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Iso-C_4 Processes

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Abstract

An oversupply of n-butane is anticipated in North America due to three primary trends: (1) increased natural gas liquids (NGL) production, (2) a lower percentage of n-butane being blended into gasoline, and (3) displacement of n-butane by ethane as steam cracking feedstock for ethylene production. Direct blending of butanes and butylenes into gasoline is limited by vapor pressure and olefin specifications. The surge in production of NGL from tight (shale) oil and gas formations due to the rapid growth of fracking technology for oil and gas production is producing considerably more associated ethane as well as butane. Where possible in North America, inexpensive ethane is already displacing n-butane and naphtha from the feedstock slate of existing ethylene steam crackers. New ethane cracking capacity is planned. US exports of ethane to Western Europe are starting to impact steam cracking there, too. Steam cracking ethane produces only a small amount of butylenes compared to cracking butanes and heavier feedstocks. Although tight oil production may well decline over the next one to two years or so, production is forecasted to then resume increasing.

These trends provide incentives to convert butanes (and n-butenes), mostly consumed indirectly or directly as fuel components, to more valuable products such as iso-C_4s (isobutane and isobutylene) that are intermediates for producing gasoline blending stocks and chemicals. n-Butane is isomerized to isobutane in petroleum refineries when additional isobutane is needed for alkylation. Isobutene is a polymerization feedstock for butyl rubber and polybutenes. It is also a feedstock for methyl tert-butyl ether (MTBE), ethyl tert-butyl ether (ETBE), isoprene, methacrylic acid, methacrylonitrile, and t-butyl alcohol.

In this PEP Report, we first review the developments in three processes producing on-purpose iso-C_4s—isomerization of n-butane to isobutane, dehydrogenation of isobutane to isobutylene, and isomerization of n-butenes to isobutylene. Process economics are then developed for producing iso-C_4s based on three successful commercial processes—the Butamer™ process for n-butane isomerization, the Catofin® isobutane dehydrogenation process, and the ISOMPLUS® n-butenes skeletal isomerization process.

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