technique is eco-friendly. Dealing with plastic waste is difficult because plastic are light weight and occupy more volume (i.e. low density material). Hence this technique is somewhat efficient. From the experimental study it is observed that petrol and toluene able to form good quality of adhesive. Thus, it is conclude that conversion of waste thermocol to adhesive is an economical, eco-friendly and efficient technique.

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