Nexant Chem Systems

Chemical Strategies

Biobutanol: The Next Big Biofuel

To face the challenges of climbing petroleum demand (as new crude oil discoveries are not keeping pace, and are forecast to decline), and of climate change related to carbon dioxide emissions, interest grows in sustainable fuels made from organic matter. Production and use of bioethanol has grown dramatically in the U.S., Brazil, China, and elsewhere. Ethanol, however, has serious drawbacks and limitations that can be addressed by biobutanol, with physical chemical and thermal properties that make it much more like gasoline – higher energy density, lower water miscibility, and lower vapor pressure. Biobutanol is being commercialized, researched, or considered by many private and public entities globally. This study examines the potential approaches to its manufacture by biological or thermochemical/catalytic routes, and its manufacturing economics, global market fit and development, regulatory issues, and practical feasibility. It considers whether and how the new biofuel could fit into the ethanol and petroleum gasoline infrastructure, including by converting existing facilities and businesses to butanol.

Biobutanol appears to be a much better "drop-in" renewable gasoline substitute than ethanol. This already widely-used industrial chemical was initially made in an early version of the bacterial fermentation route being improved today.

Nexant's new *ChemSystems* study with Chemical Strategies is a timely assessment of biobutanol's potential. Although focused on sugar/starch fermentations in North America and Europe, other feeds and routes are modeled for costs of production compared to petroleum gasoline pricing, sensitivities to cost factors, and commercial prospects. This study should be of interest to companies considering market entry or expansion, acquisitions, partnering, or offering goods or services to the emerging biofuels sector, as well as to other stakeholder organizations.

REPORT OVERVIEW

The types of biobutanol routes that are considered in the study include:

- **Fermentation** of sugar substrates (directly available or made from starches or cellulosics) to biobutanol to blend with gasoline at various levels, including:
  - Improvements to a new strain, the **classic ABE (Acetone, Butanol, Ethanol)** route including using *Clostridium beijerinckii*, focused on recent improvements by Blaschek/Tetravitae and DuPont-BP commercialization plans
  - ButylFuel/EEI's **"Dual Immobilized Reactors with Continuous Recovery" (DIRCM™)** process, using two separate Clostridium strains
  - Other developments in the United States, France, the UK, China, Japan, and elsewhere
- Potential technology for **dehydrating bioethanol** to butanol by the Guerbet reaction using Japanese Sangi's hydroxyapatite (HAP) or other catalyst systems
- **Gasification of cellulosic biomass** to make syngas, to produce biobutanol catalytically

These are evaluated from technical, economic and commercial perspectives.

The report also considers regulatory and practical end-use issues.

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