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Technology and Costs

TECH 2020-5: Benzene/Toluene

Benzene-Toluene is one in a series of reports published as part of NexantECA's 2020 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

Benzene is an important chemical intermediate. Benzene is the largest and most diverse of all the aromatics. It is used to produce a wide range of materials, such as styrene, cumene/phenol, cyclohexane, and nitrobenzene. The majority of toluene is converted into mixed xylenes and benzene. The main chemical use is the production of TDI.

More than 60 percent of global benzene production is by extraction from either reformate or pygas, with an additional 10 percent extracted from coke oven light oil. An imbalance between demand and supply for the different aromatics is corrected through toluene conversion processes. An increasing amount of benzene is produced as a co-product of integrated aromatics complexes, which are designed for the production of *para*-xylene.

This TECH report provides an updated overview of the technological, economic, and market aspects for benzene, and to a lesser extent, toluene. The following issues are addressed in this report:

- What are the major technologies for benzene production and how do they differ? Which technologies are available for license?
- How do the process economics compare across processes and different geographic regions?
- What is the current market environment for benzene? How does its growth compare in different regions? Where will new capacity be added?

Commercial Technologies

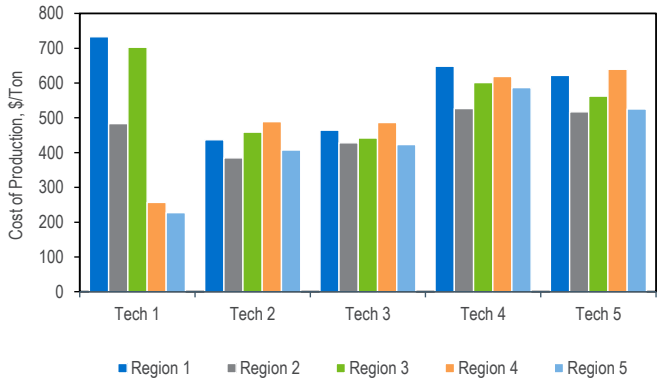
Benzene is extracted from reformate or pyrolysis gasoline in an aromatics complex by extractive distillation or liquid extraction. Benzene is produced in an aromatics complex by hydrodealkylation, toluene disproportionation, and transalkylation. Additional benzene is produced using non-conventional feedstocks such as natural gas, FCC off-gas, LPG, and gas oils.

Technologies developed by UOP, Axens, ExxonMobil, Lummus Technology, Sulzer GTC Technology, INVISTA Performance Technologies, ThyssenKrupp Industrial Solutions, and others are described and analyzed, with a focus on recent developments.

Process Economics

Detailed cost of production estimates for various commercial processes for reformate and benzene production are presented for USGC, coastal China, Middle East, Southeast Asia, and South Korea locations. Estimates are also developed for an integrated aromatics complex where *para*-xylene is the main product and benzene is a co-product.

Regional Cost of Production Comparison for Benzene Production



Commercial Overview

Global benzene consumption was 51.1 million tons in 2019. The largest derivative is the production of styrene, which accounts for almost 50 percent of global benzene consumption. Other major derivatives include cumene/phenol (20 percent), as well as cyclohexane and nitrobenzene (12 percent each). Demand growth of 2.5 percent per year through 2025 is expected, with growth driven by the Asia Pacific region. An overview of the supply, demand, and trade of benzene (and trade of toluene) on a global and regional (North America, Western Europe, and Asia Pacific) basis is provided in this TECH report, including demand by derivative and a capacity list for each region.

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- Chemistry
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- Process economics – comparative costs of production estimates for different technologies across various geographic regions
- Overview of product applications and markets for new as well as established products
- Regional supply and demand balances for product, including capacity tables of plants in each region
- Regulatory and environmental issues where relevant

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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.

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