

Recovery of Pure Acetonitrile using Pressure swing distillation

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Introduction

The use of Acetonitrile as a solvent in various sectors is increasing day by day. The alternate way for the production of acetonitrile is by Ethanol ammoxidation. This process is all about use of Pressure swing distillation for the production of acetonitrile. Two types of column are used here High pressure column (HPC) and Low pressure column (LPC) operating at 1 bar and 7 or 10 bar pressure respectively.

Background:

According to the report, the global acetonitrile market reached a volume of 113 Kilotons in 2018.

Acetonitrile is mostly used as solvent for fine chemical and pharmaceutical industry. It is used for synthesis of pharmaceutical product such as vitamin B12 and sulfapyrimidine as a intermediate to produced pesticides. It is also widely used as polar aprotic solvent. Ex. purification of butadiene, production of synthetic fibre and paint. It is also used as extraction solvent for fatty acids from animal and vegetable oil. It is also used as an entrainer for distillation in petrochemical industry.

Flowsheet description:

In DC-01 Feed stream contain the mixture of recycle stream and material stream S-01 which is entering from 7th tray. The column DC-01 is working at low pressure 1 bar and temperature 84.1 °C. Bottom product of DC-01 contain about 0.99 mole fraction of water while the distillate contain 0.4943 mole fraction of acetonitrile. The distillate further treated by entering in the column DC-02 where purification of acetonitrile is carried out as bottom product and remaining component collects as distillate. The bottom product contain 0.70 mol fraction of acetonitrile which acts as feed for DC-03. The DC-03 works at high pressure around 7 bar so we required centrifugal pump to meet the required pressure. The bottom product from DC-03 contain pure acetonitrile (0.983 mole fraction) while the distillate once again recycle back to the column DC-01. The valve is used to decrease the pressure from 7 bar to 1 bar.

Result:

Mole Fraction Component	Column			
	DC-01		DC-03	
	Top	Bottom	Top	Bottom
Water	0.2056	0.9830	0.4380	0.0134
Acetonitrile	0.4936	0.01421	0.5619	0.9865
Hydrogen Cyanide	0.06496	0.00270	2.136E-5	1.096E-9
Ammonia	0.1347	9.304E-7	4.9823E-17	4.660E-20
CO ₂	0.1010	7.014E-21	2.894E-17	2.673E-19

Conclusion:

To maximize the purity and separation of acetonitrile recovery to 99.9% is been performed by the ammoxidation process of ethanol. The complex water-acetonitrile azeotrope is been separated by pressure swing distillation operated at different pressure and dichloromethane is used as entrainer.

Pressure swing allow to achieve higher acetonitrile recovery greater than 95% with highly purity greater than 99.9% and purity can be increased by setting a number of tray in stripping section of the high pressure column.

Units of system used:

Pressure : Bar

Temperature : Celsius (⁰C)

Heat Duty : kW

Molar Flow Rate : kmol/hr

Reference

Tripodi, Antonio, et al. "Pressure-swing or extraction-distillation for the recovery of pure acetonitrile from ethanol ammoxidation process: A comparison of efficiency and cost." *Chemical Engineering Research and Design* 127 (2017): 92-102.