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Review 2014-08
Ethylbenzene by Badger EBMax℠ Liquid Phase Alkylation Process

By Mike Kelly

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Abstract

Commercial production of ethylbenzene was dominated by liquid-phase aluminum chloride catalyzed processes until the early 1980s when the first vapor-phase zeolite-based process was introduced. The zeolite vapor-phase technology subsequently achieved much commercial success as it proved more efficient and avoided the difficulty of handling aluminum chloride. However, vapor-phase processes operate at high temperatures and produce considerable by-products. While improvements were made over the years, it was not until the arrival of liquid-phase processes in the early 1990s that zeolite-based technologies could produce a high-purity ethylbenzene product.

This review presents a techno-economic evaluation of zeolite-based ethylbenzene production via the Badger EBMax^{SM} liquid-phase alkylation process. The analysis that follows is based on a plant with an annual capacity to produce 1,150 million pounds of ethylbenzene. In the process, polymer grade ethylene is reacted with benzene that is in stoichiometric excess under liquid-phase conditions in a fixed-bed, five stage alkylation reactor. Ethylene conversion is essentially complete, with selectivity to ethylbenzene in the alkylation reaction at over 90%. Unreacted benzene is separated and recycled back to the reaction section. Ethylbenzene product is recovered from polyethylbenzenes, the latter of which is fed to a single fixed-bed transalkylation reactor and converted into additional ethylbenzene product by reacting with excess benzene. The molar yield of ethylbenzene for the overall process exceeds 99.5% relative to both ethylene and benzene.

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