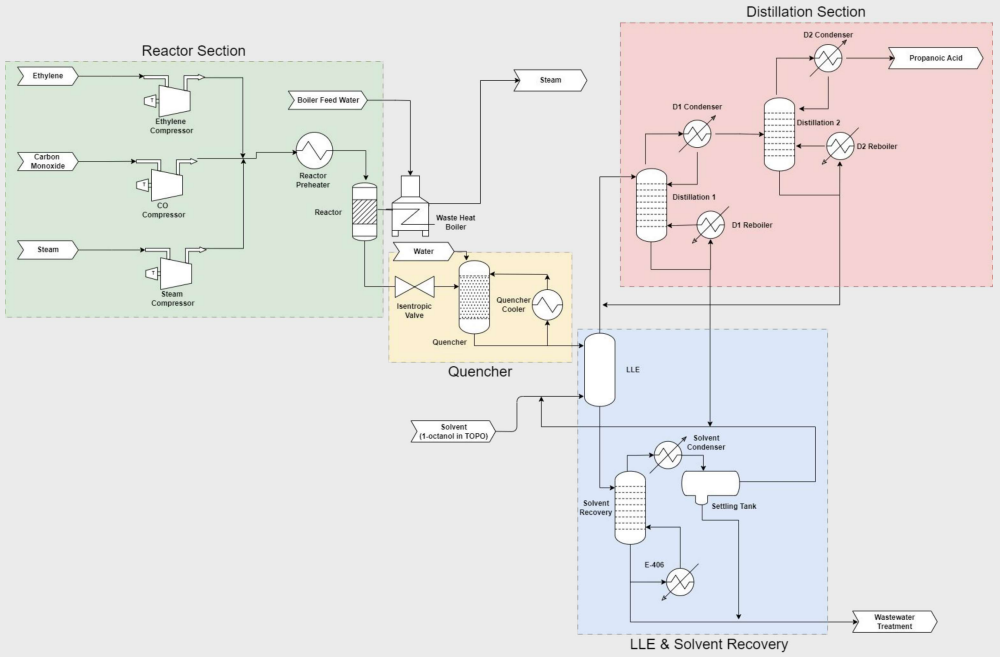
Propionic Acid Liquid-Liquid Extraction

Plant design to produce 75,000 metric tons of Propionic Acid to meet demands for the food industry.

Background

In the food industry, propionic acid is primarily used in the preservation of various packaged foods as an antifungal and antibacterial agent to prevent mold and bacterial growth. Additionally, it is also used in the production of flavorings and fragrances, and has many uses outside of the food industry as a chemical intermediate in the production of plastics and pharmaceuticals. Due to the abundance of packaged foods that require preservation, propionic acid is in high demand.

The propionic acid produced from a proposed plant needs to be food-grade in order to meet FDA standards and to be sold to the food industry, meaning a purity of 99.5% or higher. In order to facilitate extraction of propionic acid from post-reactor flows, a liquid liquid extraction (LLE) unit will be utilized. A pilot scale LLE unit will be used to validate liquid liquid extraction operations and findings will be used to modify the proposed process and scale up the LLE unit operation.

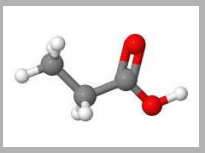


Method:

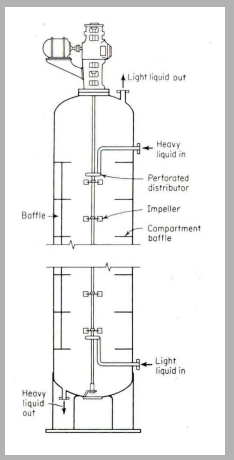
The team plans to produce propionic acid in the designed plant through the Reppe process using ethylene, carbon monoxide, and water as reagents. The reaction will be catalyzed using nickel carbonyl. This pathway has a high conversion, a high yield, uses relatively cheap raw materials, as well as a very high atom efficiency since the reaction does not create any byproducts when producing propionic acid. Separation of crude propionic acid from the aqueous reaction effluent can be done with LLE using a multitude of solvents such as 1-octanol in TOPO. This is beneficial as using liquid-liquid extraction as much as possible reduces the amount of distillation that must be done in order to purify the product.

Viewable Components

Propionic Acid Structure



Continuous liquid-liquid Extraction



Industrial Glass Liquid-Liquid Extractor

References:

(N.d.-a). photograph. Retrieved 2024, from https://udtechnologies.com/industrial-glass-equipment/glass-liquid-extraction-systems/.

(N.d.-b). Retrieved 2024, from https://pubchem.ncbi.nlm.nih.gov/compound/Propionic-Acid#section=Crystal-Structures.

(N.d.-c). photograph. Retrieved from https://armfield.co.uk/wp-content/uploads/2020/02/Armfield-UOP5MkII-retouched.jpg.

Treybal, R. E. (1982). *Mass-transfer operations*. McGraw-Hill.

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