

# POLYURETHANE RECYCLING

AX-394

## INTRODUCTION

Simply put, polyurethane is a type of plastic. Due to the broad versatility of the materials, they are around you in many products you use everyday! It can be found in liquid coatings and paints, tough elastomers such as roller blade wheels, rigid insulation for buildings, soft flexible foam in mattresses and automotive seats or as an integral skin in sports goods such as skis or surfboards.

Polyurethane is formed by reacting a polyol (a polymeric alcohol with more than two reactive hydroxyl groups per molecule) with diisocyanates or polymeric isocyanate (e.g., MDI<sup>1</sup> or TDI<sup>2</sup>) in the presence of suitable catalysts and additives.



With the diverse range of high performance properties, polyurethanes are essential to a multitude of end-use applications. Table 1 shows the total pounds of polyurethane material consumed by each major end-use market in the United States in 2004.

**Table 1: Polyurethane Consumption by End-Use Market in the United States**

	Million Pounds	Percent of Total
Building & Construction	1,459	26.8%
Transportation	1,298	23.8%
Furniture & Bedding	1,127	20.7%
Appliances	278	5.1%
Packaging	251	4.6%
Textiles, Fibers & Apparel	181	3.3%
Machinery & Foundry	178	3.3%
Electronics	75	1.4%
Footwear	39	0.7%
Other End use Markets for polyurethane	558	10.2%
<b>Total Polyurethane Production</b>	<b>5,444</b>	<b>100.0%</b>

Source: The Socio-Economic Impact of Polyurethanes in the United States (February 2004), prepared by the American Chemistry Council.

<sup>1</sup>Methylene diphenyl isocyanate

<sup>2</sup>Toluene diisocyanate

## WASTE GENERATION

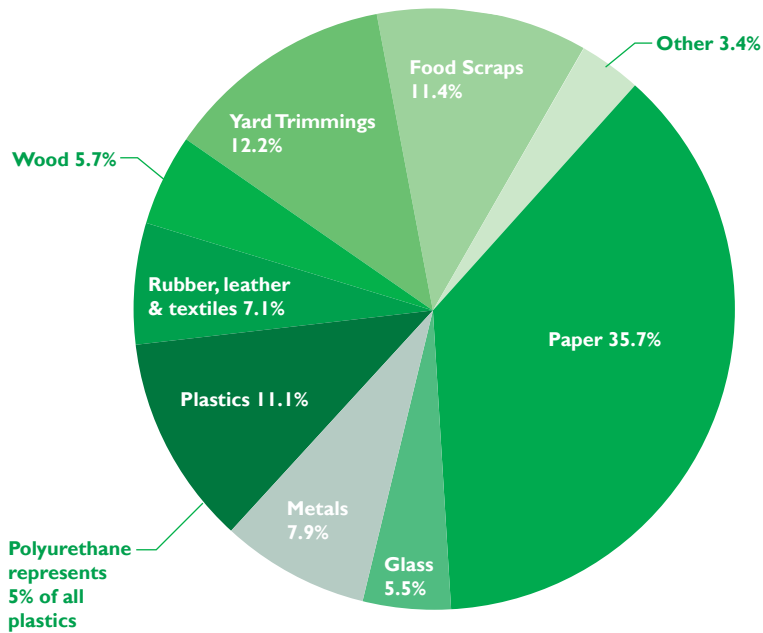
Solid waste disposal has been a problem in the United States, and trends indicate that the overall amount of solid waste that we generate continues to increase. Because polyurethanes are used in so many every day applications and industrial uses, they enter the municipal solid waste stream, usually by way of discarded consumer and industrial products. These products frequently are durable goods with a long lifespan such as upholstered furniture, mattresses and automobile parts. By weight, approximately 1.3 million tons of waste polyurethanes are generated each year

as part of the municipal solid waste stream representing five percent of all plastic waste.

