Abstract

Process Economics Program Report 6E

ACRYLIC ACID FROM GLYCERIN

(December 2011)

Acrylic acid (AA) is a 4.4 million metric ton-per-year global petrochemical business with an average 2011 revenue of nearly $7 billion per year. AA is used primarily as a feedstock to produce water-soluble acrylate coatings for the paint industry, and to produce superabsorbent polymers (SAP) for the baby diaper industry. The dominant chemical company participants are Nippon Shokubai, BASF, Evonik and Dow Chemical.

Nearly all commercial quantities of AA are produced via the two-stage oxidation of propylene monomer in air. Nippon Shokubai is the dominant AA process technology and catalyst provider, while BASF utilizes its own proprietary AA technology, primarily for captive use.

Propylene feedstock cost is the largest single component of AA production costs. Since the propylene market price is closely tied to crude oil prices due to the use of crude oil derivatives—naphtha (via steam cracking) and vacuum gas oil (via fluid catalytic cracking)—as the feedstocks for making propylene, alternative feedstocks for making AA have been considered that may, in the long term, have fundamentally lower costs to acquire, and result in fundamentally lower costs to produce AA.

One such alternative feedstock for making AA is glycerin. Most commercial quantities of glycerin are produced as a by-product of converting natural oil triglycerides (palm oil, coconut oil, PKO, etc.) to commercial acids and alcohols via hydrogenation. Biodiesel production uses the same hydrogenation chemistry with feedstocks soybeans and rapeseeds, and has the potential to produce enormous quantities of glycerin (more than the conventional market can absorb), should biodiesel economics in the future become cost competitive with conventional diesel fuel from crude oil.

Due to the potential availability of large quantities of biodiesel-based glycerin (at presumably low costs), several companies are investigating the potential for producing commercial quantities of AA from glycerin. Two such efforts have been reported by Nippon Shokubai and Arkema.

This study presents Class-3 preliminary process engineering analysis, and the corresponding production economics, for producing AA from glycerin, and compares the results to comparable analysis of the conventional route to AA from propylene monomer, and from sugar fermentation through 3-hydroxypropionic acid as an intermediate product. The results allow the estimation of the production cost of AA as a function of the feedstock acquisition costs for glycerin versus propylene.

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