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PERP Report 2017S4: Polyester Polyols

"Polyester Polyols" is one in a series of reports published as part of the 2017 Process Evaluation/Research Planning (PERP) Program.

Report Overview

This report provides a comprehensive analysis of the technology, economics, and markets for the production of aliphatic and aromatic polyester polyols, which are reacted with diisocyanates to make polyurethanes.

The following issues are addressed in the report:

- What are the major technologies employed?
- How do the process economics and markets vary across regions?
- What are the key drivers of production cost?
- Who are the key players in polyester polyols and what are the main market considerations?

Commercial Technologies and Raw Materials

Polyester polyols are produced via polycondensation reactions between diols (and less frequently triols) and dicarboxylic acids (or their derivatives, such as esters and anhydrides). The two reactions used to make polyester polyols are esterification and transesterification, as well as combinations of both reactions.

The most common diols are ethylene glycol, diethylene glycol (DEG), and 1,4 butanediol. For aliphatic polyester polyols, adipic acid is by far the most frequently employed dicarboxylic acid; while for aromatic polyester polyols, phthalic anhydride and polyethylene terephthalate scrap, such as used PET water bottles, are the most common sources of monomers. At present, the most fungible and viable bio-polyols are the aliphatic polyester polyols, where biorenewable sources of feedstock monomers such as diacids (e.g., succinic acid and adipic acid) and diols (e.g., butanediol and DEG) are increasingly available.

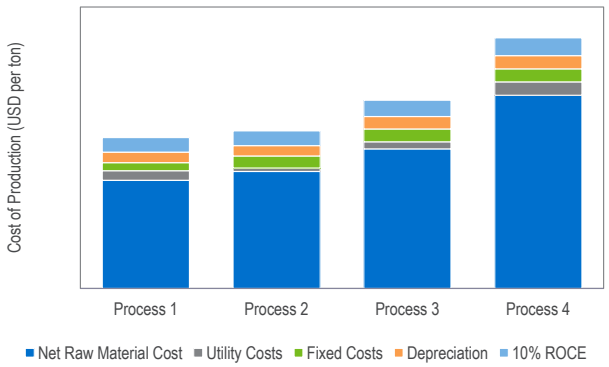
Process Economics

Commercial process technologies based on both conventional raw materials and renewable sources are discussed. Process evaluations in the report are based on information available in patents and open source literature, as well as Nexant's applied judgment and experience. Comparisons of production costs are presented for China, the Middle East, United States, and Western Europe.

The four polyester polyol processes reviewed in the report include:

- Esterification processes
  - Melt-condensation of adipic acid with 1,4-butanediol (to make an aliphatic polyol)
  - Succinic acid polycondensation with diethylene glycol (aliphatic polyol)
- Transesterification processes
  - Phthalic anhydride with DEG and MEG (esterification followed by transesterification to make an aromatic polyester polyol)
  - Phthalic anhydride and DEG with PET (aromatic polyol)

Cost of Production Comparison



Commercial Market Review

Global polyester polyol demand was approximately 2.6 million tons in 2016. The two main types of polyester polyols are aliphatic and aromatic polyester polyols, with aliphatic polyester polyols comprising 72% of total consumption.

Downstream applications are divided into three categories: rigid foam, flexible foam and coatings, adhesives, sealants and elastomers (collectively referred to as CASE). Due to significant regional variations in the demand for rigid foams and CASE made from polyurethanes, regional consumption of the two types of polyester polyols is highly skewed, with Asia Pacific accounting for 59 percent of polyester polyols consumption, including 71 percent of aliphatic polyester polyols.

Due to large local demand, Asia Pacific is the leading supplier of aliphatic polyols, with 65 percent share. In particular, China is the leading supplier of aliphatic polyols, with four of the largest eight aliphatic polyols suppliers based in China. North America and Western Europe account for 69 percent of aromatic polyester polyols capacity, while Asia Pacific and Rest of World are clearly underrepresented, leading to significant imports of aromatic polyols to these regions.

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