Waste education series

MATERIAL MANUFACTURING AND RECYCLING: GLASS

Glass Industry Background

Glass containers are manufactured at approximately 50 plants in 23 U.S. states. Most plants produce one or more colors - flint (clear), amber (brown), green, and increasingly, blue - based on consumer preference and the need to protect certain products. For example, brown glass is used to shield some beverages from ultraviolet light.

The recycling rate for post-consumer glass, or cullet, collected for recycling in the U.S. has risen every year since 1987, when data tracking was begun by the Glass Packaging Institute (GPI). GPI statistics indicate that the national glass container recovery rate for 1997 was 31 percent (2.92 million tons recovered from 9.45 million tons of bottles shipped). Most recovered glass in the U.S. is used to make new bottles and jars.

Glass Manufacturing and Recycling

Glass sand, a very pure form of silicon dioxide, is the most common ingredient in glass manufacturing. Sodium oxide, commonly known as soda ash, is used as a fluxing agent to lower the high melting point of sand. Limestone, the third major ingredient, is blended with soda ash to reduce water solubility. In addition to these and other minor ingredients, the glass container industry has always included in-house cullet in its batches. Cullet melts at lower temperatures than virgin raw materials so its use results in energy savings. Manufacturers began using post-consumer cullet in the late 1960's when improvements in the glass production process reduced the amount of available in-house cullet, and when a stable supply of quality glass was collected through beverage container deposit systems.

In the glass making process, raw materials are mixed in a “batch,” then conveyed into the melting furnace where temperatures of 2700 to 2850 degrees Fahrenheit are reached. Next, the molten glass is molded and blown into container shapes, then cooled in an annealing oven to remove stresses and to toughen the containers.

Cullet use levels of 70 to 90 percent are commonplace in many European countries, particularly in Germany and Switzerland. In the U.S., lower cullet utilization rates of 10 to 40 percent are more common. U.S. glass manufacturers point to a lack of consistent supplies of quality cullet as the reason for lower utilization rates. Contamination of recovered cullet is a major concern to manufacturers as many recycling programs have become unable or unwilling to carefully sort out unacceptable materials such as ceramics, heat-resistant cookware, light bulbs, metal rings and lids, porcelain, and non-container glass. Cullet must also be sorted by color. Mixed color cullet often results due to glass breakage during the collection and sorting of mixed containers. Contaminated cullet can cause stresses, weak finished containers, and/or variations in container color. Ceramics and heat-resistant cookware, for example, melt at temperatures higher than those reached in a glass furnace, resulting in ‘stones,’ foreign objects imbedded in a container, which cause weak spots and render the container unusable. Metals melt at the same or lower temperatures than glass, and can form molten metal pools at the bottom of the furnace, eventually corroding the furnace and increasing repair costs to the manufacturer.

Glass Recycling in Wisconsin

Wisconsin banned disposal of glass containers in landfills in 1995. The volume of glass collected since the ban was put in place has risen each year. During 2009 Wisconsin community recycling programs collected over 90,000 tons of glass bottles and jars.
Changing Practices in Glass Collection and Sorting

Methods used to collect post-consumer glass range from source separated drop-off locations, where individuals self-sort the glass by color into specific bins, to fully automated single-stream collection. Single stream collection allows all types of containers (glass, plastic and metal) to be mixed with paper for collection, reducing collection costs. Source separated glass is typically the highest quality while glass recovered from single stream sources often ends up as mixed color cullet that may not be suitable for glass manufacturers.

Cullet processors have begun to use automated sorting equipment to separate different colors of glass from mixed broken glass. Computer controlled equipment controls pulses of air that direct pieces of glass into a color sorted cullet product. These systems typically require a large capital investment and may not be suitable for recycling programs with limited quantities of mixed broken glass.

Alternate Glass Cullet Uses

As the collection and sorting processes for post-consumer glass change, so does the interest and need to develop non-container uses for glass. This need is driven by four primary factors: 1) container manufacturers are too distant to access; 2) there is a weak market for certain colors of cullet, especially green which is produced at only seven U.S. facilities; 3) breakage of bottles and jars yields a mixed color product that is not useable in large quantities for container production; and 4) highly contaminated cullet does not meet specifications levels set by glass manufacturers.

Alternative uses do exist for glass in non-container applications. Although the majority of these uses are unproven from a technical or economic standpoint, several applications are proven. These include glass as an asphalt additive called glasphalt, glass used as a road base material, glass used as a sandblast media, and glass utilized to manufacture fiberglass. For more information on alternate glass uses, see the SHWEC Waste Reduction Series fact sheet titled “Non-Container Uses for Post-Consumer Glass: Options for Wisconsin Communities.”

The Glass Packaging Institute Contributed information for this brochure

1 Table of Recyclable Materials Collected by Wisconsin Responsible Units (200-2010), 2010; Wisconsin Department of Natural Resources

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