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Technology and Costs

TECH 2022-1: Ethylene Oxide/Ethylene Glycol

Ethylene Oxide/Ethylene Glycol is one in a series of reports published as part of NexantECA's 2022 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

Ethylene oxide (EO) can be used to produce several derivatives including ethanolamines and ethoxylates which are used in the surfactant and personal care industry. However, the main derivative of EO is monoethylene glycol (MEG), which in turn is used to produce PET for use in the fiber and resin (bottles and packaging) industries.

Typical commercial production of MEG is an integrated process, where ethylene is first oxidized to EO before hydrolysis to produce MEG, with higher glycols as byproducts. In 2008 Shell commercialized its OMEGA process which produces MEG with no byproducts. In the past decade there has been massive capacity increase with the introduction of a coal-based route in China using an oxalate intermediate. Recently a new coal-based process by JM Davy has been commercialized using methanol via formaldehyde.

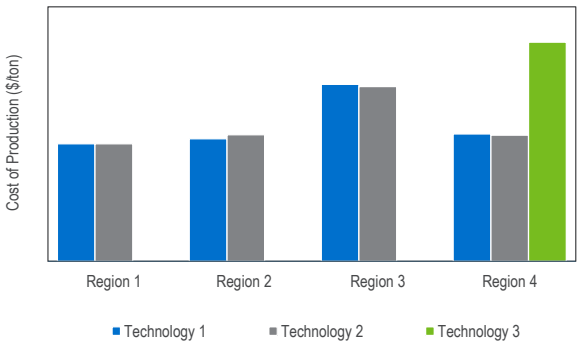
This TECH report provides an overview of the conventional and developing technological, economic, and market aspects of EO and MEG. The following are the issues addressed in this report:

- Recent developments in supply and demand and the business implications.
- Discussion on the potential impact of the introduction of the new JM Davy process on the MEG capacity landscape.
- Technology development of commercial routes, with a focus on catalyst developments of major licensors of EO production.
- Comparison of process economics for established commercial routes.
- Examination of developing renewable routes and discussion around carbon intensity and abatement mechanisms of current routes.

Process Economics

Detailed cost of production models are analyzed for established commercial technologies for ethylene oxide and ethylene glycol. These are evaluated in the main producing regions: USGC, Western Europe, Middle East and China, including sensitivity analyses on byproduct value, capital cost and raw material price.

MEG Production Costs



Sustainability

Multiple routes are available to produce bio-MEG, including the production of bio-ethylene which can then be used as a feedstock in the existing commercial process. The development of routes to bio-ethylene as well as direct routes to ethylene glycol from sugar, glycerine and biomass are explored.

The carbon intensity of commercial routes is also discussed, including an overview of process, utility and raw material emissions involved. Potential abatement mechanisms are considered, including use of the bio-MEG routes.

Commercial Overview

Global ethylene oxide consumption is estimated at 33.1 million tons in 2022, with stagnation expected after consistent growth in the last five years. Reduced MEG demand resulting from the COVID 19 pandemic had less impact on EO as low crude oil prices gave a major competitive advantage to EO/MEG producers over coal-based MEG producers.

MEG consumption is estimated to grow by 3.1 percent to 36.8 million tons in 2022 reflecting strong growth in PET demand following suppressed markets. Future demand and capacity expansions are expected to center around China with the expansion of the fiber industry in the region. As coal-based MEG capacity develops further EO producers will look to produce alternative derivatives alongside MEG.

Supply, demand and trade for both ethylene oxide and MEG across major global regions are provided in this report.

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Technology@NexantECA.com or www.NexantECA.com

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

NexantECA serves its clients from over 10 offices located throughout the Americas, Europe, the Middle East, Africa, and Asia.

Americas
Tel: +1 914 609 0300
44 S Broadway,
5th Floor White Plains
NY 10601-4425
USA

Europe, Middle East & Africa
Tel: +44 20 7950 1600
110 Cannon Street
London EC4N 6EU
United Kingdom

Asia Pacific
Tel: +662 793 4600
22nd Floor, Rasa Tower I
555 Phahonyothin Road
Kwaeng Chatuchak
Khet Chatuchak
Bangkok 10900
Thailand

For more information. please contact
Technology@NexantECA.com or www.NexantECA.com