Lummus Technology
a CB&I company

RDS/VRDS/OCR/UFR

Overview

Chevron Lummus Global* licenses a family of residuum conversion technologies and catalysts that help refiners optimize product quality, product yield, run length, capital investment, and operating cost.

Fixed-bed residuum desulfurization technologies – RDS for atmospheric residuum and VRDS for vacuum residuum – provide a short, economical process path to higher-value products from difficult feeds. These hydrogen-efficient processes sufficiently saturate products so that further processing in conversion units is greatly enhanced, ultimately producing more and higher-value light products. For example, by pretreating Residuum Fluid Catalytic Cracking (RFCC) feed in an RDS/VRDS reactor, refiners have more flexibility to choose less expensive crudes or process more residuum, while achieving higher product yields and higher RFCC on-stream performance.

Adding an Onstream Catalyst Replacement (OCR) unit enables refiners to significantly increase capacity or improve product quality from the RDS unit. This countercurrent, moving-bed reactor can be integrated into the typical RDS reactor circuit. With the ability to replace spent catalyst on-line, compared to a standard RDS unit, refiners can increase feed throughput, process heavier feeds with higher levels of contaminant metals, or achieve deeper desulfurization when processing low-metal feeds. With the OCR addition, refiners can increase cycle lengths considerably as the life of the downstream unit's catalyst is improved substantially. In either retrofit or grassroots installations, the investment cost for an OCR reactor and catalyst transfer equipment is more than offset by the savings realized in crude cost and in improved catalyst efficiency.

An effective, minimum-cost revamp alternative is the installation of an Upflow Reactor (UFR). It is similar in operation to the OCR unit but without the on-stream catalyst replacement transfer system, which can be added at a later date.

**Chevron Lummus Global, a joint venture between Chevron U.S.A. Inc., a wholly owned subsidiary of Chevron Corporation, and Lummus Technology, a CB&I company*

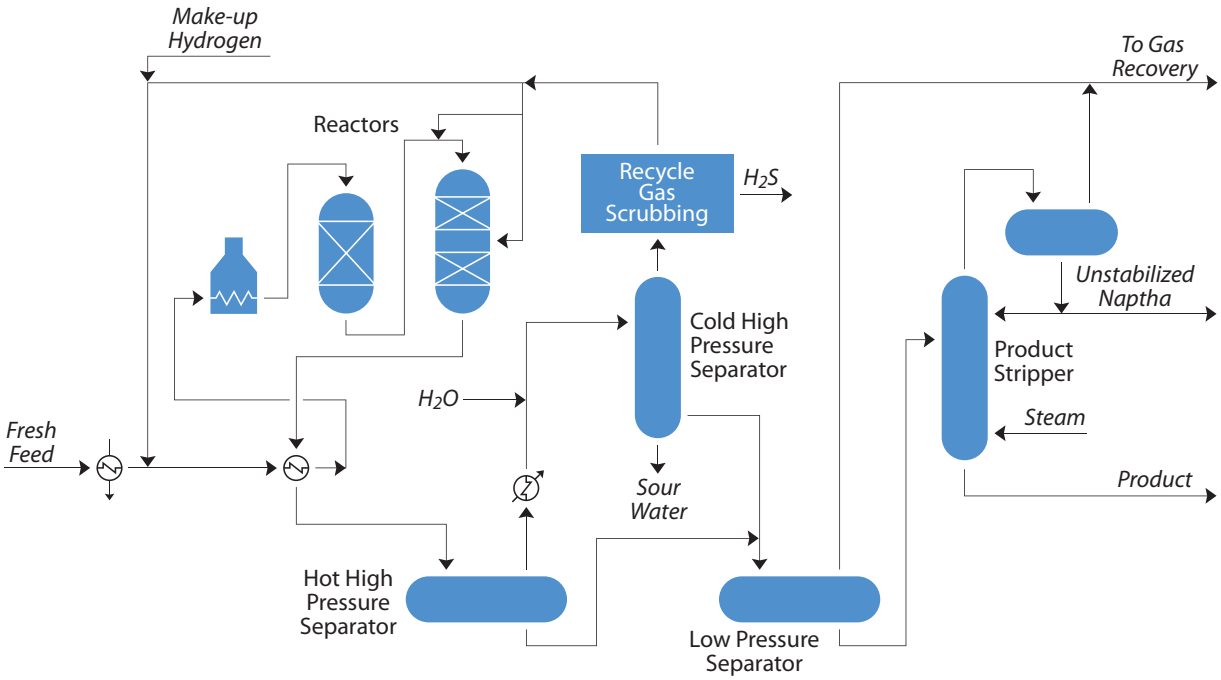
Advantages

Process Features	Process Benefits
Advanced catalyst systems	Higher product yields • Superior run lengths
Unique, high-quality catalyst grading system maintains good flow distribution and low pressure drop	Extends run lengths • Trouble-free operation
Patented hydrogen management system	Reduced hydrogen utilization • Constant product specification • Reduced operating cost
OCR reactor	Extend run lengths • Process feedstocks with higher metal concentrations
Optimized two-phase furnace and feed/effluent exchangers	Minimal fouling • Industry-leading energy savings

Process Experience

- Nearly 50% of all operating residuum hydroprocessing barrels were designed and licensed by Chevron.
- Widest experience in processing various feedstocks, including 100% vacuum residue with API gravity as low as 4.
- Only licensor having operating experience with on-stream, moving catalyst bed designs.
- Greatest number of operating and licensed units, including the deepest desulfurization unit and the largest unit.
- The most active R&D program in the industry and continuous feedback from Chevron's operating units and licensees ensure the best designs and catalysts.

Process Flow Diagram



Process Description

RDS/VRDS: After passing through preheat exchangers, the residuum feed is combined with recycle gas and sent through additional exchangers and the feed furnace. After reaching a set inlet temperature, the combined feed enters the reactors from the top. The number of reactors, in parallel or series, is determined by the overall objectives and feed rate.

From the reactor section, heat is recovered in the feed/effluent exchangers and then further cooled and flashed in the separation section. The recycle gas, bleed, and makeup gas are optimized to provide the highest purity hydrogen for the reactor section at minimal cost. The fractionation section draws the liquid from the separation section and separates the lighter components into off-gas, distillates and treated atmospheric residual fractions as required.

OCR: Fresh catalyst is added at the top of the reactor while residuum is fed into the bottom. The catalyst moves through the reactor in countercurrent flow, causing the dirtiest residuum to contact the oldest catalyst first. Spent catalyst is removed at the bottom of the reactor in a batch operation (typically once or twice per week), with no interruption to the process. The equipment moving the fresh and spent catalysts to and from the reactor is automated and requires minimal operator attention.

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