ON-PURPOSE BUTADIENE PRODUCTION

By

Richard Nielsen

with a Contribution by Russell Heinen

(June 2011)

ABSTRACT

1,3-Butadiene is currently almost entirely produced as a by-product of ethylene steam cracking of naphtha or gas oil feedstocks. Some butadiene is recovered from olefinic refinery gases, mainly from the fluid catalytic cracker. Butadiene is recovered in the ethylene cracker in the crude C_4 fraction. The production of butadiene is dependent upon the feedstock cracked, operating rate and severity of cracking. In high severity naphtha cracking, the C_4 fraction is about 9 wt% of the cracked products and contains 45–50 wt% butadiene. The small amount produced by cracking light feedstocks is not economically recoverable and these units usually do not have butadiene extraction equipment.

A switch to lighter feedstocks has reduced the amount of butadiene available from ethylene cracking and presented a foreseeable market demand for on-purpose butadiene. In 2012, at least two butadiene plants are expected to start up in India with 11 more projects scheduled to start-up in the next five years.

As our primary objective, we extensively reviewed proven or potential technologies for producing 1,3-butadiene, whether commercial or in the research or development stage, with emphasis on developments since 1990. Today, there is interest in producing butadiene from renewable resources such as ethanol, which was a major feedstock before the development and commercialization of petroleum-based processes, mainly during World War II. Since catalysis is a very major contributor to the successful production of butadiene, the catalyst literature is reviewed.

The two main processes, the Houdry Catadiene process and the Texas Petrochemical Corporation Oxo-D process, are described and discussed in greater detail. These two processes have demonstrated the most commercial success historically. Process economics for producing 100,000 mt/year of 1,3-butadiene from n-butane via these two processes, combined with extractive distillation purification, are updated based on PEP Reports 35A1 and 35B plus PEP Review 2002-12.
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