



Research Article

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Shaan Tahilramani

Chemical Engineering Department, G. H. Patel
College of Engineering and Technology, Bakrol
Road, Vallabh Vidyanagar 388120, Gujarat,
India

Dharmik Shah

Chemical Engineering Department, G. H. Patel
College of Engineering and Technology, Bakrol
Road, Vallabh Vidyanagar 388120, Gujarat,
India

Brij Patel

Chemical Engineering Department, G. H. Patel
College of Engineering and Technology, Bakrol
Road, Vallabh Vidyanagar 388120, Gujarat,
India

Chirag Vidja

Chemical Engineering Department, G. H. Patel
College of Engineering and Technology, Bakrol
Road, Vallabh Vidyanagar 388120, Gujarat,
India

Endrick Contractor

Prof. Chemical Engineering Department, G. H.
Patel College of Engineering and Technology,
Bakrol Road, Vallabh Vidyanagar 388120,
Gujarat, India

Study of Properties of Adhesive Formed by Waste Polystyrene

Shaan Tahilramani*, Dharmik Shah, Brij Patel, Chirag Vidja, Endrick Contractor

Abstract

The polystyrene products involved in day to day life serve to its best as per its utility. It possesses the several properties like Insulation, Light in weight, Cushioning, Non-Reactive Material and Non- Biodegradable. Serving multipurpose it finds wide application in food industry for food packaging, material packaging in the electrical device sector, construction sector etc. There are demerits associated with the product after use i.e. waste product disposal is the major problem incurred currently. It is becoming a part of landfill and increasing the amount of solid waste. It can even harm animals that scavenge food from the landfills. Our project aims to reduce and develop methodologies to treat the polystyrene waste.

Keywords: Polystyrene Waste, Organic Solvent, Solid Waste Management.

INTRODUCTION

Solid waste management is the most crucial aspect for environment conservation. Improper disposal without segregation is common these days. Some of the techniques for waste reduction that are adopted are incineration, river dumping and land dumping. Of this solid waste, plastic is a major contributor for which methods can be devised for its recycling. Amongst the plastics polystyrene holds a contribution of 22% in the state of Delhi.

The durability & other properties of the plastics are difficult to replace and compete with. Considering plastics and its recycling, polystyrene is a contributor. The styrene is derived from petroleum or natural gas in other words it is actually the combination of ethylene and benzene. Next the styrene is subjected to suspension polymerization with an initiator which together converts into polystyrene.

The following two aspects of the polystyrene are indeed its cause and prevention.

Being lighter in weight and having quite low density it occupies sufficient volume and becomes a part of landfill.

Polystyrene is a thermoplastic as a result of which it can be remolded with the help of heat and even has a property of getting dissolved in organic solvents. [1]

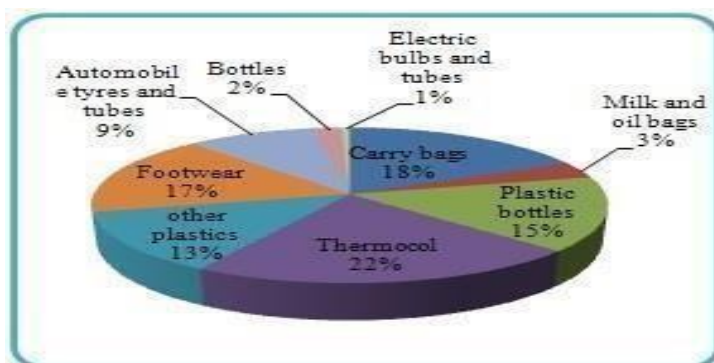


Figure 1: Solid Waste Generation in Delhi, India

Correspondence:

Shaan Tahilramani

Chemical Engineering Department,
G. H. Patel College of Engineering
and Technology, Bakrol Road,
Vallabh Vidyanagar 388120,
Gujarat, India

Email: shaan3799hn@gmail.com

OBJECTIVE

To reduce and recycle the polystyrene waste by Preparing economically viable product from the waste and spread awareness about waste management.

MATERIALS & METHODS

There are various methods to recycle the polystyrene waste, some of them are listed below:

1. To Recover Styrene Monomer

Pyrolysis is a process of chemically decomposing organic materials at elevated temperature in the absence of oxygen. A special fluidized bed reactor is designed for pyrolysis of polystyrene (PS) waste in the range 450–700 °C. The styrene monomer yield is around 80% and other laboratory reagents like benzene, toluene, xylene can also be recovered.

