Olefins Conversion Technology

Overview

Lummus Technology's Olefins Conversion Technology (OCT) is used as an on-purpose polymer-grade propylene production technology. The key reaction components for this metathesis technology are ethylene, normal butenes and/or normal/iso pentenes.

This technology can be used with a variety of C_4 streams including the mixed C_4s produced in steam cracking, raffinate C_4s from MTBE or butadiene extraction and C_4s produced in FCC units.

In addition, C_5 feeds from refinery or cracker source can be utilized to give a further boost to propylene production from an Olefins Conversion Unit.

Advantages

Process Features	Process Benefits
Converts pyrolysis C_4s to propylene	Greatly improves C_4 processing economics
Converts C_5s from pyrolysis gasoline or refinery C_5s to propylene	Provides further boost to propylene production and improves C_4/C_5 processing economics
High conversion and selectivity at moderate operating conditions	Lowest capital investment for incremental propylene production. Improves cracker economics
The OCT can be integrated with a steam cracker	Permits an increase in propylene-to-ethylene production ratio to above 1.0, a 50% increase
The OCT can be integrated with a fluid catalytic cracker (FCC)	Ethylene and butylene produced in the FCC are upgraded to propylene, improving FCC operating economics
Nearly "energy neutral" metathesis reaction	Environmentally friendly with low emissions and "greenhouse" gases
Easier propylene purification	Reduced capital investment since superfractionator not required
Has a fixed bed catalyst system with *in situ* regeneration	Simple reactor operation
Highly flexible propylene production	Allows owner ability to optimize the product ratio when prices change
Capability to operate in reverse mode	Sustains operating income for client under volatile market conditions

Performance Characteristics

The OCT process can handle a wide range of feedstock compositions, making the unit flexible to take advantage of many lower-value feedstocks. The ethylene stream can vary from dilute ethylene, typically from an FCC, to polymer-grade ethylene. The C_4 stream has similar flexibility because butanes pass through the system as inerts. Raw pyrolysis gasoline from an ethylene plant or C_5s from a refinery after pre-treatment can be directly processed in the Olefins Conversion Unit.

Another important characteristic of the process is product purification: the system does not require the superfractionator usually associated with propylene purification. Both C_2 and C_4 feeds generally have only minor quantities of propane, and since the reaction system does not generate any propane, propane/propylene separation is not required.

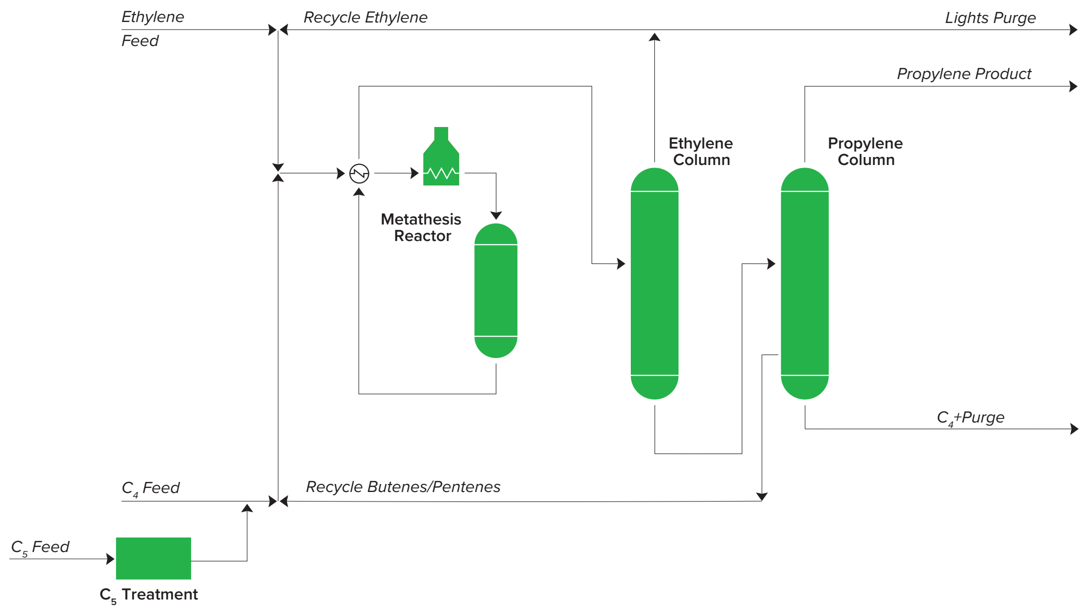
The propylene produced contains only the propane contained in the ethylene or C_4 feed. This means

Performance Characteristics *(cont.)*

that the propylene purity usually exceeds the polymer-grade level produced by the majority of steam crackers, without any superfractionators. Ultra high purity propylene has benefits in reducing the comonomer requirement in a polymer plant.

When integrated with a grassroots steam cracker, the by-product flexibility of the cracker is greatly enhanced. With high propylene value and demand, the OCT unit can be operated to increase the propylene-to-ethylene ratio to above 1.0. Importing an external C_4 and C_5 stream can further increase the ratio. Should propylene value fall, the steam cracker is able to produce as much as 115% of its nameplate ethylene capacity while exporting either a mixed C_4 stream or a C_4 stream where the butadiene has been hydrogenated to butenes. Operation can thereby be optimized depending on the relative values of ethylene, propylene, butene, mixed C_4s and C_5s. This product flexibility ensures profitable operation as by-product values shift over the 30+ year life-cycle of the facility.

Process Flow Diagram



Process Description

Ethylene feed plus recycle ethylene are mixed with the C_4/C_5 feed plus butenes/pentenes recycle and heated prior to entering the fixed-bed metathesis reactor. The catalyst promotes the reaction of ethylene and butene-2 to form propylene, ethylene and pentenes to propylene and butenes, and simultaneously isomerizes butene-1 to butene-2. A small amount of coke is formed on the catalyst, so the beds are periodically regenerated using nitrogen-diluted air. The process is designed for high olefin utilization, typically in the range of 90 to 97 % and propylene selectivity of about 94 to 95%.

The reactor product is cooled and fractionated to remove ethylene for recycle. A small portion of this recycle stream is purged to remove methane, ethane, and other light impurities from the process.

The ethylene column bottoms is fed to the propylene column where butenes/pentenes are separated for recycle to the reactor and some is purged to remove unreacted butenes, isobutenes, butanes, unreacted pentenes, isopentenes, pentanes and heavies from the process. The propylene column overhead is high-purity, polymer-grade propylene product.

This process description is for a stand-alone OCT unit complex. The utility requirements—which include cooling water, steam, electricity, fuel gas, nitrogen, and air—are typically integrated with the existing complex.

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