NexantECA

Technology and Costs

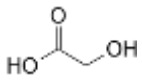
TECH 2023S2: Glycolic Acid and Polyglycolic Acid

Glycolic Acid and Polyglycolic Acid is one in a series of reports published as part of NexantECA's 2023Technoeconomics – Energy & Chemicals (TECH) program.

Overview

Glycolic acid (GA), first synthesized by Carothers in 1932, is the smallest α-hydroxy acid (AHA) possible and is slightly stronger than acetic acid. It is a colorless, odorless, and hygroscopic crystalline solid highly soluble in water. Beyond the production of polyglycolic acid (PGA), and due to its capability to penetrate the skin, glycolic acid finds applications in skin care products, most often as a chemical peel used to improve the skin's appearance and texture.

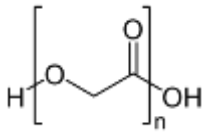
Structure of Glycolic Acid



Glycolic acid is widespread in nature. Many plants make glycolic acid during photorespiration, while glycolic acid can be isolated from sugarcane, sugar beets, pineapple, cantaloupe, and unripe grapes. Synthetic glycolic acid is most commonly produced via the carbonylation of formaldehyde or hydrolysis of chloroacetic acid. A promising route being explored in China uses an existing intermediate in coal to MEG plants to produce the aldehyde (methyl glycolate) for subsequent processing.

Polyglycolic acid (PGA) is a biodegradable, thermoplastic polyester polymer and the simplest of the poly-hydroxyalkanoate (PHA) class of polyesters possible. It is this ready biodegradability that has led to a lot of interest in developing PGA as a packaging resin.

Structure of Polyglycolic Acid (PGA)



This report focusses on the potential for glycolic acid/polyglycolic acid to gain prominence as a large volume commodity polymeric material, suitable for a wide range of extrusion and molding applications.

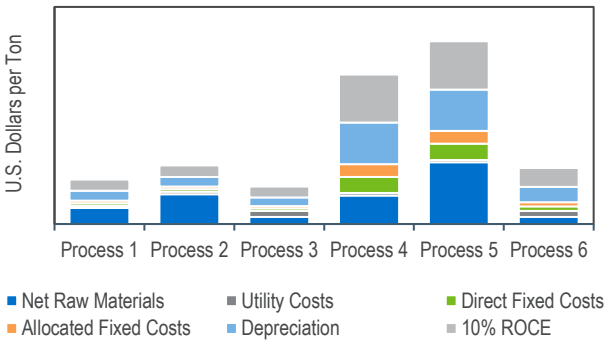
Technologies

This TECH report provides a description of the key routes being explored for glycolic acid and polyglycolic acid. Recent developments (i.e., patents) related to process technology are also reviewed.

Process Economics

For this report, NexantECA evaluated petrochemical as well as biochemical routes to glycolic acid and polyglycolic acid. The evaluation provides:

- Investment and cost of production (COP) estimates for a grassroots facility
- Estimates are made for plants located in the USGC, Western Europe, and the Inland China
- Provides economics for the production of glycolic acid from formaldehyde and glucose (by fermentation), and their subsequent use in PGA
- The route to GPA from coal was also developed for Inland China



Commercial Overview

Glycolic acid finds use in cosmetics, personal care formulations, as a disinfectant, and in chemical synthesis. Additionally, glycolic acid is used as a monomer in the preparation of polyglycolic acid and other biocompatible copolymers (e.g., PLGA, PLG, or poly(lactic-co-glycolic acid).

Polyglycolic acid can be injection molded and can also be used to produce bi-axially oriented films and monofilaments. Applications for Kureha's commercialized PGA - Kuredux® - include shale gas extraction products, industrial films and components, filters, civil engineering and agricultural products, and beverage or toiletry bottles.

Demand for 2022 and capacity tables for glycolic acid and polyglycolic acid are also provided in this report.

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), 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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