

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 C₄ streams including the mixed C₄s produced in steam

cracking, raffinate C₄s from MTBE or butadiene extraction and C₄s produced in FCC units.

In addition, C₅ 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 ₄ s to propylene | Greatly improves C ₄ processing economics |
| Converts C ₅ s from pyrolysis gasoline or refinery C ₅ s 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 |
| 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 <i>in situ</i> regeneration | Simple operating cycle |
| Highly flexible • Can operate from nameplate to zero propylene production | Allows owner ability to optimize the product ratio when prices change |

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, typical from an FCC, to polymer-grade ethylene. The C₄ stream has similar flexibility because butanes pass through the system as inerts. Raw pyrolysis gasoline from ethylene plant or C₅s from refinery after pre-treatment can be directly processed in 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 C₂ and C₄ 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 C₄ feed. This means that the propylene purity usually exceeds the polymer-grade level produced by the majority of steam crackers, without any superfractionators.

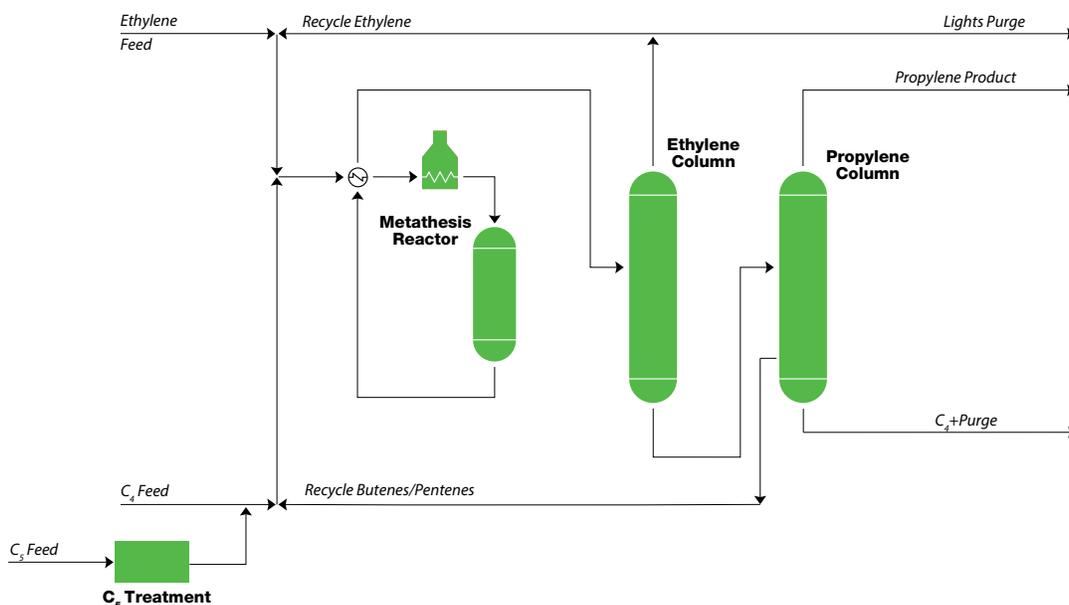
When integrated with a grassroots steam cracker, the by-product flexibility of the cracker is greatly enhanced. With high propylene value and demand, the OCT unit can be operated to increase the propylene-to-ethylene

Performance Characteristics
cont

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_4 s and C_5 s. 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 ethylene-to-olefins feed ratio to the reactor is optimized to maintain high olefin conversion in the range of 60 to 80% and propylene selectivity greater than 92%.

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 that can be added onto any refining/petrochemical 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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