UNLOCK THE POTENTIAL OF YOUR FCCU

KOCH-GLITSCH

Have you noticed these issues with your FCCU?

Increased Hydrocarbon Entrainment to the Regenerator

Can lead to:

- Lower product recovery
- Elevated catalyst regenerator temperatures
- Reduced capacity, reliability, and operational flexibility
- Lower cat/oil ratios and reduced conversion
- Lower unit profitability

Excessive Use of Stripping Steam

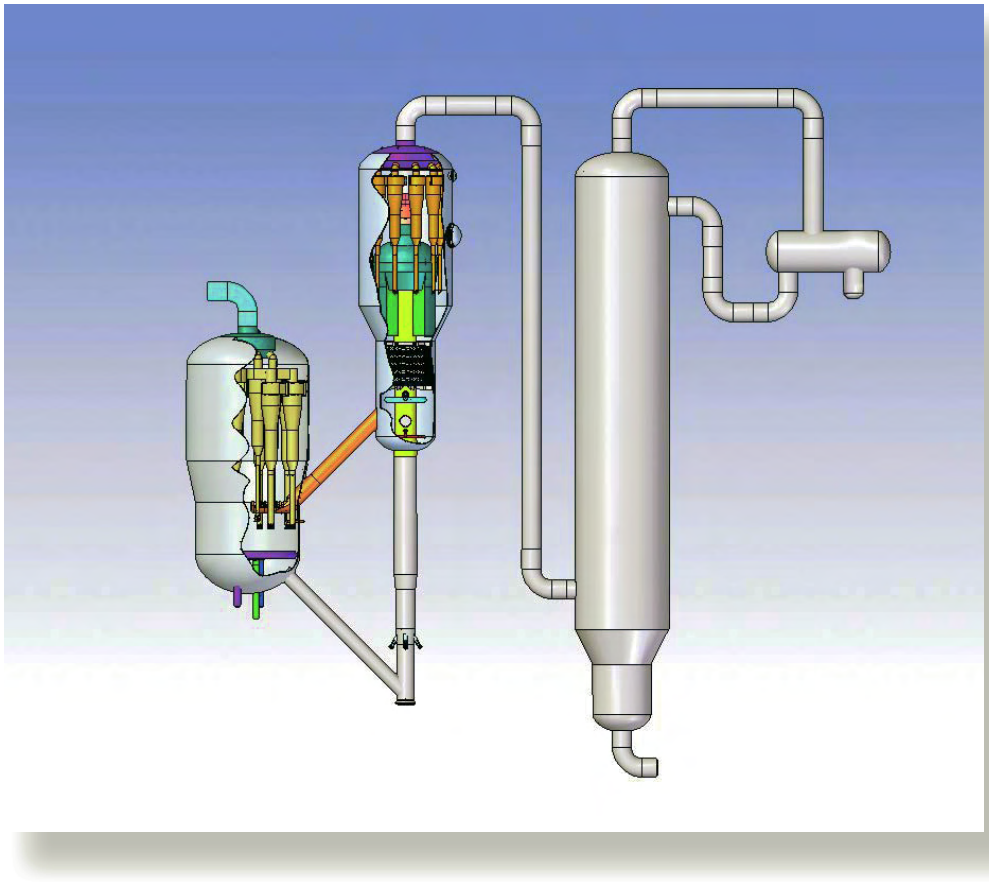
Can result in:

- Increased operational costs and burden to the utilities system
- Lower available capacity of the FCC main fractionator and its overhead condenser
- Excessive sour water discharge
- Increased costs in the Sour Water Stripper Unit

Poor Head Gain over the Spent Catalyst Slide Valve

Can lead to:

- Unstable flow of catalyst to the regenerator
- Restricted catalyst circulation that constrains unit capacity and reduces operational flexibility to accept heavier feeds



Other refiners have had the same issues.

And found the key to unlocking the potential of their FCCU is in the catalyst stripper.

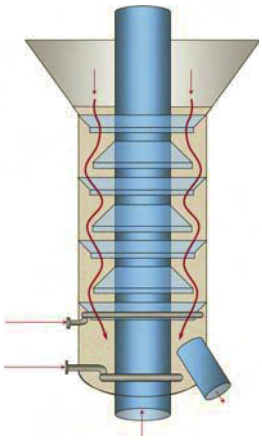
You may be thinking that upgrading your stripper technology won't make that big a difference.

