

# Refineries: Application Focus

## HF Alkylation

### Process Description

Olefins (C3-C4) from the FCC unit are combined with isobutane (i-C4) and are first treated with a mol sieve bed to remove water. Concentrated Hydrofluoric Acid (HF) is then mixed in and fed to the reactor. The alkylation reaction takes place combining the olefins with the isobutane to form the alkylate product which consists of high octane value products that are later blended into the gasoline pool. The hydrocarbons leaving the reactor mostly consist of alkylate, unreacted isobutane, n-butane, and propane.

The HF and alkylate product are separated by a settler and the HF is recovered for re-use in the reactor. The reactor hydrocarbons are separated by the main fractionator where the isobutane is recycled to the reactor, alkylate is drawn off the bottom and an n-butane product stream is separated and treated with caustic (KOH). The overheads consist mostly of HF acid fumes and propane gas.

The overheads are then cooled and the HF separated. Propane is further treated through the propane splitter to remove any dissolved HF and finally treated with alumina to remove fluorinated organics, and then caustic (KOH) to neutralize any remaining acid.

Effective separation is a critical component of an efficient, reliable and safe H<sub>2</sub>SO<sub>4</sub> alkylation process.

Ensure your Alkylation unit operates reliably, with minimum corrosion, low acid consumption, and on spec products.



