Ethylene

Overview

Lummus Technology's proprietary ethylene process is the most widely applied process for the production of polymer-grade ethylene and propylene. The process is noted for its performance, including high product yield; energy efficiency; low investment cost; and operating reliability. Plant owners have selected this technology for more than 200 projects, accounting for about 45% of worldwide ethylene capacity. Lummus Technology's experience encompasses plants designed for ethylene capacities up to 1,800,000 MTA, and feedstocks from ethane through gasoils.

The high capacity SRT® pyrolysis furnace module is designed for short residence time and low pressure drop. The latest-generation SRT VII cracking coil provides maximum performance for all feedstocks and results in an easy-to-operate and robust mechanical design. The patented, close-coupled, single stage Quick Quencher transfer line exchanger (TLE) offers significant operating and cost advantages over competing designs.

The energy-efficient olefins recovery system minimizes capital investment by reducing the number of compressor casings by 40% and eliminating up to 25% of the equipment pieces used in a conventional system. Its key features are a low pressure chilling train that operates at less than half the operating pressure of a conventional flow scheme, and the enhanced binary refrigeration system that produces refrigeration from 40°C to - 140°C in a single refrigeration system. The lower piece count also reduces maintenance costs and improves reliability.

The CDHydro® process, which combines reaction and distillation in a single vessel, can be used for the combined acetylene/diene hydrogenation of the C_2 through C_5 fraction in plants that do not recover butadiene. This combines all hydrogenation systems and can remove up to 35% of the pyrolysis hydrogen by chemical reaction instead of by cryogenic separation, thereby reducing energy consumption.

Lummus Technology's design approach emphasizes reliability, ease of operation, and broad feed flexibility at competitive costs. All plants meet designed capacity and exceed guaranteed performance. Average onstream time is above 98%, except in turnaround years where it is above 96%.

Advantages

Process Features	Process Benefits
SRT pyrolysis module (capacities over 300 kta of ethylene)	High olefins yields • High thermal efficiency • Long run-length • Reliable operation • Low investment • Feed flexibility • Site Specific Optimization
Gas turbine integration	Energy efficiency
Quick Quencher TLE	Low pressure drop and residence time result in minimum yield degradation • Lower cost
TLE decoking technology	Less maintenance • Longer tube life • Reduced emissions
Heavy Oil Processing System (HOPS)	Ability to crack crude & heavy natural gas liquids • Eliminate feed contaminants • Low investment
Low pressure chilling train	Energy efficient • Low investment • High reliability • Reduced maintenance
CDHydro process for acetylene/-diene hydrogenation	High selectivity • Low cost • Operating ease • Minimizes green oil production • Lower energy consumption
Enhanced Binary refrigeration	Mixed refrigeration system lowers investment • Simpler to maintain • Higher reliability
Integration with energy-neutral metathesis processes	Provides product flexibility • Upgrades lower-value olefins to higher-value olefins

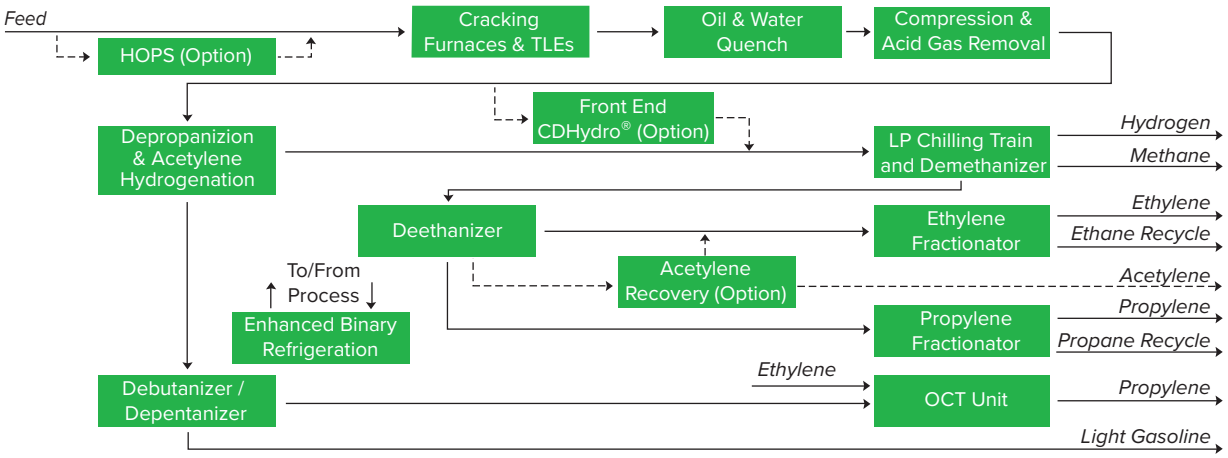
Metathesis Process Integration

Integrating the ethylene plant with Lummus Technology's Olefins Conversion Technology (OCT) process, which reacts the cracker C_4 s & C_5s with ethylene to produce propylene, further improves operating margins. If used to produce the same quantity of propylene as a conventional ethylene plant, the integrated unit produces up to 40% more benzene, reduces non-aromatic pyrolysis gasoline up to 60%, drops energy consumption by 13%, and reduces capital investment by 6%. Alternatively, it can be used to increase the propylene-to-ethylene product ratio from a typical maximum of 0.65 to as high as 1.1 and above.

Utilizing Lummus Technology's Ethylene Dimerization Technology and OCT, ethane crackers can become major propylene producers and heavier-feed plants can produce any desired propylene-to-ethylene product ratio.

Lummus Technology's Comonomer Production Technology (CPT) can produce comonomer-grade butene-1 and hexene-1 from the cracker C_4s. Using isomerization and metathesis chemistry, CPT produces these highly valued products from lower valued C_4s rather than from polymer-grade ethylene. Ethylene and propylene are co-produced.

Process Flow Diagram



Process Description

Feedstock to the ethylene plant can be ethane, propane, butane, naphtha, kerosene, diesel, gasoils or hydrocracked vacuum gasoils. Fresh feed and recycled ethane and propane are thermally cracked in the presence of steam in a bank of pyrolysis furnaces. The olefin-bearing effluent gas is quenched progressively by generating steam, and through direct contact with oil and/or water. The effluent is compressed in a three-stage centrifugal compressor, acid gases are removed by amine solution and/or caustic soda, and then the gases are dried over a molecular sieve.

Product recovery takes place under cryogenic conditions in refrigerated fractionation systems. Acetylene compounds are hydrogenated in catalyst systems, and hydrogen is purified via PSA or methanation. Methane offgas is recovered and used as plant fuel.

Polymer-grade ethylene and propylene are produced by super-fractionation towers that are highly integrated to reduce energy consumption. Mixed C_4 product and pyrolysis gasoline are also co-produced and recovered. The C_4s can be utilized as feed to an OCT or CPT unit to produce propylene, butene-1 or hexene-1.

A single mixed refrigeration system supplies all the refrigeration requirements. Utilities required for the process – steam, cooling water, and fuel – are fully integrated to improve overall efficiency.

A gas turbine generator can also be integrated with the pyrolysis furnaces to produce electrical power and additional super-high-pressure steam. The hot exhaust gases from the turbine are sent to the furnaces to provide hot combustion air. This approach lowers the specific energy consumption for the ethylene plant by up to 25%.

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