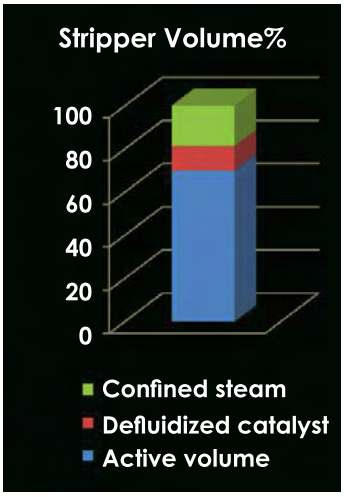
You may want to think again . . .

Repeated upgrading of the FCCU for higher capacity, heavier feeds, and improved yields has left many catalyst strippers with capacity and stripping efficiency constraints.

Trays Block 50% of the Vessel Area

- Reduces capacity
  - Constricts flow area in pinch points
- Reduces residence time
  - Encourages high catalyst velocity through the stripper
  - Contributes to some catalyst defluidization
- Reduces efficiency
  - Decreases contacting
  - Increases back mixing
  - Increases channeling and bypassing

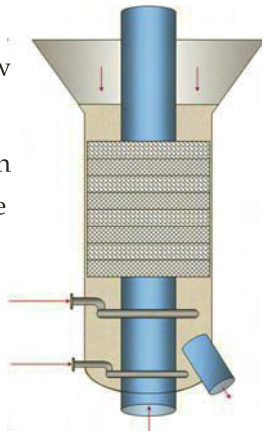


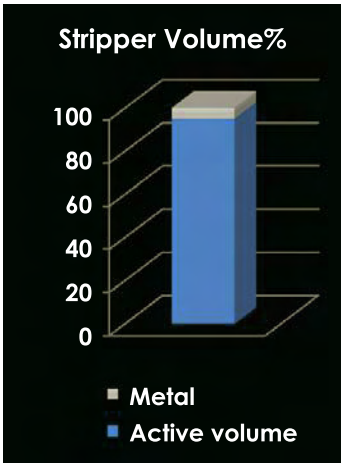


Disc-and-donut trays
62° catalyst slip angle

Structured Packing Uses the Entire Vessel Area

- Maximizes available capacity
  - Allows 95% of vessel area to be available for process flow
- Maximizes residence time
  - Eliminates empty zones and zones of catalyst de-aeration
  - Provides slow and uniform catalyst velocity through the stripper
- Improves stripping efficiency
  - Provides maximum catalyst residence time with low catalyst velocity
  - Reduces back mixing
  - Improves contact through smaller bubble size
  - Reduces channeling and bypassing
  - Provides superior catalyst stripping
- Reduces the required stripping steam by as much as 50%
  - Decreases operational costs and burden to the utilities system





KFBE™ Packing

KFBE™ packing provides a short payback.

With no costly vessel replacement and modest installation requirements, customers have realized fast payout on projects.

Koch-Glitsch engineers routinely design for hot and cold wall vessels with full diameter or annular KFBE packing elements.

Easy Installation

- Makes retrofits easy
- Eliminates vessel replacement
- Provides installation-friendly designs
- Promotes efficient revamp schedules

Spent Cat Line and Valve Protection

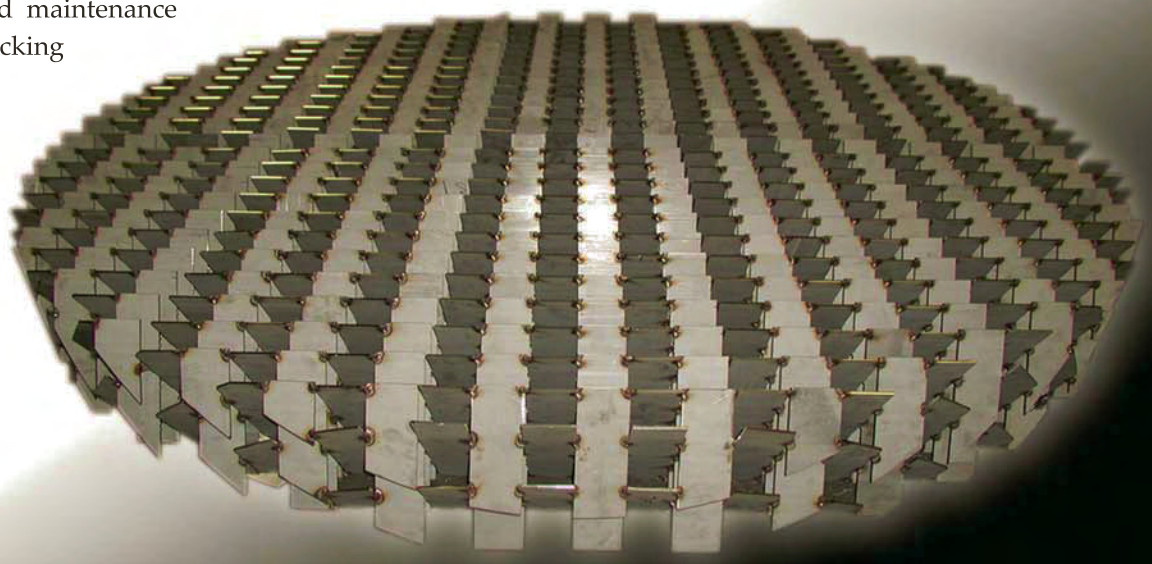
- Retains large debris on top of bed
- Protects valve from debris
- Saved at least one FCCU from a catastrophic shut-down

