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Report 292
Bio-Based Succinic Acid

By Susan Bell

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Abstract

Succinic acid is a linear C_4 molecule with carboxylic acid groups on each terminal carbon atom. It has tremendous potential as a platform chemical for a number of industrial chemicals. It is currently used as an intermediate in the production of polyesters, alkyd resins, polyurethanes, plasticizers, 1,4-butanediol and solvents. The conventional process to produce succinic acid uses a petroleum-derived feedstock, which is both costly and environmentally unfriendly. In North America, the growing availability of inexpensive natural gas from shale has led to a shortage of C_4 chemicals as ethylene steam cracker operators have moved from crude-based feeds to natural gas-based ethane. Thus, there has been higher volatility in pricing and availability of C_4 petroleum-based feedstock and the value chains that depend on them, including succinic acid. Consequently, there has been a great deal of interest in producing C_4 and higher compounds such as succinic acid from renewable resources not only for the environmental benefits, but also to escape the economic volatility associated with petroleum-based feedstocks. A number of companies are commercializing the production of succinic acid from renewable resources via the fermentation of sugars, with the intent of making bio-based succinic acid a drop-in replacement for conventional succinic acid. Several relatively large-scale bio-based succinic acid production plants are currently being built.

In this PEP report, we present process designs and associated cost estimates for producing succinic acid using three bio-based processes, specifically processes based on patents and other publicly available literature associated with BioAmber, Myriant, and Reverdia. The designs presented in this report are for a base case capacity of 37.5 kta or 82.7 million lb/yr of succinic acid. Both Reverdia and BioAmber use genetically modified yeast to produce succinic acid, while Myriant technology is based on genetically modified bacteria. Process economics presented for these technologies include both capital costs as well as production costs, thereby enabling a direct comparison of the economics of these technologies.

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