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Tower Technical Bulletin

Effective Water Removal Can Create Extra Capacity in Your Absorber-Stripper

Background

Free or soluble water carrying over from the FCC or Coker Main Fractionator overhead systems can cause foaming problems and flooding in the Absorber-Stripper columns. Column designs that incorporate effective water removal can free-up capacity for valuable naphtha or LPG production.

The Problem

Even with bulk water removal in the overhead knockout drums or high pressure receivers, water carryover can go hand-in-hand with capacity creep. Higher charge rates can create superficial velocities that exceed design separation capabilities. Carried-over free water only compounds the problem of soluble water that typically drops out of solution inconveniently in the middle of the column. Without an effective design for removal, water can cycle up in the system – condensing and re-vaporizing multiple times in the column and thus taking up valuable hydraulic capacity. Additionally, when the soluble water begins to drop out of solution, two distinct liquid phases form, and the system is susceptible to foaming. Foaming will cause poor separation of components and increase column pressure drop, hindering capacity.

The Solution

There are several conventional methods that column designers use to remove water from the Absorber-Stripper including: water draw recessed pans, water draw collector trays, and external water draw pumparounds. Water separation outside of the column (whether upstream or as a pumparound) will be covered in a future Sulzer Tower Technical Bulletin.

Water draw sumps or recessed pans are typically added to a center downcomer at the top of the Stripper or in the middle/bottom of the Absorber column, where the temperatures are cool enough to create a free water phase. In the water draw sump design, the primary separation of water from hydrocarbon must occur within the volume of the recessed pan. The small stream of water is drawn from the column and the hydrocarbon liquid overflows the sump to feed the tray below. The biggest challenge of this design is residence time. Free water droplets formed from soluble water are typically very small and require several minutes of residence time to effectively coalesce and drop out of the hydrocarbon phase. Very rarely can the volume of a sump or pan provide that amount of residence time. Additionally, when two distinct liquid phases begin to form (water drops out of solution), foaming is likely, which further complicates the ability to separate water from hydrocarbon.

Water draw collector trays can offer an order of magnitude more residence time than the recessed pan or sump design; however, a chimney tray with a lot of residence time can take up significant vertical space in a column. In a revamp design, where the column capacity has creeped over time, several methods can be used to create additional collector tray residence time. The riser and overflow duct heights can be extended to create a larger liquid volume. The downcomers from the tray above can be extended down into the liquid level on the collector so that the water can be discharged closer to the hydrocarbon-water interface, aiding in coalescence. The draw location can be located to where the liquid's path of travel across the tray is maximized. Perforated dispersion plates can be installed in the water draw sumps to create a low turbulence zone closest to the draw so that any liquid influx does not disturb separation.

The Payout

Combined with an optimized tray or packing design, effectively removing water from the system can allow the refiner to increase FCC or Delayed Coker light product yields or charge rates. Sulzer's retrofit water draw designs can be tailored to address the refiner's particular constraints so that the effective removal of water can free up column hydraulic capacity for valuable hydrocarbon production.

The Sulzer Refinery Applications Group

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