Open and Free-flowing Design

- Allows smaller debris to pass through
- Encourages free catalyst flow around large debris
- Promotes efficient catalyst drainage from blades during shutdown

Robust and Durable Construction

- Protects against mechanical failure
- Withstands normal handling without damage
- Allows easy removal for safe and unconstrained access during inspection and maintenance
- Promotes reuse of packing



But don't take our word for it.

Customers who have upgraded to KFBE™ packing have realized significant benefits.

Reliability Project Pays Out in Under 6 Months

Refiner "A" replaced a shed deck design with KFBE packing to reduce stripping steam and avoid ongoing maintenance issues.

Using KFBE packing:

- Reduced usage of stripping steam by 50%
- Increased available capacity in the main fractionator
- Reduced sour water discharge to the sour water unit

The reduction in sour water ultimately allowed the refiner to avoid a capacity revamp in the sour water unit. Although the project was aimed at unit reliability, payout was less than 6 months.

Conversion Increase Project Pays Out in Under 3 Months

Refiner "B" was experiencing FCCU capacity and feed limitations due to a catalyst stripper that was "just too small." Mechanical and structural constraints prevented them from considering a larger catalyst stripper.

Revamping the catalyst stripper with KFBE packing:

- Reduced hydrocarbon product loss to the regenerator
- Lowered regenerator operating temperature
- Increased head gain over the spent catalyst line

The combined effect of these improvements allowed the refiner to increase catalyst circulation by 5%, increasing conversion by 3-5% depending on the feedstock. Payout of the project was less than 3 months.

Operation Constraints Revamp Pays Out in Under 60 Days

Record feed rates and declining feedstock quality left Refiner "C" operationally constrained by excessive catalyst regeneration temperatures and after-burn. Conversion was suffering and the refiner was concerned about the effect of high temperature on mechanical reliability of the regenerator. Poor stripping and entrainment of hydrocarbon into the regenerator was causing the high temperatures. In addition, the refiner wanted to reuse the existing catalyst stripper based on cost and schedule.

Revamping the stripper with KFBE packing:

- Allowed use of existing catalyst stripper vessel
- Reduced the temperature in the regenerator dense bed catalyst by 50°F
- Virtually eliminated after-burn in the regenerator
- Reduced stripping steam use by 40%

The higher cat/oil ratio allowed by the lower regenerator temperature improved unit conversion by 3%. Payout for the revamp was less than 60 days.

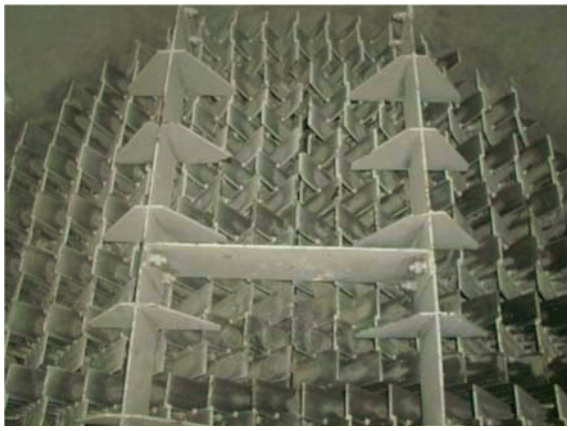
And they aren't the only ones.

With proven performance and reliability, KFBE™ packing has been installed in dozens of refineries around the world.

Replacement of the stripper vessel is seldom required because of KFBE packing's exceptional ability to maintain stripping efficiency at high catalyst flux. Installation is trouble free and can be accommodated during most FCC maintenance schedules.

