



TECH 2020-4: Phenol/Acetone/Cumene

Phenol/Acetone/Cumene is one in a series of reports published as part of NexantECA's 2020 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

Cumene is used almost exclusively in the manufacture of phenol and co-product acetone. Phenol is used in a diverse array of end-uses. However, the market is being driven predominantly by the bisphenol A (BPA)/polycarbonate (PC) sector.

The commercial importance of phenol is such that research work on alternative processes continues to be developed. Much of this work is motivated by the desire to find a process that does not involve acetone co-production, and can compete economically with the conventional cumene to phenol process.

An alternative route that has received some attention in recent years involves the alkylation of benzene with cyclohexene to produce cyclohexylbenzene (CHB). Cyclohexylbenzene can then be oxidized, and subsequently undergoes cleavage in a similar manner to cumene hydroperoxide (CHP), except than when CHB is used, cyclohexanone is the coproduct.

This TECH report provides an updated overview of the technological, economic, and market aspects of cumene, phenol, and acetone. The following issues are addressed in this report:

- What are the main routes for cumene, phenol, and acetone production? Who are the major licensors?
- How do the economics of producing ammonia change across different geographic regions?
- Is an investment in phenol production attractive today?
- How does growth compare in different regions? Where will future capacity additions take place?

Commercial Technologies

Cumene is produced by the reaction of benzene with propylene in the presence of a zeolite catalyst. Licenses are available from Badger Licensing, Honeywell UOP, and Versalis/Lummus.

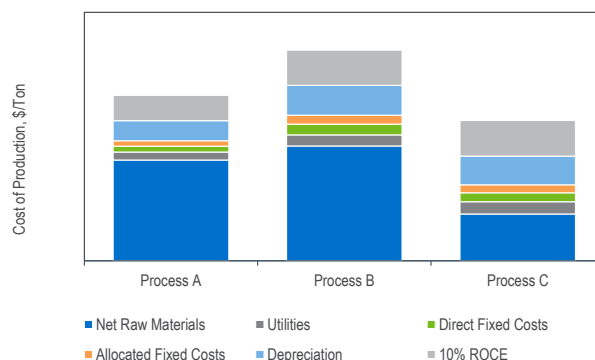
The cumene to phenol process involves two primary chemical steps, namely oxidation of cumene to CHP and acid catalyzed CHP cleavage to phenol and acetone.

All commercial production of phenol is via the commercial technology providers who market both the phenol and acetone products. Mitsui Chemicals used to recycle the co-produced acetone back into the process at one of its plant (in Chiba, Japan). However, the plant ceased operations in 2014. Licenses are available from Honeywell UOP, KBR, Mitsui Chemicals, and Versalis/Lummus.

Process Economics

Detailed cost of production estimates for phenol technologies are presented for USGC, Western Europe, China, Japan, and Southeast Asia locations. Estimates are developed for conventional and Mitsui commercial routes to phenol. Economics for the alternative production of phenol (and cyclohexanone coproduct) via the hydroalkylation of benzene were also developed. Sensitivity analyses on feed pricing, economy of scale, and capital investment were also developed. An assessment on investment attractiveness and a historical analysis of phenol cash cost production are also included in this report.

Phenol Production Costs



Market Overview

Global cumene demand was 15.1 million tons in 2019, while global phenol demand was 11.1 million tons in the same year. Phenol demand is expected to grow at around 2 percent annually until 2025.

Global acetone demand was 7.2 million tons in 2019. Major applications for acetone include solvents (direct application), MMA, and BPA, collectively accounting for approximately 85 percent of total acetone demand.



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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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