Ester-grade Acrylic Acid Technology

LUMMUS TECHNOLOGY

Overview

The Ester-grade Acrylic Acid Process is a reliable, commercially proven route, achieving world scale production capacity for production of Acrylic Acid from Propylene.

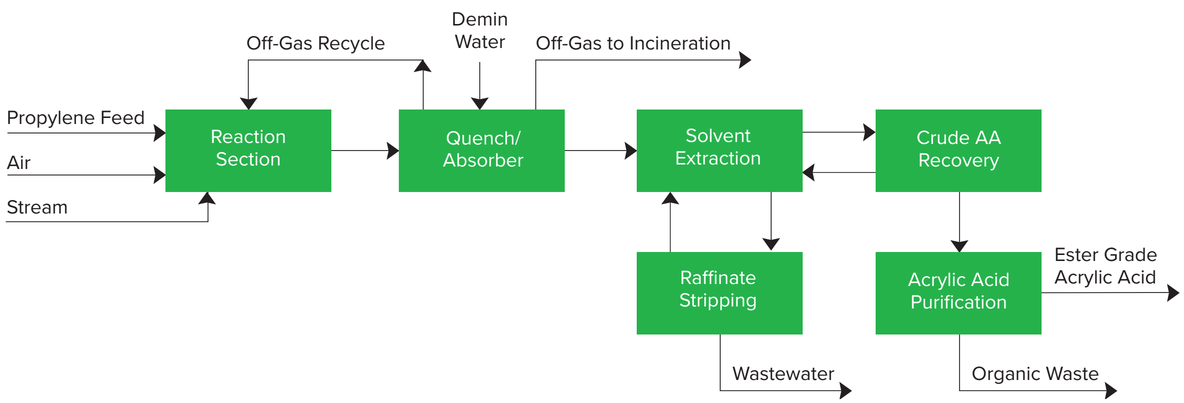
The largest single train built is 160 KMTA, with up to 250 KMTA possible with a single reactor and downstream fractionation. Stand out features of the technology include its high energy efficiency, low waste generation, use of a non-toxic extraction solvent, and patented design to prevent fouling in the distillation section.

Nippon Kayaku is the exclusive supplier of the proprietary catalyst, achieving high yield, high selectivity and extended catalyst life. For fixed capacity, the high-performance catalyst allows for a reduction in investment cost with the minimization of reactor size and a saving in operating cost with reduced raw material consumption.

Advantages

Process Features	Process Benefits
Well-proven technology, with large single train capacity	BPCL's 160 KMTA Acrylic Acid plant at Kochi started up in 2021 and CNOOC's 140 KMTA at Huizhu started up in 2012.
High performance catalyst	Nippon Kayaku's catalyst is the highest performing commercial catalyst, providing high yield, high selectivity and long catalyst life. In addition, the high-performance catalyst allows the use of Refinery Grade Propylene (> 80% purity) as feedstock.
Process safety	The technology has a proven safety track record and is equipped with many process safety features.
Low energy consumption	The distillation columns are operated at the lowest possible pressure, thereby minimizing the energy requirements.
High on-stream efficiency	The process has patented features to minimize the prevalence of fouling from polymerization.
Low environmental impact	Vent gas and preliminary wastewater treatment are included in the process design.
Highest quality products	Superior quality Ester-grade Acrylic Acid is produced, suitable for production of the highest quality Acrylates.

Block Flow Diagram



Process Description

Acrylic Acid is produced in the reactors by two step catalytic oxidation of Propylene. In the first step, propylene is oxidized to Acrolein. In the second step, Acrolein is further oxidized to Acrylic Acid. The reactor effluent is quenched to absorb the produced Acrylic Acid in water. Water and Acrylic Acid are then separated by Solvent Extraction followed by distillation to produce Ester-grade Acrylic Acid.

Acrylic Acid Recovery

Quench and Absorber Section

Acrylic Acid Reactor effluent is quenched using recirculating solution consisting of water, Acrylic Acid and Acetic Acid. The uncondensed gases from the Quench Tower are sent to an Absorber to recover the remaining Acrylic Acid. A part of the uncondensed gas is recycled to the first reactor and the remaining is sent to the incinerator.

Product Recovery

Solvent Extraction

The aqueous solution from the Quench Section is fed to a liquid – liquid extractor, where Acrylic Acid is separated with a solvent. The top product of the extractor, containing Acrylic Acid is sent to a Solvent Recovery Column to recover solvent and Acrylic Acid. The raffinate from the Extractor bottom is sent to the Raffinate Stripper for recovery of dissolved solvents before disposing of the wastewater. In the Solvent Recovery Column, nearly all the solvent is distilled off as overhead product stream. The bottoms product is sent to the Crude Acrylic Acid column. The remaining solvent is removed in a further column, the Acrylic Acid Recovery Column.

Crude Acrylic Acid Purification

The Crude Acrylic Acid Column produces a concentrated Acrylic Acid bottoms stream by distilling off Acrylic Acid, solvent and Acetic Acid.

Acrylic Acid Purification

In the final step of Ester-grade Acrylic Acid purification, Ester-grade Acrylic Acid is separated from the heavies by distillation.

Process Chemistry

$$C_3H_6 \quad + \quad O_2 \quad \longrightarrow \quad C_3H_4O \quad + \quad H_2O$$

$$C_3H_4O \quad + \quad \tfrac{1}{2}\,O_2 \quad \longrightarrow \quad CH_2CHCOOH$$

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