

Comonomer Production Technology – 1-Butene



Overview

Lummus Technology's Comonomer Production Technology (CPT) maximizes production of comonomer grade 1-butene from raffinate streams. In the CPT process, 2-butene contained in the butene feedstock is isomerized to 1-butene, thus increasing 1-butene production. The 1-butene from isomerization together with the 1-butene contained in the feed are then recovered by fractionation to produce 1-butene product.

The CPT process for 1-butene production is based on isomerization technology, first developed for propylene production in the Olefins Conversion Technology (OCT). In the OCT process, isomerization and metathesis are combined; in the CPT process, the metathesis function of the catalyst is removed, leaving only the isomerization of 2-butene to 1-butene.

1-Butene production is not limited by 1-butene content of the feed, therefore CPT can use low value C₄ feedstocks, including raffinate-2 from processes such as MTBE, TBA production, or isobutene recovery. Economic recovery of such raffinates, where butadiene has already been removed, is possible since the 2-butene content can be converted to 1-butene. For typical cracker-based raffinates, this means 50% or more 1-butene can be recovered compared to distillation alone.

Using a proven isomerization catalyst combined with an energy-efficient heat pump system, 1-butene comonomer is economically produced from even low-value raffinates. CPT does not consume valuable ethylene as do competing dimerization processes, and it uses environmentally friendly catalyst.

Advantages

Process Features	Process Benefits
Isomerization reaction system	Uses low-cost C ₄ feed rather than high-cost ethylene. Raffinates containing a low amount of 1-butene relative to 2-butene can be economically processed to produce more 1-butene; 1-butene product rate is no longer limited by 1-butene content of the feed.
No byproduct production	The catalyst functionality is strictly limited to isomerization only – no other reactions occur. Raffinate from CPT consists of unconverted 2-butene plus any butane present in the feed. The raffinate can easily be recycled to a cracker and is free of any impurities.
Solid fixed-bed catalyst	CPT uses a proven solid catalyst system. The catalyst has long life and no make-up or addition of catalyst is required. Catalyst is non-hazardous and is regenerated in-situ to maintain conversion throughout its life.
Vapor phase reaction system	CPT reactions are vapor phase. The catalyst is fixed on the catalyst bed support media and does not leave with the reactor effluent so no fouling of downstream equipment or the reactors is experienced. No cleaning or maintenance operations are required.
Environmentally friendly catalyst	CPT fixed-bed catalyst is non-toxic, environmentally inert and easily disposed of after hydrocarbon decontamination.

Performance Characteristics

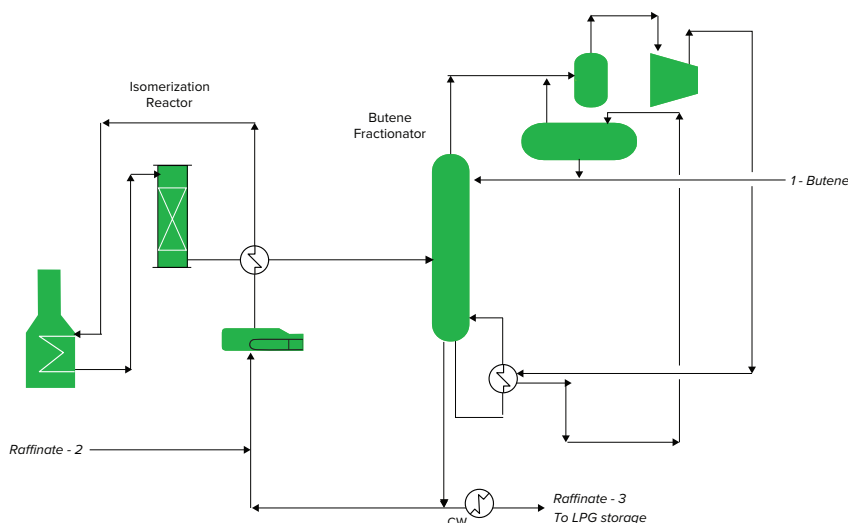
PRODUCT QUALITY

Appearance Clear, Colorless, Transparent

1-butene	99 wt % min.
Other butenes content	1 wt % max.
Butanes	1 wt % max.
Butadiene and Propadiene	200 ppm wt max.
Total Acetylenes	10 ppm volume max.
Carbon Monoxide	1 ppm volume max.
Carbon Dioxide	1 ppm volume max.
Oxygen	1 ppm volume max.
Water	20 ppm volume max.
Total sulphur	1 ppm wt max.
Carbonyl as Acetone	5 ppm volume max.
Alcohol as Methanol	1 ppm mol max.
MTBE	1 ppm mol max.

The process can handle a wide range of 1- and 2-butene concentrations in the raffinate feedstock. Production of 1-butene is maximized by converting 2-butene to 1-butene.

Process Flow Diagram



Process Description

The CPT process for 1-butene production has two sections: butene isomerization and butene fractionation. In the Butene Isomerization section, raffinate-2 feed from OSBL is mixed with butene recycle from the Butene Fractionation section and vaporized. The combined vapor stream is preheated and fed to the Butene Isomerization Reactor, where 2-butene is isomerized to 1-butene over a fixed bed of proprietary isomerization catalyst. The reaction is driven by equilibrium so the reactor effluent contains both 1-butene and 2-butene. Reactor effluent is cooled, condensed, and sent to the Butene Fractionation section.

In the Butene Fractionation section, reactor effluent is separated into 1-butene product and recycle

2-butene in a Butene Fractionator. The 1-butene product is recovered overhead and the bottoms contains recycle 2-butene and butane. The column uses a heat-pump system to efficiently separate 1-butene from 2-butene and butane with no external heat input. A portion of the bottoms is withdrawn as raffinate-3 to maintain butane concentration in the feed before the remaining bottoms is recycled to the isomerization reactor.

Lummus Technology offers a number of options for upstream processing of C₄ feed including Selective C₄ Hydrogenation, MTBE Production, or Isobutene/Isobutane removal so that raw C₄s, raffinate-1, or raffinate-2 can be processed to make 1-butene.

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