Abstract

Thermoplastic polyester engineering resins, sometimes referred to as terephthalate engineering resins, include polybutylene terephthalate (PBT), polyethylene terephthalate (PET), and polycyclohexylene dimethylene terephthalate (PCT). These products are all thermoplastic linear condensation polymers based on dimethyl terephthalate (DMT) or terephthalic acid (TPA), but on different glycols.

Polybutylene terephthalate (PBT) resins and polyethylene terephthalate (PET) engineering resins are high-performance, high-molecular-weight materials that can be converted into functional components and parts that are in turn used in a diverse array of assemblies for automotive, electrical/electronic, appliance and industrial equipment applications. PBT resins and PET engineering resins share many of the same markets; however, PBT is consumed in much larger volumes than PET (accounting for about 89% of the total consumption of PBT and PET) because of its easier processability and shorter processing times.

The following pie chart shows world consumption of polybutylene terephthalate:

Overall use of PBT in automotive applications has increased as a result of greater use of electrical/electronic devices such as housings for electric motors for window and seating adjusters, as well as passenger airbags, safety belt tensioners, and others. Newer PBT grades with improved hydrolytic stability are being used in under-the-hood parts such as plugs, connectors, and housing parts, which must withstand the increasingly stressful demands of the automotive industry.
Also, polyester resins have benefited from improvements in mold design, better understanding of flow behavior in molds, increased robotics, and increased computer simulation, which have improved the efficiency and economics of the production of large, molded parts.

In recent years, the industry has been researching methods to become more environmentally friendly as part of the global “green” movement. Since 2006, DuPont has been marketing commercialized polytrimethylene terephthalate (PTT) engineering thermoplastic resin, which is made from purified terephthalic acid (PTA) and biopropanediol (bio-PDO). The bio-PDO is made from renewable resources. Also, SABIC Innovative Plastics now offers Valox iQ resins, which are made by converting postconsumer PET bottles into engineering plastics as replacements for PBT. Valox iQ compound is now used to make brackets for side air deflection systems for Volvo heavy-duty trucks.

During the last decade, the global growth rate for thermoplastic polyester engineering resins was well above that for most engineering thermoplastic resins. PBT resin demand grew at an average annual rate of almost 4% during 2007–17. Overall consumption of PBT resin fell in 2008–09 as a result of the global economic crisis, but demand recovered in 2010 and has continued to grow. Global consumption of PBT resin is expected to slow to about 2.7% over the next five years.

The largest application for PBT was automotive uses, which accounts for about 38% of the total PBT consumed. The combination of high mechanical and electrical properties, good thermal stability, and superior chemical resistance creates many automotive application opportunities for both PBT and PBT alloys.

Electrical/electronics is the next-largest sector for PBT consumption. The largest single use for PBT and PET in the electrical/electronics market is for connectors, where their dielectric and arc resistance properties, insulation characteristics, strength, chemical and heat resistance, and dimensional stability are valued.

Additional applications for terephthalate engineering resins are widely diverse. The industrial/machinery market is very fragmented, with many small-volume applications. Terephthalate engineering resins have replaced metal parts and thermosetting resins such as alkyds and phenolics because of their strength; resistance to heat, moisture, and chemicals; low cost; and the ease with which parts can be assembled. Home appliance components and parts (including kitchen/bath) represent a strong market for both PBT and PET engineering resins. Thermoplastic polyester engineering resins offer good heat resistance, lower material and processing costs per part, and better moldability, strength, electrical properties, surface appearance, and color capabilities than thermosets and ceramics. Applications in consumer goods include buckles, buttons, pen barrels, shower heads, bicycle parts, lawn mower chutes, and pocket calculators. The range of suitable applications of terephthalate engineering resins is expected to expand with the development of new, modified products; however, the most significant growth for PBT and PET engineering resin applications will remain mainly in the automotive and electrical/electronics categories.
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