### Definition:

**Municipal Solid Waste**-more commonly known as trash or garbage-consists of everyday items such as product packaging, grass clippings, furniture, clothing, plastics, food scraps, newspapers, appliances, paint, and batteries. This waste is generally generated by businesses, schools and individuals.

**Figure 1: 2003 Total Municipal Solid Waste - 229 Million Tons**



Source: 2003 Total MSW Generation, Recycling and Disposal in the United States: Facts and Figures (EPA530-F-05-003)

## WASTE REDUCTION

Polyurethane disposal is generally via landfill, incineration or recycling. In 2003, 55.4 percent of all the municipal solid waste generated ended up in a landfill, while only 30.6 percent was recycled.

Polyurethanes often are recyclable materials.\* Leading raw materials suppliers of the polyurethane industry have committed themselves over the years to find economically viable ways to reclaim discarded polyurethane-containing

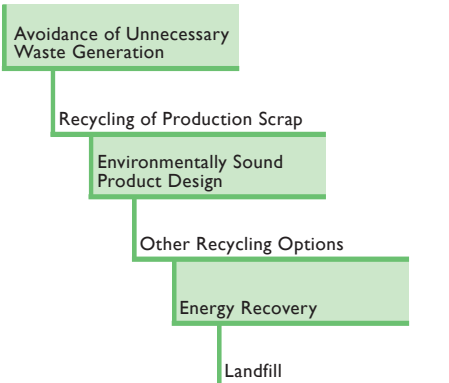
products and have successfully recycled a variety of consumer products, including:

- Appliances
- Automobiles
- Bedding
- Carpet cushion
- Upholstered furniture

\*Recycling Facilities may not be available in all areas. Check to see if a recycling facility exists in your area.

Similar to EPA's hierarchical approach for reducing waste, the polyurethane industry relies on a planned, integrated approach for waste management. Avoidance of unnecessary waste generation is the first tier of the approach, followed by recycling, and controlled landfill as a last resort. Figure 2 provides more details on the polyurethane integrated waste management approach.

**Figure 2**



The Polyurethane Recycle and Recovery Council (PURRC) is an issue management group within the Alliance for the Polyurethanes Industry (API), and focuses on economically viable recycling of polyurethanes. PURRC is involved in numerous polyurethane recycling initiatives, including--

#### **Vehicle Recycling Partnership (VRP) Cooperative Research and Development Agreement (CRADA).**

This agreement builds on recycling technology developed by Argonne National Lab to create a cost-effective process to more fully recycle end-of-life vehicles, specifically shredder residue. Shredder residue is a mix of many different materials that may include plastics, rubber, polyurethane foams, glass and metals as well as rocks and dirt. This mix often ends up in a landfill. The VRP is working with a number of different groups to evaluate various recycling technologies.

**Glycolysis Project at Troy Polymers, Inc.** A process to glycolyze mixed polyurethanes has been developed by Troy Polymers, Inc. This advanced form of chemical recycling can yield materials that can then be reused to form new polyurethane polymers that largely retain the properties and functionality of the original materials.

**The Recycled Polyurethane's Market Database.** This searchable database provides a service to the plastics industry that allows users to match sellers and buyers of recycled polyurethanes.

**Waste-to-Energy Combustion.** Municipal solid waste combustors with state-of-the-art energy recovery and flue gas cleaning technology exist in various countries today. This type of combustion can help reduce the volume of solid waste as well as dependence on fossil fuels.

## **HOW YOU CAN HELP**

Join in the fight against waste by recycling your polyurethane scrap materials whenever possible. Whether you are a consumer interested in disposing of a mattress or a large business disposing of construction materials, there are things you can do to help. Visit API's recycling website and check out the Recycled Polyurethane Market's Database to find a seller or buyer of recycled polyurethanes. Additionally, Websites such as epa.gov and earth911.org are available to help you find recycling centers for many polyurethane materials. Your State Environmental Agency's Website also may have programs in place for recycling your polyurethane waste.

For a more advanced discussion on this topic, visit API's website at [www.polyurethane.org/recycling](http://www.polyurethane.org/recycling).