Lummus Technology
a CB&I company

AlkyClean® Solid Acid Catalyst Alkylation Technology

Overview

Lummus Technology, Albemarle Catalysts, and Neste Oil have developed and demonstrated a solid acid catalyst gasoline alkylation technology that is now being offered for license. The AlkyClean® process employs a robust zeolite catalyst formulation coupled with a novel reactor processing scheme to yield a high quality alkylate product.

The total installed cost of the facility, including OSBL (regeneration facilities, safety installations, etc.), is significantly lower than current liquid-acid processes. With no liquid acids or chlorides in the system, no product treatment or disposal of acids or chlorides is required. The lack of corrosive acids in the system and the mild operating conditions allow for carbon steel construction, while limited pretreatment and no post-treatment result in fewer OSBL equipment pieces.

Advantages

Process Features	Process Benefits
Robust, true-solid-acid catalyst	Eliminates corrosive liquid acid use and associated safety concerns • Tolerant to feedstock impurities, changes in feedstock olefin composition, and process upsets (e.g., water spikes)
Removes safety risks associated with liquid acids	Lower maintenance and monitoring requirements • Eliminates costs associated with mitigation (acid dump and water spray systems), disposal of acids or chlorides, and vapor suppression additives
Low pressure, liquid phase operation in the temperature range of 50°C-90°C	Eliminates costly refrigeration requirements associated with H_2SO_4 units • Carbon steel construction material results in lower costs
Does not produce acid soluble oil by-product	Improves alkylate yield • No by-product disposal requirement
No emissions to air, water, or ground	Environmentally friendly process

Performance Characteristics

The solid acid catalyst used in the AlkyClean process contains no halogens and is very robust with regard to water and other feed impurities such as oxygenates, sulfur compounds, and butadiene. Any deactivation from these impurities is restored via moderate temperature (250°C) gas phase regeneration with hydrogen.

The product quality and alkylate yield from the AlkyClean process are comparable to that of liquid acid processes; however, no acid-soluble oils are formed. This results in reduced olefin feed consumption per unit of alkylate production (higher yield) and eliminates the need for by-product disposal. High quality product can be obtained with various feeds, including raffinate containing butene-1 (an octane debit for HF alkylation units) or a stream high in isobutene (a debit for H_2SO_4 units).

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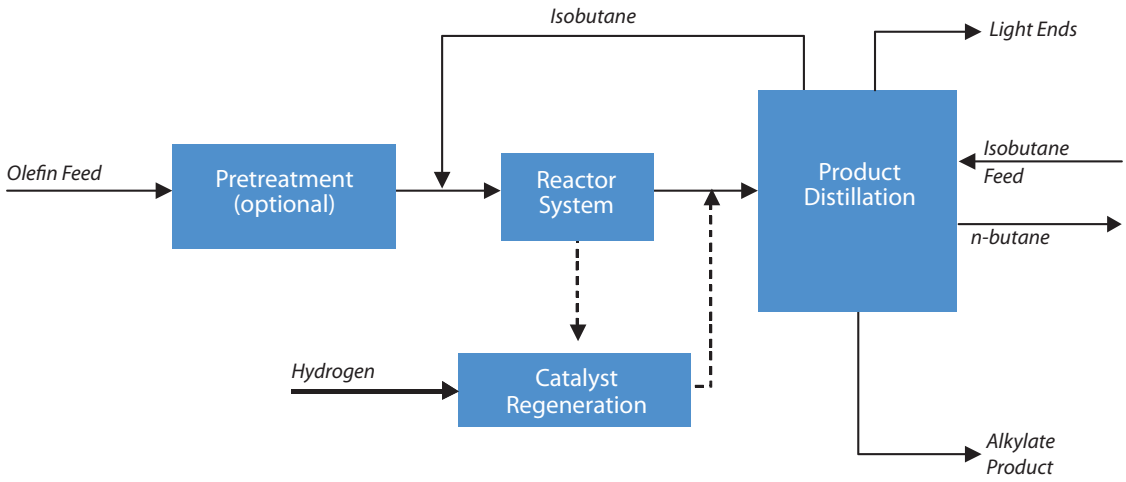
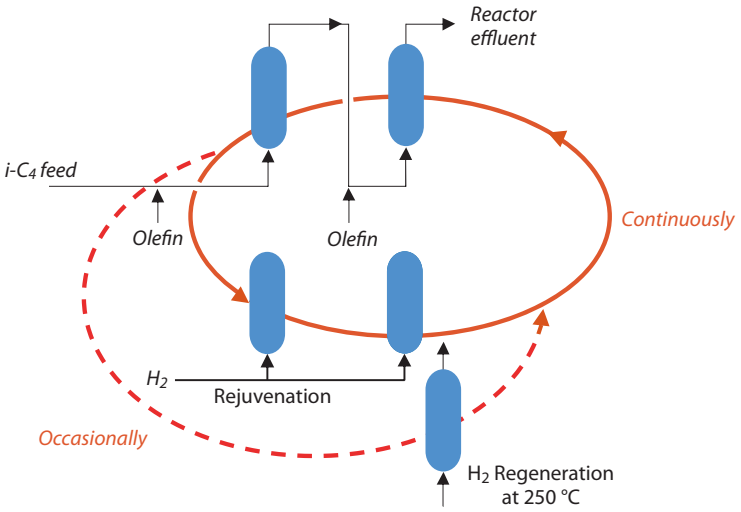
Block Flow Diagram



Reactor Schematic



Process Description

The process consists of four main sections: feedstock pretreatment (depending on contaminant level), reaction, catalyst regeneration, and product distillation. Olefin feed is pretreated if necessary and, together with isobutane recycle, enters the reactor. The reactor operates in the liquid phase in the temperature range of 50°C-90°C. Multiple reactors are used to allow for continuous alkylate production, as individual reactors cycle between on-line alkylation and rejuvenation, and are intermittently taken off-line for regeneration.

During rejuvenation, olefin addition is stopped and hydrogen is added to achieve a low reactor concentration of dissolved hydrogen, while maintaining liquid-phase alkylation reaction conditions. This allows for a seamless switchover between operations and minimizes energy consumption. Over time, there is still a gradual loss of catalyst activity, which is recovered by taking a reactor off-line for a moderate temperature regeneration that fully restores catalyst activity. The swing reactor, coupled with long catalyst life, allows the refiner to tailor turnarounds in line with FCC requirements.

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