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SINOALKY Technology: Novel Sulfuric Acid Alkylation Process

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PURPOSE OF THE ABSTRACT

Among various high-octane gasoline blendstocks, alkylate gasoline is the ideal component for blending clean gasoline due to their low vapor pressure as well as low contents of alkenes, aromatics, and sulfur.Alkylate gasoline are produced by the alkylation of isobutane with butene using sulfuric acid as catalyst. At present, there are two main industrial C4 alkylation processes: sulfuric acid or hydrofluoric acid catalyst-based. With stricter environmental regulations, hydrofluoric acid alkylation unit is more difficult to be approved for construction. Because the sulfuric acid alkylation process is superior to the hydrofluoric acid alkylation process in terms of operability and safety, it has become the preferred alkylation process for refiners.

DuPont technology is currently the most popular sulfuric acid alkylation technology, accounting for about 80% of the global sulfuric acid alkylation market. DuPont technology uses STRATCO horizontal eccentric stirred-tank reactor. The heat released by alkylation reaction is absorbed by the decompression gasification of liquid isobutane in the tube bundles. The product also needs to undergo acid and alkali washing process. Although the DuPont sulfuric acid alkylation technology is mature, there are still some disadvantages: (1) The use of mechanical agitation is prone to leakage and high equipment maintenance costs; (2) Acid and hydrocarbon phase is easy to stratify, and singel reactor capacity is small; (3) Gas-liquid two-phase refrigerant flows through the tube, causing poor heat extraction; (4) The product needs to be washed by acid, alkali and water step by step, resulting a large amount of wastewater discharge as well as high investment and operational cost.

In order to overcome the disadvantages of the conventional stirred-tank reactor technology, SINOPEC Research Institute of Petroleum Processing developed a new alkylate gasoline manufacturing process, which has characteristics as follows: SINOALKY technology integrates n-type multi-stage and multi-segment static mixing reactor, self-vaporizing acid-hydrocarbon separator in the process, and the alkylation reactor is with high reaction efficiency, simple and reliable operation and easy maintenance. The multi-point feeding method can reduce the circulation amount of isobutane while ensuring the product quality, thereby reducing the energy consumption of the whole unit. SINOALKY technology uses high-efficiency acid hydrocarbon coalescing materials to separate acid from hydrocarbons of the reaction effluent , eliminating the acid and alkali washing process in the conventional process.

Compared with the conventional stirred-tank reactor technology, SINOALKY technology has obvious advantages: (1) The reactor has no dynamic sealing, and is simple to maintain, which overcomes the disadvantages of conventional reactor with complicated maintenance and short service life. (2) The reactor is easy to scale up, with a single unit throughput up to 350,000 tons/year. (3) Self-gasification acid hydrocarbon separator removes heat quickly and has good separation effect. The reactor inlet temperature can be controlled at around 0°C. The octane number of the product can be increased by 0.5~1. Sulfuric acid consumption can be reduced by 30%.(4) Eliminating the acid and alkali washing process in the conventional process and simplifying the process can significantly reduce the wastewater discharge and alkali consumption. There is no water in the fractionation system , so the corrosion of the device is greatly reduced, and the clean production is realized.

The first 200,000 tons/year industrial demonstration unit using the SINOALKY technology has been completed and started up at SINOPEC Shijiazhuang Refining & Chemical Company on June 18, 2018. The alkylate gasoline product is qualified and the RON value is 97.2.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

BIBLIOGRAPHY