

Plastics

Plastics play an important role in almost every aspect of our lives. Plastics are used to manufacture everyday products such as beverage containers, household items, and furniture. The widespread use of this valuable material demands proper management of used plastics, as they have become a larger part of the municipal solid waste (MSW) stream in recent decades.

Just the Facts

- In 2006, the United States generated about 14 million tons of plastics in the MSW stream as containers and packaging, over 6 million tons as nondurable goods, and almost 9 million tons as durable goods.
- The total amount of plastics in MSW—almost 30 million tons—represented 11.7 percent of total MSW generation in 2006.
- The amount of plastics generation in MSW has increased from less than 1 percent in 1960 to 11.7 percent in 2006.
- Plastics are a rapidly growing segment of the MSW stream. The largest category of plastics are found in containers and packaging (e.g., soft drink bottles, lids, shampoo bottles), but they also are found in durable (e.g., appliances, furniture) and nondurable goods (e.g., diapers, trash bags, cups and utensils, medical devices).
- Plastics also are found in automobiles, but recycling of these materials is counted separately from the MSW recycling rate.

How Plastics Are Made

Plastics are polymers. The most simple definition of a polymer is something made up of many units. Polymers are chains of molecules. Each link of the chain is usually made of carbon, hydrogen, oxygen, and/or silicon. To make the chain, many links, are hooked, or polymerized, together.

To create polymers, petroleum and other products are heated under controlled conditions and broken down into smaller molecules called monomers. These monomers are the building blocks for polymers. Different combinations of monomers produce plastic resins with different characteristics, such as strength or molding capability.

Plastics can be divided into two major categories: thermosets and thermoplastics. A thermoset is a polymer that solidifies or "sets" irreversibly when heated. They are useful for their durability and strength, and are therefore used primarily in automobiles and construction applications. Other uses are adhesives, inks, and coatings.

A thermoplastic is a polymer in which the molecules are held together by weak bonds, creating plastics that soften when exposed to heat and return to original condition at room temperature. Thermoplastics can easily be shaped and molded into products such as milk jugs, floor coverings, credit cards, and carpet fibers.

Plastic resins are processed in several ways, including extrusion, injection molding, blow molding, and rotational molding. All of these processes involve using heat and/or pressure to form plastic resin into useful products, such as containers or plastic film.

Types of Plastics

HDPE	High-density polyethylene (i.e., milk jugs)
LDPE	Low-density polyethylene
LLDPE	Linear low-density polyethylene
PET	Polyethylene terephthalate (i.e., soda bottles)
PP	Polypropylene (i.e., long underwear)
PS	Polystyrene (i.e., packaging "peanuts")
PVC	Polyvinyl chloride (i.e., pipes)

How Plastics Are Recycled

According to the American Plastics Council (APC), more than 1,800 U.S. businesses handle or reclaim post-consumer plastics. Plastics from MSW are usually collected from curbside recycling bins or drop-off sites. Then, they go to a material recovery facility, where they are sorted either mechanically or manually from other recyclables. The resulting mixed plastics are sorted by plastic type, baled, and sent to a reclaimer. At the reclaiming facility, the scrap plastic is passed across a shaker screen to remove trash and dirt, and then washed and ground into small flakes. A flotation tank then further separates contaminants, based on their different densities. Flakes are then dried, melted, filtered, and formed into pellets. The pellets are shipped to product manufacturing plants, where they are made into new plastic products.

In 1997, APC estimated that roughly one-half of all U.S. communities—nearly 19,400—collected plastics for recycling, primarily PET and HDPE bottles, such as soda bottles. Roughly 7,400 communities collected plastics at the curb, and approximately 12,000 communities collected plastics through drop-off centers.

Resin Identification Code

The Society of the Plastics Industries, Inc. (SPI) introduced its voluntary resin identification coding system in 1988. Municipal recycling programs traditionally target packaging containers, and the SPI coding system offered a way to identify the resin content of bottles and containers commonly found in the residential waste stream. Plastic household containers are usually marked with a number that indicates the type of plastic. Consumers can then use this information to determine whether or not certain plastic types are collected for recycling in their area.

**SPI Resin
Identification Codes**

- 1 PET
- 2 HDPE
- 3 Vinyl
- 4 LDPE
- 5 PP
- 6 PS
- 7 OTHER

Benefits of Plastics Recycling

While overall recovery of plastics for recycling is relatively small—1.4 million tons, or 3.9 percent of plastics generation in 2003 - recovery of some plastic containers has reached higher levels. PET soft drink bottles were recovered at a rate of 25 percent in 2003. Recovery of HDPE milk and water bottles was estimated at about 32 percent in 2003. Significant recovery of plastics from lead-acid battery casings and from some other containers also was reported in 1999.

Plastics are recycled for both economic and environmental reasons. Recycling and reuse of plastics have the obvious benefit of decreasing the amount of used plastics that end up in landfills. With increased plastics recycling, fewer natural resources need to be extracted to produce virgin plastic.

According to APC, plastics production accounts for 4 percent of U.S. energy consumption. Though they are derived from nonrenewable natural resources, plastics' adaptable characteristics often enable manufacturers to reduce the material used, energy consumed, and waste generated in making a variety of products.

Markets for Recovered Plastics

Markets for some recycled plastic resins, such as PET and HDPE, are stable in most geographical areas in the United States and are expanding in many others. Currently, both the capacity to process post-consumer plastics and the market demand for recovered plastic resin exceed the amount of post-consumer plastics recovered from the waste stream. The primary market for recycled PET bottles continues to be fiber for carpet and textiles, while the primary market for recycled HDPE is bottles, according to APC.

In the future, new end uses for recycled PET bottles might include coating for corrugated paper and other natural fibers to make waterproof products like shipping containers. PET can even be recycled into clothing, such as fleece jackets. Recovered HDPE can be manufactured into recycled-content landscape and garden products, such as lawn chairs and garden edging.

The plastic lumber industry also is beginning to expand. New American Society for Testing and Materials (ASTM) standards and test methods are paving the way for use of these materials in decks, marinas, and other structural applications for both residential and commercial properties.

Source Reduction/Lightweighting

Source reduction is the process of reducing the amount of waste that is generated. The plastics industry has successfully been able to reduce the amount of material needed to make packaging for consumer products. Plastic milk jugs weigh 30 percent less than they did 20 years ago. Plastic packaging is generally more lightweight than its alternatives, such as glass, paper, or metal.

Source: United States Environmental Protection Agency