



Biorenewable Insights: Butadiene

Butadiene is one in a series of reports published as part of NexantECA's 2019 Biorenewable Insights program.

Overview

Due to the trend of lightening cracker feedstocks, significant pressure is being put onto the C₄s markets. Tightness in the butadiene markets bodes well for the prospects of bio-butadiene commercialization; however generally high costs of production lead to non-competitive economics when compared to current market prices. When compared to the price high of the past ten years (2011, nearly three times the current price), these costs of production are highly competitive. Development in bio-butadiene is further hindered by the fact that butadiene development is generally a second priority to developers behind development of higher profile targets such as BDO and isobutylene, or development of the upstream bio-based chemical intermediate (e.g., butanol or succinic acid) has experienced operational or financial problems. Due to these related developments and unique juxtaposition of market forces, Nexant does not expect commercialization to be likely within the next three years; however, renewed interest post-2020 could still see these technologies commercially proliferate within the next 5 to 10 years.

Since the Coperbo and Lebedev processes were each fully commercialized in the past, and feed ethanol, which is the largest bio-based chemical produced in the world, whose cost of production has continued to trend down, and whose production from non-food sources appears to be rapidly commercializing, it would seem to be the lowest-risk alternative to pursue one of these for Biobutadiene. Both are about as attractive as any other alternative globally and are the most economically attractive in Asia. In a breakthrough, in September 2019, The BioButterfly™ partnership of Michelin, IFP Energies Nouvelles, and Axens announced that it was undertaking ethanol-to-butadiene validation with their process of the same name at 20 to 30 tons per year.

Technologies

Several technologies are profiled in this report:

- Direct Fermentation to butadiene as developed by
 - Genomatica
 - Global Bioenergies

- Fermentation to BDO, followed by dehydration to butadiene, as developed by
 - Genomatica and Scientific Design for sugars feedstock
 - LanzaTech and Invista for CO/syngas feedstock
- Ethanol Butadiene
 - The Lebedev process, a one-step conversion of ethanol to butadiene – as practiced in the former USSR
 - The Coperbo (AKA Ostermilinsky Reaction) a two-step conversion of ethanol to butadiene – as practiced in Brazil
- Processes with Feedstock Constraints
 - Fermentation to succinic acid, hydrogenation of succinic acid to BDO, dehydrated to butadiene, as above.
 - Fermentation to n-butanol, dehydration of butanol to butenes, and Oxidative Dehydration Process to produce butadiene.

Process Economics

Cost of production models for USGC, Brazil, Western Europe and China are shown for butadiene from:

- Direct Fermentation of Sugars
- Sugar to BDO to Butadiene
- Carbon Monoxide to BDO to Butadiene
- Ethanol to Butadiene:
 - Lebedev Process
 - Coperbo Process

Capacity

NexantECA has catalogued existing and planned renewable butadiene capacity and profiled projects.

For more information. please contact
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