[2]

2. To Form Activated Charcoal

As we know that the polystyrene is a rich carbon source, modifying its properties can give us activated charcoal. The primary treatment of the waste material is carried out by washing and drying. The H₂SO₄ is used for dehydration in the muffle furnace. After this task is accomplished the KOH is added to create adsorption sites on the material, which can be further used as charcoal. [3]

3. Adhesive Formation

Polystyrene has the property of getting dissolved in organic solvents like acetone, toluene, kerosene etc. Take up the suitable solvent in a clean dry glass beaker. Cut the waste into small pieces and slowly add into the beaker. Stir simultaneously and keep on adding the waste up to the time when no more waste gets dissolved. The resultant viscous coagulated mass that is formed is adhesive.[4]

Mechanism behind the solubility

It's a basic concept of like dissolves like. Here both the polystyrene and the acetone are polar in nature. In this entire process the air present in the foam is released. [5]

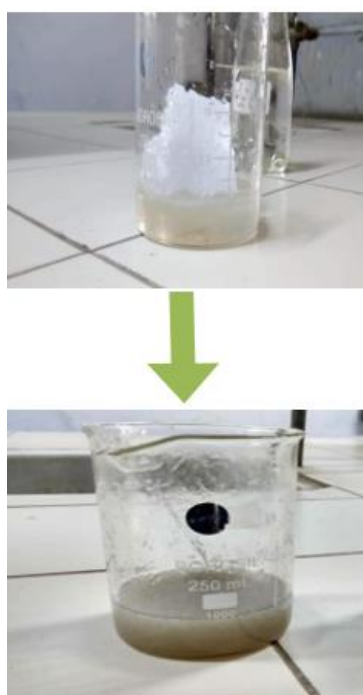


Figure 2: Adhesive formed by polystyrene waste and toluene as a solvent

RESULTS AND DISCUSSION

Experimental work was carried to form adhesive. The adhesive formed underwent tests as mentioned below.

Specimen comprising of two wood sticks (15cmx2.5cm) were placed in an interlocking position.

Water Resistance: The Specimen was kept in the water for a duration of 12 hours and it remained unaffected without the bond breakage.

Heat Resistance: With the help of sand bath the specimen was heated up to 90 C and could resist the heat. In fact by heating, increase in physical strength was seen.



Figure 3: Sand bath of the sample

Acid & Base Resistance: In 0.1 M solution of acid and base, the specimen was soaked for 24 hours keeping the specimen unchanged.

Drying time (Curing): The adhesive takes 30 minutes to dry when applied after which the joint can be used.

Tensile Strength: The most important of all tests

With the help of the Universal Testing Machine (UTM) the tensile strength of the specimen was measured.

A computer aided graph was generated for the same which indicates the maximum load bearing capacity of the adhesive formed by various solvents.

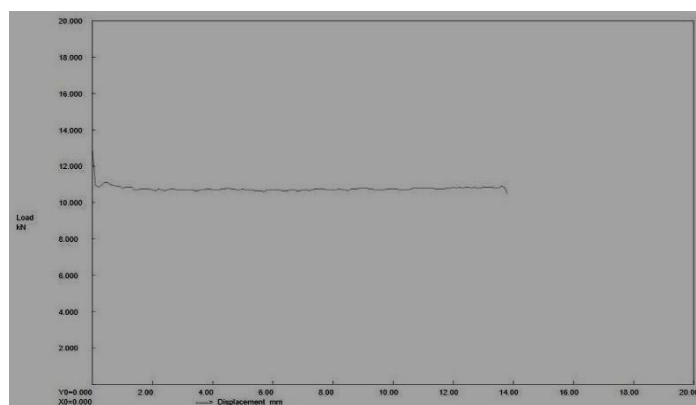


Figure 4: Load Vs Displacement (Toluene based Adhesive)

From the above tests the following findings were obtained. The adhesive formed is market compatible. (Strength & economy wise)

Table 1: Solvent Based Polystyrene Adhesive Vs Commercially sold Adhesive

Sample	Peak Load (kN)
Acetone Base Adhesive	14.05
Toluene Base Adhesive	14.15
Commercially sold Adhesive	13.5

CONCLUSION

Waste management is the prime concern now. Plastic though being advantageous during use can also be reused. [6]

From the experimental work, it is concluded that organic solvents like acetone & toluene are able to form good quality adhesive.

Qualities of adhesives are Market Compatible, Resistant to Environmental factors (Heat, Rain, Physical Shocks etc.), Eco Friendly. The adhesive can be applied and used for multipurpose like Wood & Sunmica (Furniture Work), Paper Envelope Work, Footwear Adhesive, PVC joints.

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