



Optimix™ FCC Feed Distribution System

Refining

Introduction

The latest generation of the Optimix feed distributor, Optimix (ER), combines improved distributor tip geometry with material selection to enhance the reliability and reduce maintenance cost and time.

In every case – regardless of the feed quality or processing severity – a uniform and controlled catalyst environment and proper feed distribution are the keys to good mixing and quick vaporization of the raw oil feed in the FCC reactor riser. For this reason, UOP's feed distribution technology is focused on both the catalyst environment into which the feed is injected, and the feed distributor itself. UOP's catalyst acceleration zone at the base of the reactor riser establishes a uniform catalyst environment of moderate velocity and density prior to feed injection. Optimix feed distributors, the heart of the UOP feed system, are used to atomize the feed and inject it into the conditioned catalyst in the reactor riser.

Acceleration zone

The base of the riser, commonly called the wye section, is a very turbulent zone where the flow of regenerated catalyst changes direction and moves up the riser. It is important to have the catalyst moving evenly up the riser prior to feed injection to minimize backmixing and the inefficient contact of the feed and catalyst. UOP's feed distribution system injects either steam and/or dry gas at the base of the wye to accelerate the catalyst to a moderate velocity and to achieve an even, plug-flow catalyst distribution at a moderate density. This uniform and moderate density enhances penetration and quick vaporization of the feed. Commercial unit performance testing has confirmed the benefits of the acceleration zone.

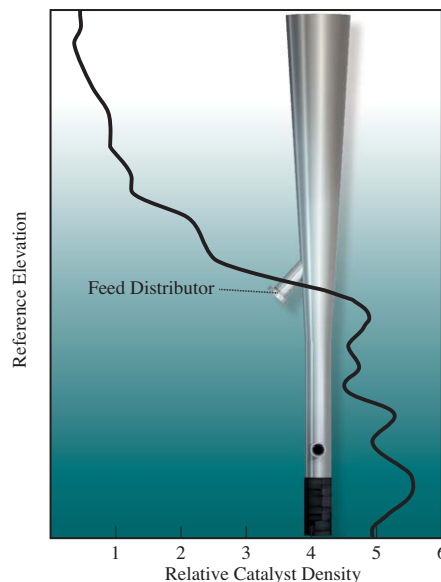
Table 1 ■ Acceleration Zone Benefits

	J-Bend & Radial Feed Nozzles	Wye Section & Optimix Feed Distributors
Conversion, vol-%	80.2	81.0
Yields:		
C ₂ -, wt-%	3.1	2.6
LPG, vol-%	29.3	24.8
Gasoline, vol-%	61.4	66.3
LCO, vol-%	13.1	12.6
Clarified oil, vol-%	6.8	6.4

For a 30,000 bpsd FCC unit, the economic benefits of changing from feed injection at the base of the riser to an elevated Optimix feed distribution system typically pays for itself within six months of operation.

During testing, gamma scans were used to measure the resulting catalyst density profiles through the acceleration zone and up past the feed injection point (Figure 1). The catalyst density in the acceleration zone can be varied between 15 and 20 lb/ft³ depending on the amount of acceleration media used. Within 1.5 riser diameters downstream of the feed injection point, the density decreases to approximately 5 lb/ft. This confirms that the feed is vaporized very rapidly and efficiently by the moderate density catalyst phase. Density maps also show that the Optimix feed distribution system facilitates an even plug-flow regime in the riser both before and after the feed injection point.

Figure 1 ■ Riser Gamma Scan



Optimix Feed Distributor

The Optimix feed distributor (see Figure 2) is a sophisticated mechanical device that efficiently atomizes the raw oil feed. Only a small amount of steam, typically 1.0 to 2.5 wt-% of fresh feed, but can range from 0.5 to 6.5 wt-% of fresh feed is required for good atomization and distribution of the feed through the use of an innovative three-stage atomization technique. One of the most

important features of the Optimix feed distributor is that atomization occurs close to the distributor's tip and prevents drop coalescing and pulsating flow.

The Optimix feed distributor tip generates a uniform, flat, fan spray pattern. This flat spray pattern is generated using a series of special orifices. These orifices (instead of larger slots) are designed and oriented to create the flat fan for each installation based on the feed quality, feed rate and riser dimensions. The spray pattern of the Optimix feed distributor generates a very uniform spray, containing small oil droplets with a narrow range of droplet sizes. The Optimix feed distributor generates a controlled spray angle, even at 50% turndown, to provide complete coverage of the reactor riser cross sectional area. In the vertical direction, the flat fan pattern remains thin, facilitating quick and uniform feed vaporization for superior yields and selectivity.

Each Optimix feed distributor is designed and tested for each specific installation. This allows UOP to design the distributors to provide full riser coverage at moderate pressure drop and exit velocities to avoid catalyst attrition and erosion problems. It also allows the maximum reuse of existing feed system equipment.

The tip design of the latest generation of Optimix feed distributors, the Optimix (ER), addresses an FCC industry

Figure 2 ■ Optimix Feed Distributor



wide issue of tip mechanical integrity. Proprietary materials and geometric features reduce tip erosion and extend service life. Optimix tip replacement, whether due to a significant change process conditions or for maintenance reasons, is quick and easy. This is facilitated by our unique DUR O LOK® coupling, which allows easy replacement of the internal and external components without welding.

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Process performance

Optimix feed distributors offer:

- High yields of the desired liquid products
- Reduced dry gas make
- Reduced delta coke
- Lower investment and operating costs
- Significant potential for capacity increase

These benefits have been confirmed by tests conducted in commercial units. One such test where elevated premix nozzles were replaced with elevated Optimix feed distributors is summarized in Table 2.

Table 2 ■ Optimix Feed Distributor Benefits

	<i>Elevated Premix Nozzles</i>	<i>Elevated Optimix Distributors</i>
Conversion, vol-%	77.5	77.9
Yields:		
C ₂ -, wt-%	4.4	3.7
LPG, vol-%	24.8	24.1
Gasoline, vol-%	62.5	63.7
LCO, vol-%	10.9	12.1
Clarified oil, vol-%	11.6	9.9

Optimix Commercial Experience

As of June 2007, 87 Optimix feed distribution systems have been commissioned. Since 1995, UOP has commissioned, on average, eight Optimix installations each year. With another 23 installations in some phase of design or construction, the next few years should easily maintain this average. Optimix feed distribution systems are in service in units with feed capacities ranging from 8,000 to 188,000 bpsd and with feed qualities ranging from hydrotreated vacuum gas oils to 100% atmospheric resid. UOP has more than 670 years of cumulative operating experience with Optimix with more than 3.4 million barrels per day of FCC feed being processed.

For more information

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