Technology and Costs

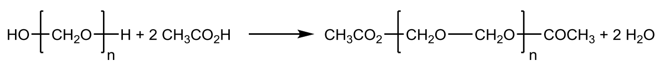
TECH 2019S1: Polyoxymethylene (Polyacetal)

Polyoxymethylene (Polyacetal) is one in a series of reports published as part of Nexant's 2019 Technoeconomics – Energy & Chemicals (TECH) program.

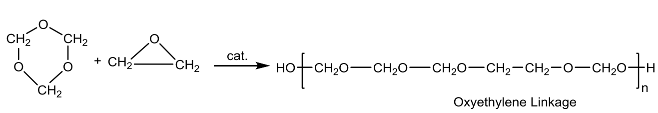
Overview

Acetal polymers, also known as polyoxymethylene (POM) or polyacetal, are formaldehyde-based thermoplastics that have been commercially available for about 60 years. Polyformaldehyde (the homopolymer of polyacetal) is a thermally unstable material that decomposes on heating to yield formaldehyde gas. Two methods of stabilizing polyformaldehyde for use as an engineering polymer were developed:

- DuPont's route to a stable polyacetal involves acetylation of the terminal hydroxyl groups of polyformaldehyde using acetic acid or acetic anhydride. The acetate ester end groups prevent initiation of the thermal depolymerization or unzipping of the polyformaldehyde.



- The Celanese route for the production of polyacetal yields a more stable copolymer product via the copolymerization of trioxane, the cyclic trimer of formaldehyde, and a cyclic ether. Polymer unzipping is stopped when a cyclic ether unit is reached.



Commercial Technologies

Homopolymer polyacetal is produced in a solution process followed by a vapor-phase stabilization reaction.

In contrast, there are three copolymer processes. The first is commonly referred to as the solution hydrolysis process because the polyacetal polymer is placed into a solution or slurry prior to undergoing the hydrolysis reaction. The second copolymer process is commonly referred to as the melt hydrolysis process or bulk copolymer process, as polymerization and hydrolysis are all performed without any solvent.

The third copolymer process is called the simplified bulk process and represents the current state of copolymer polyacetal production technology. The simplified bulk process incorporates improvements in the area of trioxane purification (lower impurities results in a polymer with fewer unstable end-caps), catalyst efficiency (reduced use per unit of polymer), more effective stabilizers (formaldehyde scavengers), and catalyst deactivation (as opposed to removal).

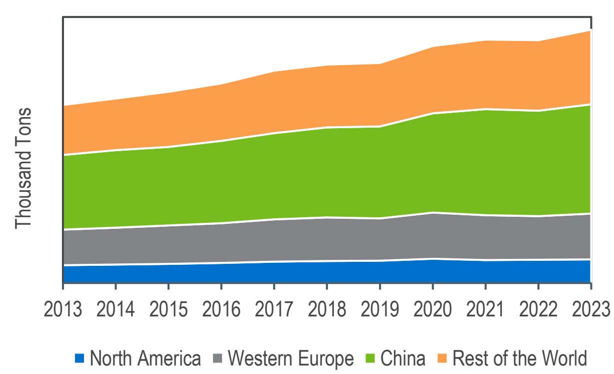
Process Economics

Economics were developed for polyacetal homopolymer and copolymer plants in the U.S. Gulf Coast, Western Europe and Coastal China. An integrated formaldehyde unit has also been incorporated into these analyses.

Commercial Overview

Global polyacetal resin demand by region is provided for 2013-2018 as well as a five-year forecast. Global and regional supply/demand balances are also provided.

Global Polyacetal Demand by Region, 2013-2023



Polyacetal's versatility and usefulness in small parts is largely responsible for the demand by end-use pattern, which was also analyzed in the report. Key markets include; electrical/electronics, appliances, transportation, consumer, and industrial/machinery.

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program (formerly known as PERP), the Biorenewable Insights program (BI), the Sector Technology Analysis, and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

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