Honeywell UOP

REFINING

ISOALKY™ Alkylation Process Solution

A new Ionic Liquid Alkylation process for the production of a high-octane gasoline blend component

Background

Ongoing changes to gasoline specifications and vehicle performance requirements worldwide have increased the importance and value of alkylate as a blending component. Alkylate is mainly produced using conventional liquid catalysts such as hydrofluoric or sulfuric acid. The complex handling requirements of these catalysts has driven a need to develop a simpler alternative while maintaining economic performance. UOP is introducing an alkylation technology based on a unique catalyst with a stronger acid function and lower handling risks while providing a comparable process and economic performance to conventional liquid acid catalysts.

Ionic Liquid Advantages

The alkylation process upgrades low-value refinery butanes and olefins to a high-value blend component which helps to offset combinations of gasoline pool vapor pressure, sulfur, octane, aromatic, and olefin content limitations present in today's gasoline pool.

UOP's ISOALKY process produces high quality alkylate that enables refiners and gasoline merchants to meet fuel standards while maximizing profitability and flexibility. UOP's ionic liquid ISOALKY catalyst has a negligible vapor pressure (<0.1 psia) and is less corrosive to skin than other liquid alkylation catalysts. The ISOALKY catalyst's stronger acidity results in a catalyst consumption 400 times lower than H_2SO_4, vastly reducing the catalyst transportation requirements.

The ISOALKY process uses a small, in-situ catalyst regeneration scheme , eliminating the need for expensive, sulfur emitting stand-alone or toll-based acid regeneration plants. Unlike conventional alkylation processes that produce a heavy oil byproduct that must be incinerated or blended away, the ISOALKY process produces no heavy oil byproduct. Instead the ISOALKY process converts heavy oil byproduct into valuable product improving overall alkylate yield without the risk of environmental emissions.

UOP is the leading licensor of alkylation technology with more than 210 licensed units around the world. With our alliance partner, UOP has more than 25 years of combined research and development with ionic liquids including more than five years of operating experience in a demonstration plant. UOP

The ISOALKY process solution offers refiners the ability to produce alkylate using a specialized ionic liquid catalyst that simplifies handling procedures and provides comparable process and economic performance to conventional liquid or solid acid catalysts. The technology is backed by 80 years of innovation in alkylation by Honeywell UOP and an alliance with one of the world's leading integrated energy companies.

FEATURES & BENEFITS

- Negligible catalyst vapor pressure
- 400 times lower catalyst consumption than H_2SO_4
- No heavy oil by-product
- Increased C_3 - C_5 olefin feed flexibility

offers the ISOALKY process with unique enhancements, improved profitability, and lower risk profile compared to current alkylation process designs.

Feed flexibility

To provide more olefin feed flexibility, UOP's ISOALKY technology can process high quality alkylate over a wide range of C_3 to C_5 olefins, unlike sulfuric alkylation. In fact, sulfuric alkylation requires the C_3, C_4 and C_5 olefins to be segregated in different reaction trains, resulting in sulfuric consumption up to two times greater than with C_4-only alkylation. With UOP's ISOALKY process, the olefins do not need to be segregated and the catalyst consumption will be up to 800 times lower than sulfuric when alkylating C_3 and C_5 olefins.

Undesirable propane and isopentane production and reduction of make-up isobutane requirements also are possible because UOP's ISOALKY process has negligible hydrogen transfer reactions. In other alkylation processes up to 50 percent of C_3 and C_5 olefins can undergo the hydrogen transfer reaction. This is demonstrated by ISOALKY's negligible production of propane and isopentane and up to 50 percent lower consumption of isobutane when processing C_3 and C_5 olefins.

Process description

The alkylation reaction catalytically combines C_3-C_5 olefins with isobutane to produce motor fuel alkylate.

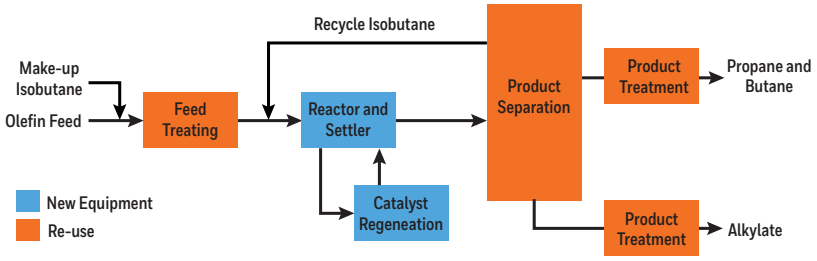
Alkylation takes place in the presence of a minimal amount of ISOALKY ionic liquid catalyst under conditions selected to maximize alkylate yield and quality. A general process flow diagram for the production of motor fuel alkylate is shown in Figure 1. Actual designs will be tailored to achieve individual refinery needs and objectives.

Makeup-isobutane and olefin feed are treated to remove water and other contaminants before being combined with isobutane recycle and sent to the reactor system. The reactor system is designed to ensure efficient contacting and mixing of hydrocarbon feed with the ionic liquid catalyst.

The net effluent from the reactor is phase-separated into the heavier ionic liquid phase and lighter hydrocarbon phase. The ionic liquid is returned to the reactor while the hydrocarbon is sent to the fractionation section. A small slipstream of the ionic liquid catalyst is sent to a small on-site catalyst regeneration sub-process. The ionic liquid undergoes mild hydroprocessing which efficiently regenerates it without producing environmental pollutants or liquid byproducts.

The fractionation section is nearly identical to existing alkylation process designs consisting of a main fractionator, stripper, and product treatment. Propane is sent overhead and is passed through a stripper for removal of light ends and residual catalyst material. Recycle isobutane is produced as a side-draw from the fractionator and sent to the reactor section. N-butane product is removed as a lower side draw. High quality alkylate is produced from the bottom of the fractionator. Typically the propane, butane, and alkylate products will be passed over an adsorbent to remove residual catalyst material before being sent to storage or gasoline blending.

Figure 1 – ISOALKY process



Revamp opportunities of existing units

Revamps of existing HF and H_2SO_4 alkylation units that require major modifications to achieve refinery revamp goals should consider incorporating the ISOALKY process flow configuration to increase feed rate and feed flexibility capabilities. Typically, the ISOALKY process solution should be considered when a full reactor/settler replacement is required to achieve a capacity expansion or when changing the acid catalyst is desired to reduce the risk profile. Existing feed pretreatment and fractionation sections can be repurposed in the ISOALKY process.

For more information
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