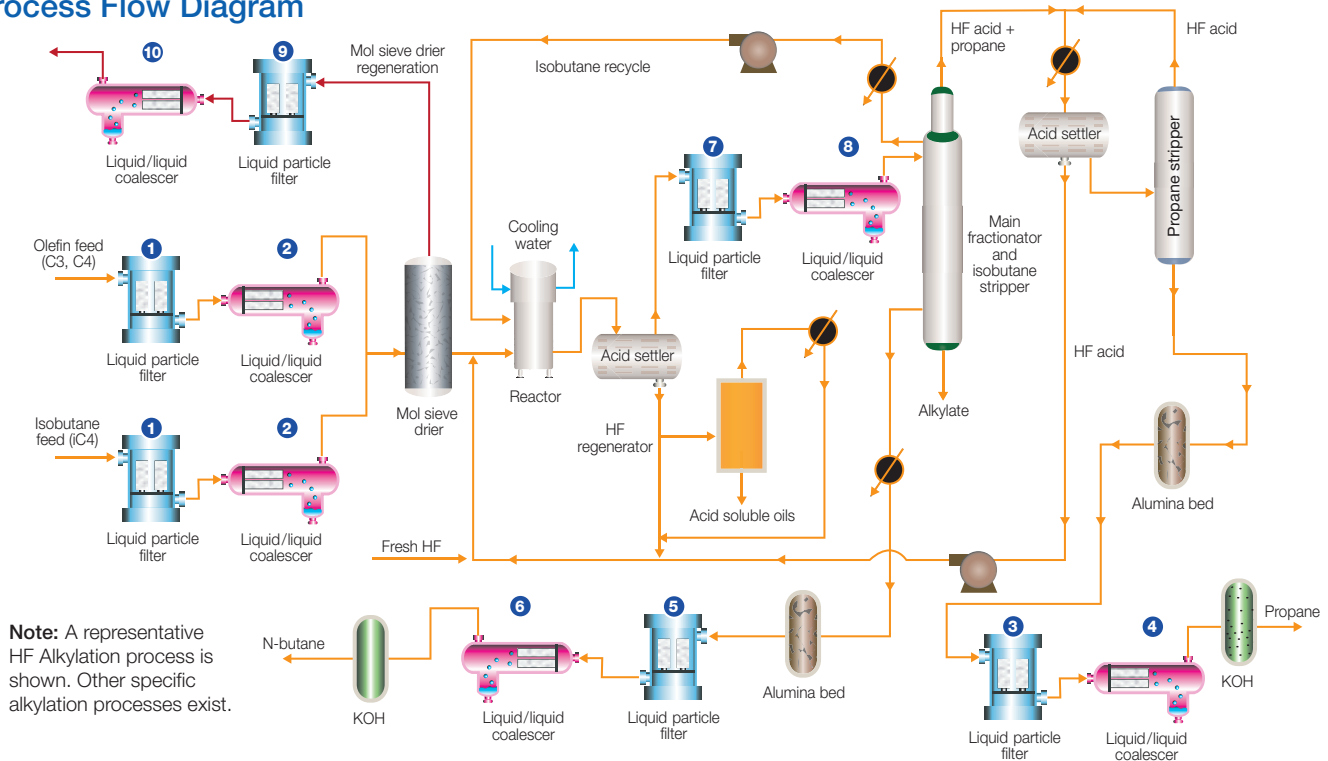
### Refinery Needs

- Equipment reliability / minimized corrosion to meet 4-6 year refinery turn around schedule
- Meet product specs for high octane value alkylate and caustic free propane and n-butane
- Low acid makeup costs by minimizing acid dilution from wet feedstocks
- Maintain high levels of safety by avoiding any equipment failures that could lead to fugitive emissions of HF

### Production Challenge/Pall Solution

Challenge	Solution
<b>Meet product specifications</b> due to bed fouling and associated channeling	<b>Improve refinery productivity and product specifications</b> by removal of water from the olefin and isobutane hydrocarbon feed streams and by removing any carryover caustic in the propane and n-butane streams. <ul style="list-style-type: none"> <li>• Free water will reduce the life of the mol sieve driers and potentially lead to HF dilution.</li> <li>• High efficiency AquaSep® XS and PhaseSep® liquid/liquid coalescers reliably meet 'clear and bright' product specification and sodium levels downstream.</li> </ul>
<b>Protect fractionator towers from corrosion &amp; plugging</b>	<b>Improve protection of main fractionator / isobutane stripper and propane stripper.</b> <ul style="list-style-type: none"> <li>• KO pots, mesh pads and cyclonic devices may not effectively remove emulsified water, caustic or acid droplets and fine solids.</li> <li>• High efficiency PhaseSep X liquid/liquid coalescers reliably remove HF acid carryover from the acid settler and is made with Hastelloy hardware to withstand severe HF service.</li> </ul>
<b>Control acid makeup costs</b>	<b>Ensure reliability of molecular sieve dryers.</b> <ul style="list-style-type: none"> <li>• High efficiency AquaSep XS or PhaseSep liquid/liquid coalescers remove free water that can overload sieves, allowing acid dilution.</li> </ul>

## Process Flow Diagram



## Key Applications/Filter Recommendations (other applications not shown)

Application	Pall Product	Advantages	Customer Benefits
1, 3, 5, 7, 9 Pre-filtration prior to liquid/liquid coalescer	Ultipleat® High Flow or Profile® Coreless PPS filter	Efficient removal of solids	Lower operating costs by improving the life of the liquid/liquid coalescer
2 Feed water (or caustic) removal	AquaSep XS (or PhaseSep) liquid/liquid coalescer	Remove water (or caustic) from feed hydrocarbons	Prevent dilution of HF acid catalyst and potential for corrosion – extend mol sieve life
4 Water removal from propane	PhaseSep X liquid/liquid coalescer	Remove carryover water and trace HF from propane	Ensure propane meets purity spec/prevent dilution of KOH
6 Water removal from n-butane	PhaseSep X liquid/liquid coalescer	Remove carryover water and trace HF from n-butane	Ensure n-butane meets purity spec/prevent dilution of KOH
8 HF acid removal after reactor HF acid settler	PhaseSep X liquid/liquid coalescer	Remove HF acid from reactor products	Reduce corrosion and potential fouling of trays in the isobutane stripper
10 Water removal from olefin regenerant from mol sieve	PhaseSep liquid/liquid coalescer	Remove water from olefin regenerant	Allow re-use of olefin

### For fast track upgrades, NO CAPEX:

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**Pall filter and coalescer housing rentals** enable a technology upgrade for rapid problem resolution



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