

Comonomer Production Technology – 1-Butene

Overview

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

The CPT process for 1-butene production is based on isomerization technology first developed for the olefins conversion technology (OCT) for propylene production. In the OCT process isomerization and metathesis are combined. In the CPT process, the metathesis catalyst function is removed leaving only the isomerization function for isomerization of 2-butene to 1-butene. CPT can use low value C₄

feedstocks (raffinate-2 from MTBE, TBA production or from isobutene recovery). CPT makes economical recovery of more 1-butene possible from such raffinates where butadiene has already been removed, since 2-butene content can be converted to 1-butene. For typical cracker-based raffinates this means 50 percent or more 1-butene can be recovered compared with distillation alone.

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

Advantages

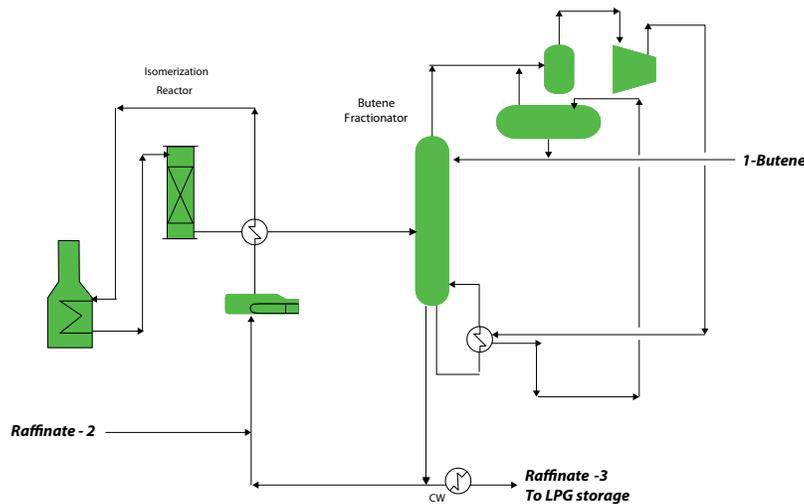
Process Features	Process Benefits
Isomerization reaction system	Uses low-cost C ₄ feed rather than high-cost ethylene. Raffinates containing a low amount of 1-butene relative to 2-butene can be economically processed to produce more 1-butene; 1-butene product rate is no longer limited by 1-butene content of the feed.
No byproduct production	The catalyst provides isomerization functionality only - no heavy byproducts or oligomers are produced.
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	The catalyst is contained in the fixed-bed reactor 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.

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 is vaporized, preheated and then 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 equilibrium limited, so the reactor effluent contains both 1-butene and 2-butene. Reactor effluent is then cooled and condensed and flows to the butene fractionation section.

In the butene fractionation section, isomerization reactor effluent is separated into 1-butene product and recycle 2-butene in a butene fractionator. The 1-butene

product is separated overhead and recycle 2-butene and butane contained in the feed are produced from the bottom. 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 purged to remove the butane in the feed together with some 2-butene before it is recycled to the isomerization reactor.

Lummus Technology can also provide 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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