Premiere Catalyst Stripper Technology

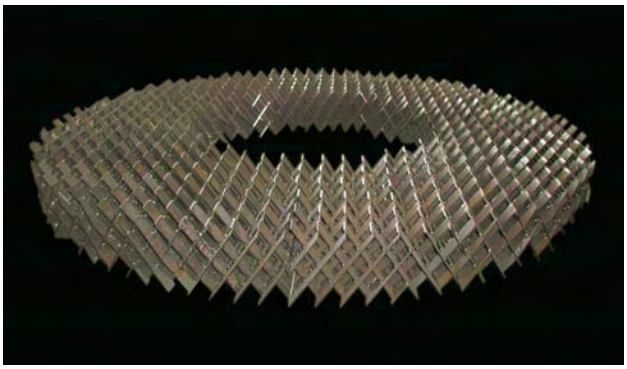
- Preferred catalyst stripper technology since 2000
- Licensed in more than three dozen catalytic cracking units, which includes 12 grass-roots design units
- More than 1.7 MM BPD licensed capacity
- More than 80 years of combined operating experience
  - 16 VGO units
  - 9 VGO + resid units
  - 11 resid units
  - 4 DCC units



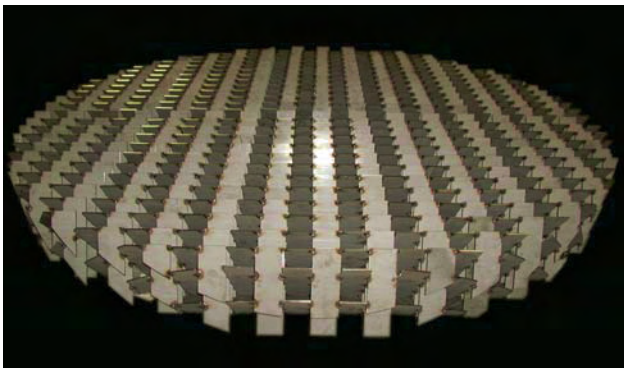
KFBE structured packing after 3 years normal operation

KFBE Packing Installed in Most Configurations

- Exxon Model IV
- Exxon Flexicracker
- KBR Orthoflow™
- The Shaw Group Resid Fluid Catalytic Cracking (RFCC)
- The Shaw Group Deep Catalytic Cracking (DCC)
- UOP Stacked
- UOP Side-by-Side



"Annular" KFBE Element



"Full Diameter" KFBE Element

If you think we can help, let's talk . . .

KFBE™ packing is available through Koch-Glitsch or our Authorized Licensors, The Shaw Group and Axens.

Koch-Glitsch is proud to offer our packed catalyst stripper technology in tandem with The Shaw Group and Axens, world leaders in FCC technology. Our KFBE packing technology is available for direct purchase from Koch-Glitsch or licensed through our technology partners.

Work with our licensors to receive:

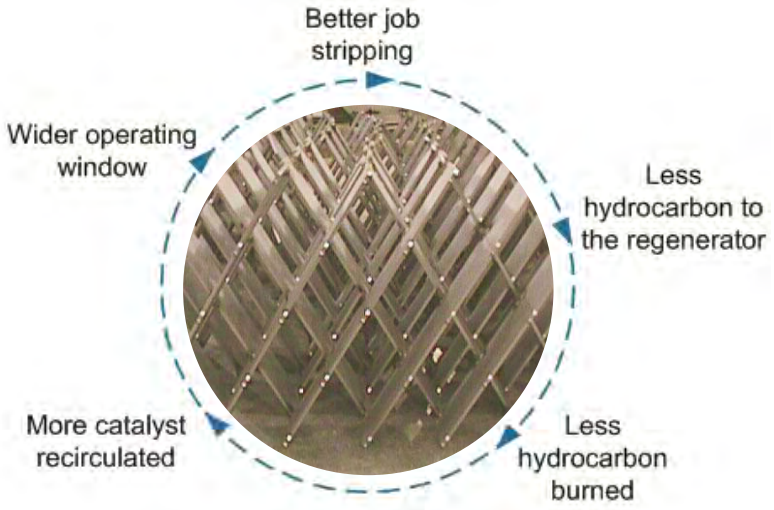
- Process simulations
- Yield guarantees
- Project management
- Mechanical reviews
- Process safety reviews
- P&ID reviews
- Procurement services
- Start-up support
- FCCU troubleshooting
- Additional FCC technologies

Work directly with Koch-Glitsch if you need:

- Mechanical design
- Equipment supply
- Field installation

Improve stripper performance and unlock the potential of your FCCU:

- Increase available stripper capacity
- Improve hydrocarbon recovery
- Improve catalyst circulation
- Improve operational flexibility
- Reduce regenerator operating temperature
- Reduce stripping steam requirement
- Reduce sour water discharge



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