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Report 35F

On-Purpose Butadiene Production II

By Richard Nielsen

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Abstract

Currently, 1,3-butadiene is almost entirely produced as a by-product from the ethylene steam cracking of naphtha or gas oil feedstocks. A switch to lighter feedstocks has reduced the amount of butadiene available from ethylene cracking. Foreseeable market demand for on-purpose butadiene will increase as ethane for cracking is exported from the United States. The small amount of butadiene produced during steam cracking of light feedstocks is not economically recoverable.

The demand for 1,3 butadiene continues to grow, driven primarily by the development of demand in the emerging markets, especially for motor vehicle tires. As a result of the decline in supply and the growth trend in demand, the price of butadiene more than doubled in 2008, and again in 2011, but has been volatile since, dropping to a range about one-third to one-fourth the 2012 peak price. These supply and price conditions have renewed interest in on-purpose butadiene production.

PEP Report 35E (2012) presented the process economics for two commercially successful processes: n-butane dehydrogenation based on the Lummus Catadiene® process, and mixed butenes oxidative dehydrogenation based on the TPC Oxo-D™ process. We also presented process economics for our version of the American Process, developed by Carbide and Carbon Chemicals Corporation in the 1940s, which converts ethanol to butadiene. Purification of the crude butadiene product by NMP extraction was covered as a separate process.

In PEP Report 35F, we concentrate on new processes. We first review proven or potential technologies for producing 1,3-butadiene. Since 2011, emphasis has been on developments for dehydrogenation of n-butane or mixed butenes feedstocks. Based on our concept of the processes from patent information, process economics are then developed for producing 100,000 mt/year of 1,3-butadiene by two new oxidative dehydrogenation processes, processes that react linear butenes to crude butadiene products. The first process is a low energy intense process disclosed by TPC. The second process uses a dual catalyst system disclosed by SK Energy, but with a conventional oxidative dehydrogenation flowsheet used in PEP Report 35E.

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