UOP
A Honeywell Company

UOP ReVap™ Modified HF Technology

Refining

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Reduced volatility, increased safety

In the early 1990's, Phillips Petroleum, and Mobil Oil, combined forces to discover an additive which, when combined with Hydrofluoric (HF) acid, forms a new catalyst with substantially lower volatility.

The technology is a passive mitigation system compatible with all existing HF alkylation reactor systems. Pre-blended catalyst is available, eliminating the need for pure HF storage and significantly reducing storage and transportation risks.

As of 2007, millions of barrels of alkylate have been produced using ReVAP Process Technology. The ReVAP Process can be installed either as part of a grassroots setup or retrofitted to an existing HF Alkylation unit with minimal capital investment.

Following a signed license, start up can occur with minimal interruption to unit operation, requiring only one shutdown for the installation and connection of necessary tie-ins. Further, the catalyst is compatible with existing alkylation unit equipment and metallurgy.

In-depth research, recognized quality

More than 300 additives were tested during the extensive joint research effort. After conducting in-depth pilot plant and bench-scale evaluations, the ReVAP additive was tested at a 15-barrels-per-day demonstration unit at Mobil's Paulsboro, New Jersey, refinery. The facility operated continuously for 11 months using the catalyst to react with plant olefin feed.

Commercially available since 1997, the ReVAP Process recently was chosen by Valero Energy Corporation for upgrading the alkylation unit at the company's Wilmington, California, refinery. The ReVAP Process also was accepted by a third-party safety advisor for the city of Torrance, California.

Advantages of the ReVAP process

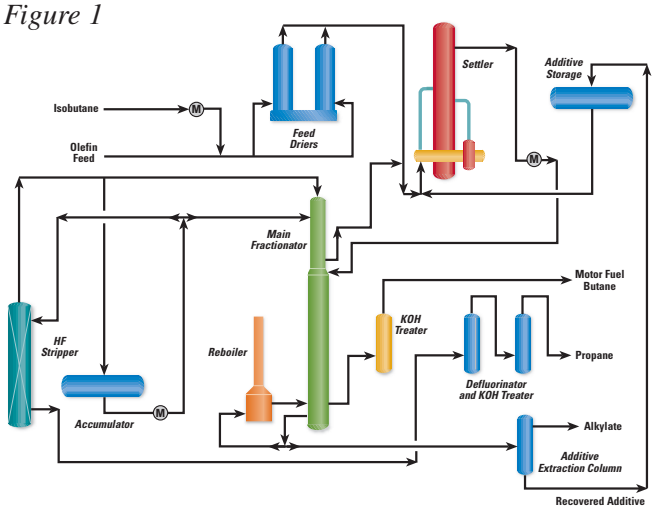
- Inherently safer process
- Significant reduction in HF vapor pressure
- Demonstrated aerosol reduction
- Potential increase in alkylate octane levels from propylene, isobutylene and amylene feedstocks
- Lower catalyst consumption than traditional HF alkylation units
- Startup in as little as 12 months, with only one shutdown to install/connect tie-ins
- Pre-blended catalyst available, reducing or eliminating on-site storage and transportation of pure HF
- Available for use with all existing HF alkylation reactor systems
- Requires a minimal plot area
- Enhances permitting for expansion projects
- Commercially proven since 1997

How it works

The alkylation process, which combines propylene, butylenes or amylenes with isobutane in the presence of the catalyst to form alkylate, remains essentially unchanged when using the ReVAP catalyst.

The basics of the process are shown in figure 1.

Figure 1

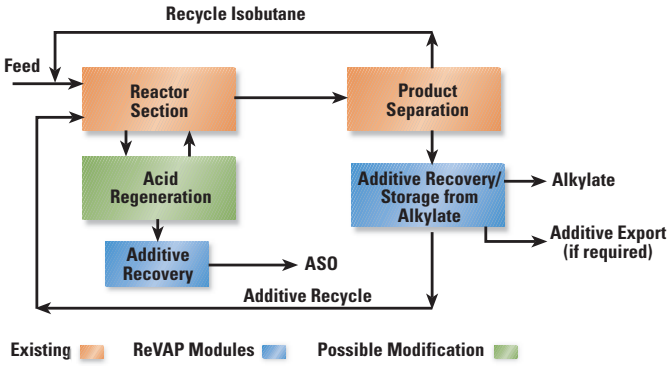


Olefin and isobutane feed streams are brought into the unit feed driers, where saturated water is removed before joining with the isobutane recycle stream. The mixture is injected into a circulating ReVAP catalyst stream and flows to the reactor, where it is highly dispersed into a moving bed of catalyst. Conversion of reactants to high-quality alkylate occurs quickly, and the

mixture flows upward to the settling zone. Here catalyst breaks out as a bottom phase and flows, by gravity, on a return cycle through the catalyst cooler.

The hydrocarbon phase from the settler, containing propane, recycle isobutane, normal butane and alkylate, is charged to the main fractionator. High-purity propane is sent overhead and is passed through the HF-propane stripper, defluourinator and KOH treater. Recycle isobutane is produced as a side-draw from the fractionator. N-butane product is taken as a vapor side-draw from the fractionator, condensed and KOH treated. The alkylate product comes from the bottom of the fractionator and is then processed in a small column to remove residual levels of ReVAP catalyst before being sent to storage. The recovered ReVAP catalyst is then recycled for further use. Catalyst is regenerated on-site in the regeneration section, where heavy polymer oils are removed from the catalyst. In addition, additive is recovered from the polymer and returned to the reactor section. Figure 2 illustrates the more detailed explanation of the process.

Figure 2



In one instance, a licensed facility has demonstrated that alkylate produced with the ReVAP catalyst has increased RON and lower endpoint, with other alkylate properties remaining essentially unchanged.

For more information

For more information, contact your local UOP representative or our Des Plaines sales office:

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