uop
A Honeywell Company

AF™ FCC Spent Catalyst Stripper Technology

Refining

Background

Many of today's state-of-the-art fluidized catalytic cracking (FCC) units utilize UOP's advanced technologies such as Optimix™ feed distributors and VSS™ riser termination devices. An outcome of the enhanced catalytic cracking from these technologies is increased catalyst circulation. As a result, the spent catalyst stripper frequently operates well above the original catalyst flux design value, which can compromise hydrocarbon displacement efficiency and unit performance. Advanced fluidization spent catalyst stripping technology was developed to not only improve the FCC unit yield performance, but also its catalyst circulation (hydraulic) performance.

Process description

The spent catalyst stripper is a very important element of the FCC unit. Its function is to strip the entrained and adsorbed hydrocarbons from the spent catalyst before it enters the regenerator vessel. These hydrocarbons are commonly referred to as coke on catalyst. In general four different types of coke can be associated with the spent catalyst: catalytic coke, contaminant coke, additive coke, and cat-to-oil coke.

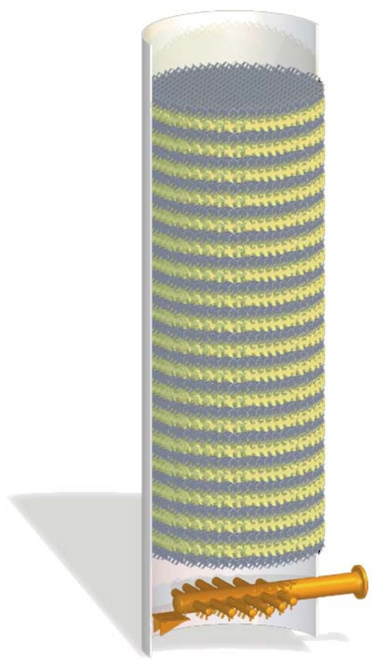
Catalytic, contaminant and additive coke are functions of the feed quality, catalyst type, and operating severity, and do not present much improvement opportunity for the catalyst stripper. Cat-to-oil coke, however, is entrained strippable hydrocarbon directly linked to the catalyst circulation rate. This type of coke is strongly impacted by the stripper performance.

AF stripper technology was developed during a three year optimization program that included computational fluid dynamic modeling and extensive cold flow modeling work. The cold flow modeling effort tested numerous tray designs (commercial and experimental) at a wide range of fluxes (up to 140,000 lbs/hr/ft2), and a wide range of stripping media rates. These efforts made it quite clear that optimal stripper performance is a result of proper control of the stripping media to ensure maximum use of the stripper's cross sectional area. The outcome of this optimization program was the AF stripper technology (Figures 1-3), which bring improved performance by creating a superior fluidization and contacting regime throughout the entire stripper vessel. The AF stripper technology is a family of three distinct internals:

- AF trays
- AF grids
- AF packing

The performance within this family is similar and often the optimal selection is dependent on the unique configuration of the unit, site constructability, and inspection issues.

Figure 1 ■ **AF Packing**



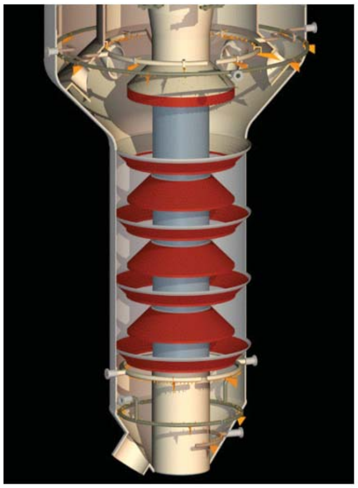
Benefits

AF stripper technology delivers its ideal performance by activating the entire stripper vessel via improved fluidization and steam / catalyst contacting. The result is both improved stripping efficiency of hydrocarbon as well as improved hydraulic capacity through the stripper. This leads to significant benefits:

- Lower delta coke operation
- Lower regenerator temperature
- Increased catalyst circulation (cat-to-oil ratio)
- Lower dry gas yield
- Higher conversion
- Improved product selectivity to gasoline or light olefins depending on the mode of operation
- Improved efficiency (able to operate at catalyst fluxes between 30,000 and 140,000 $lb/hr/ft^2$)

- Increased capacity (ability to re-use existing stripper vessel)
- Reduced steam requirement, which lowers the cyclone velocity and the vapor traffic in the main column.

Figure 2 ■ **AF Trays**



Applications

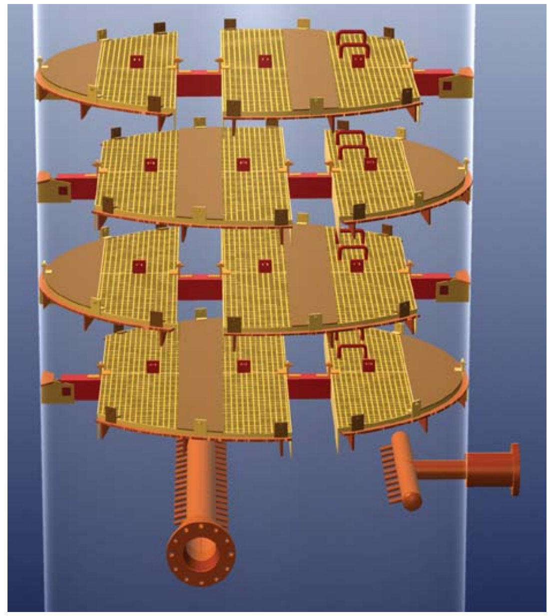
AF spent catalyst stripper technology can be applied to any and all FCC units and stripper styles. With the family of AF stripper technology, the refiner has the ability to select the option that best suit their unique needs regardless of the constraint.

Economics

The economics for upgrading to AF stripper technology can be quite attractive. A few commercial examples are described below.

- A large RFCC unit in Asia was revamped to the AF tray design. This refiner recognized a delta coke reduction of 0.04 wt-% which reduced the regenerator temperature 14°F, and improved conversion by 2.3 LV-%. This revamp paid for itself in a matter of months.
- A small FCC unit in the US installed AF grid technology, improved conversion by 3.0 LV-% and gasoline yield by 2.8 LV-%. This project had a pay back of less than three months.
- A large FCC in the US used AF tray technology to overcome catalyst circulation bottlenecks and now operates at a higher feedrate with the stripper catalyst flux consistently exceeding 120,000 $lb/hr/ft^2$.

Figure 3 ■ **AF Grids**



UOP experience

Since its availability, the AF stripper technology has been incorporated into 52 operating units with an additional 17 applications in design and construction. All of these units achieved the expected performance improvement.

For more information

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