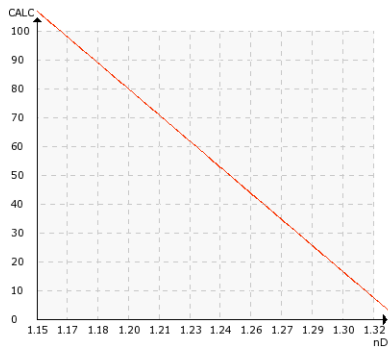


HYDROFLUORIC ACID, HF

Typical end products

Alkylate (premium higher octane gasoline blending stock for motor fuel and aviation gasoline)

Chemical curve: Hydrofluoric acid R.I. per Conc% b.w. at Ref. Temp. of 20°C



Introduction

Motor fuel alkylation using liquid hydrofluoric acid (HF) or sulfuric acid (H_2SO_4) is one of the oldest catalytic processes used in the refining of petroleum. The purpose of the alkylation is to improve motor and aviation gasoline properties (higher octane) resulting in as much as 90% lower emissions compared to conventional fuel.

Alkylation is a catalytic process, combining low molecular weight olefins and aliphatics to form higher molecular weight isoparaffinic compounds with superior stability and antiknock characteristics.

The alkylation process used in refining is the reaction of isobutane with an olefin to form an isoparaffin.

Usually, the olefin used is butylene, which combines with isobutane to yield iso-octane.

Application

A catalyst is used in the alkylation process, typically a high strength "dry" hydrofluoric acid. In the HF acid alkylation process the reaction temperature is about 45°C (113°F) prior to entering the reactor. The reactor is cooled to control the exothermic reaction. The acid and the hydrocarbon are then thoroughly mixed.

After the reactor, the mixture enters a separation vessel, where the acid and hydrocarbon separate. The acid is then recycled back to the reactor. Isobutane levels are maintained in excess of the olefin to enhance the conversion to iso-octane.

Installation

The K-Patents Process Refractometers are located before and after the reactor to measure the acid concentration. The concentration of re-circulated hydrofluoric acid is also measured.

The acid is first sent to a settler and then to a regenerator. It is advantageous to ensure the correct acid concentration before recirculation to the reactor. The final acid concentration can be controlled by altering the duration of the reaction or by the acid recycle ratio.

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| OIL REFINING AND PETROCHEMICAL | |
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| HYDROFLUORIC ACID ALKYLATION | |

The isobutane/olefin ratio can also be monitored to maintain the appropriate ratios for the optimization of iso-octane production.

Continuous monitoring can reduce the frequency of the titration measurements. The K-Patents refractometer gives a continuous indication to gradual changes in the acid flow resulting in better control, which generally reduces unit acid consumption resulting in cost savings. The K-Patents refractometer provides precise acid strength readings, regardless of the amount of hydrocarbons present.


Instrumentation

The K-Patents Process Refractometer System for HF Acid Alkylation Measurement Consists of:

1. a) K-Patents Process Refractometer PR-23-AX/FM/CS to be used in hazardous locations in Zone 2.
or
b) K-Patents Intrinsically Safe Process Refractometer PR-23-IA/IE/IF to be used in hazardous locations up to Zone 0.

2. Options:
 - 2.1 Flowcell for mounting in a ¾" by-pass line
 - 2.2 EXd enclosure for easy isolator and transmitter mounting
 - 2.3 Parts for a start up
 - 2.4 Spare parts supplied for two years of operation
 - 2.5 Start up & commissioning service
3. User specified tests and documentation.

Monel 400 is the recommended material for process wetted parts (sensor and flowcell). However, it is the end user's responsibility to specify the appropriate material, ensuring that it is satisfactory for the intended operating requirements. Appropriate equipment with hazardous and intrinsic safety approvals are available when required.

| Instrumentation | Description |
|---|---|
|  | K-Patents Process Refractometer PR-23-GP is an industrial refractometer for large pipe sizes and tanks, cookers, reactors and kettles. Installation through a flange or clamp connection. |
| Area classification: | Intrinsic safety and hazardous area approvals available. |
| Measurement range: | Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight. |