PERP Program
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Chem Systems' Process Evaluation/Research Planning program has published a new report, ***Developments in PET Recycling (99/00S4)***.

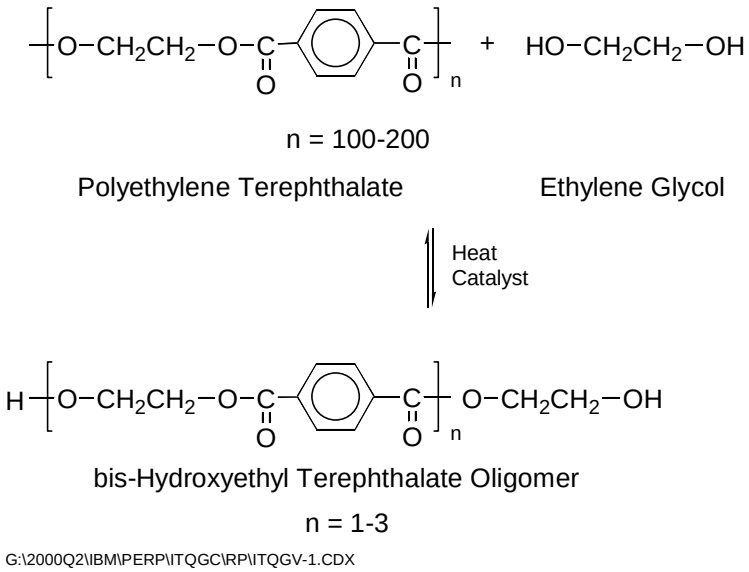
Advances in recycling technology are important to plastics in general and to polyethylene terephthalate (PET) in particular because of the limitations on PET reuse in food applications. By not permitting mechanical recycling of PET for these high value applications, it is imperative that economic technology be developed that can effectively allow for the reuse of the resin by way of chemical recycling. Feasible technologies, such as depolymerization and feedstock recovery are now available, but until these routes can compete with PET produced from virgin raw materials, they will not be employed in large scale.

The term chemical recycling refers to the conversion of solid plastic material into smaller molecules, either partially to an intermediate or completely to the monomer(s). In the case of PET, chemical recycling can amount to the break down of the polyester backbone to low molecular weight bis-HET (bis-hydroxyethyl terephthalate oligomer) intermediate or the complete depolymerization to PTA (or DMT) and ethylene glycol.

Eastman Chemical has developed a chemical recycling process for PET resin that produces food-contact grade resin and avoids the added expense of color sorting. In the process, flaked waste PET is dissolved in a solvent and depolymerized for use in place of virgin raw materials. According to Eastman, the process is expected to handle the coatings, composites and enhanced-barrier material being developed for bottled beer and other beverages. The process is being pilot-tested at Eastman’s Kingsport, TN facility.

The Eastman process is based on glycolysis of PET with ethylene glycol to give bis-HET, as shown in the figure on the next page.

A variation, partial glycolysis, uses a stoichiometric quantity of ethylene glycol to depolymerize the PET molecules to oligomers of a substantial chain length, rather than the few repeat units obtained in full glycolysis.



In the Eastman process, ethylene glycol is added to the polyester at a mole ratio of glycol to dicarboxylic acid component in the polyester of two to six, including the glycol incorporated into the polyester. The reaction is operated at between 180 and 240°C for between 10 minutes and four hours, or sufficient time to produce the desired oligomeric material.

In the second stage of the process, the first reactor mixture is dissolved in a hot solvent selected from alcohols, ethers, nitriles, chlorinated hydrocarbons, aromatic hydrocarbons, ketones, or water. Optionally, the hot solvent may be contacted batchwise with a small amount of adsorbent such as activated carbon.

The hot solution is filtered to remove insoluble impurities such as pigments used in colored polyester. The product is removed by cooling the filtered hot solution and precipitating the product by filtration or centrifugation. The solid product can be then sent to the polycondensation section of a PET plant. The filtrate can be disposed of or purified by distillation for reuse.