Fluid Catalytic Cracking

MCDERMOTT TECHNOLOGY

Overview

Lummus Technology's Fluid Catalytic Cracking (FCC) process is a proven state-of-the-art technology used to convert gasoils and resids to lighter, higher-value products. Combining an advanced reaction system design with an efficient catalyst regeneration system, the process achieves high conversion and selectivity to light products, allowing refiners to meet the most rigorous challenges of producing today's clean fuels and petrochemicals.

It all started with extensive process development and commercialization by Texaco and continues with the improvements made by Lummus Technology since acquiring the technology over a decade ago. The process converts a wide range of feedstocks, from hydrotreated and unhydrotreated gasoils to resids. While it can be used to maximize the production of gasoline, the flexibility of the process allows conversion and selectivity to vary from maximum distillate production at one extreme, to maximum propylene production at the other. This FCC technology can be applied fully in grassroots units or partially, as applicable, in the revamp of existing units.

Advantages

Process Features	**Process Benefits**
Micro-Jet™ feed injectors	Uniformly contact feed with catalyst, maximizing catalytic cracking (i.e., high liquid yields and selectivity) • Minimal erosion and catalyst attrition • Minimal thermal cracking (i.e., less dry gas and coke) • Low pressure drop
Short contact time riser reactor	Minimal back-mixing and less erosion • Efficient catalyst/oil contacting • Reduced hydrogen transfer • High yield selectivity
Patented direct-coupled cyclones at the end of the riser reactor for quick and efficient recovery of product vapors	Minimal after-cracking • Low dry gas yield and delta coke • High liquid and light olefin yields retained • Minimal hydrocarbon loading in the stripper
ModGrid™ catalyst stripper design	Highly efficient removal/recovery of hydrocarbon product vapors from the catalyst • Reduced delta coke • Low stripping steam requirement • High catalyst mass flux/lower stripper vessel size
Dual diameter catalyst regenerator and turbulent bed combustion	Low carbon on regenerated catalyst • Minimal catalyst deactivation • Efficient use of combustion air • Reduced after-burning and NOx emissions
Regenerated catalyst standpipe with external hopper	Smooth, stable catalyst flow over a wide operating range • Insensitive to unit upsets • Low erosion/ catalyst attrition
Spent catalyst square-bend transfer line and distribution of spent catalyst into the center of the regenerator	Improved catalyst regeneration • Improved slide valve pressure differentials • Lower catalyst hydrothermal deactivation • Stable spent catalyst flow • Lower capital and operating cost
Simple side-by-side reactor/regenerator layout	Low capital and operating cost • High mechanical reliability • Less downtime • Longer run-lengths • Lower maintenance costs • Safer operation

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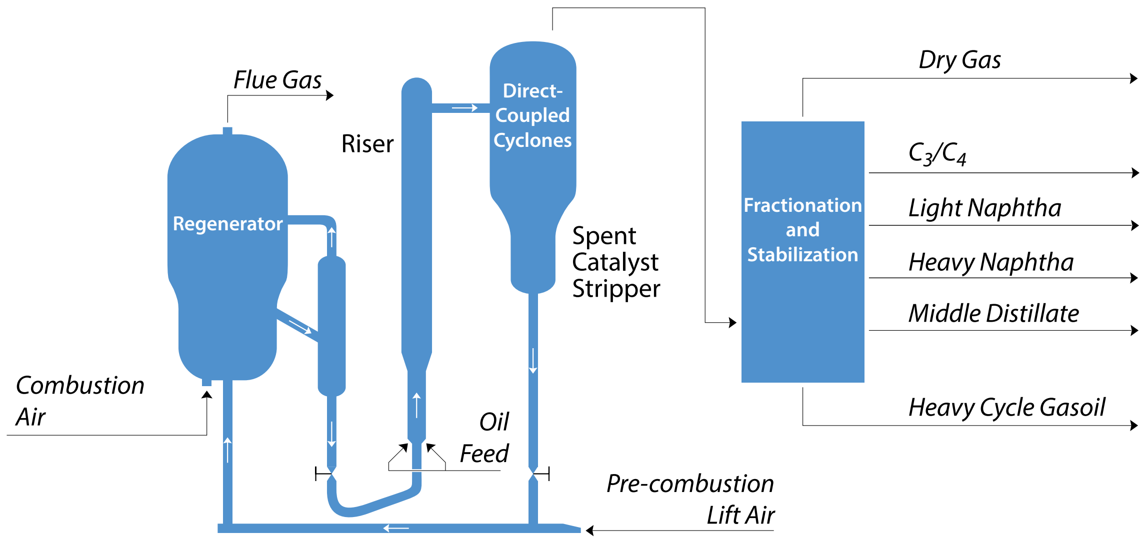
Process Flow Diagram



Process Description

The FCC process operates in a dynamic heat balance with hot regenerated catalyst supplying the net heat demand required by the reaction system. Finely sized solid catalyst continuously circulates in a closed loop between the reaction system and the catalyst regeneration system. The feed and catalyst are intimately contacted in the riser reactor, in the proper ratio and with the proper residence time and temperature to achieve the desired level of conversion. The reaction products are disengaged from the spent catalyst using a patented riser/reaction termination device. The catalyst passes through a highly efficient, patented, spent catalyst stripper where any hydrocarbon product vapors entrained with the catalyst are removed and recovered. The regeneration system restores catalytic activity of the coke-laden spent catalyst by combustion with air. It also provides heat of reaction and heat of feed vaporization by returning hot, freshly regenerated catalyst back to the reaction system.

Hot regenerated catalyst flows to the base of the reaction system riser where it is contacted with feed supplied through feed injectors. Vaporized feed and catalyst travel up the riser where catalytic reactions occur. The reacted vapor is rapidly disengaged from the spent catalyst in direct-coupled riser cyclones and routed directly to product fractionation, minimizing time for non-selective, post-riser cracking. Reactor vapors are quenched and fractionated in the product recovery system, which yields dry gas, LPG, naphtha, and middle distillate products.

The spent catalyst separated by the riser cyclones is degassed of most of the reaction vapor while flowing via diplegs into the catalyst stripper. In the stripper, hydrocarbons are effectively removed from the catalyst by efficient contacting with steam.

The spent catalyst is transported from the stripper into the regenerator using a proprietary square-bend transfer line. The hydrogen-rich portion of the coke deposits reacts with the lift air at a lower combustion temperature relative to the regenerator dense bed temperature, which reduces catalyst hydrothermal deactivation. The carbon-rich portion of the coke deposits is burned off in the turbulent dense phase of the regenerator. Regeneration flue gasses are first routed through cyclones to minimize catalyst losses and then sent to energy recovery and environmental treatment before being ejected from the stack.

Hot regenerated catalyst overflows into an external catalyst hopper where it is aerated to the proper density before flowing back to the base of the riser.

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