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Bio-Based Monoethylene Glycol

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Abstract

This report presents process designs and economics for production of monoethylene glycol, MEG, from the biomass raw material corn kernels. Recent developments, background technologies, and catalyst synthesis chemistry are discussed in relation to process design.

Fast moving consumer goods companies such as Nestlé, PepsiCo, Unilever, and Coca-Cola have been under intense environmental pressure to address sustainability in their supply chains. The key issue is sustainable packaging. Sustainable feedstocks are created from renewable resources, which reduce both dependency on crude oil and emission of greenhouse gas. For packaging composed of polyethylene terephthalate (PET), made from terephthalic acid and MEG, interest in bio-based production has grown. Coca-Cola introduced PlantBottle™ packaging, using PET bottles made partially from plants, in 2009. Commercially available bio-based PET is produced from bio-based MEG, replacing 30% of the petroleum feedstock used to produce PET with renewable feedstock.

India Glycols (Uttar Pradesh, India) has operated the world's only commercial scale bio-based MEG plant since 1989. The process involves four chemical steps, and the product is much more expensive than conventionally produced, ethylene-based MEG. Factors most influencing the economics of bio-based MEG include the cost of processing biomass to obtain sugars, the relative prices of renewable feedstocks vs. ethylene, and the scale of production.

Recently, new bio-based MEG processes have been developed and claim lower production costs. The biotechnology company Avantium developed a one-step direct process, called the Avantium RAY Technology™, to produce bio-based MEG by catalytic hydrogenolysis of glucose. Haldor Topsøe developed a two-step process, using their MOSAIK™ platform, to produce MEG by pyrolysis of glucose followed by hydrogenation.

This report reviews the current industrial status and recent technical developments in bio-based technologies to produce MEG. Process economic evaluations of integrated MEG production plant using the current process, MEG production based on public disclosures related to Avantium's RAY technology, and MEG production based on public disclosures related to Haldor Topsøe's MOSAIK™ technology are presented.

The Bio-based MEG interactive iPEP module is included, enabling the user to compare economics for the different processes in multiple geographic regions.

While the processes presented herein represent the IHS Markit Process Economic Program's (PEP's) independent interpretation of the literature, and may not reflect in whole or in part the actual catalyst formulations and plant configurations, PEP believes the conceptual designs are sufficiently representative of materials and plant configurations used to enable Class III economic evaluations.

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