

Separation of Methyl Acetate/Methanol/Acetaldehyde using Pressure Swing Distillation

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Introduction

It is a method used for separating a pressure – sensitive azeotrope. A simple change in pressure can alter the relative volatility of the mixture with close boiling temperature. This method requires no additional entrainer and separation takes place with the help of two columns operated at different pressures. This process is far simpler than multiple compound distillation and very robust.

Abstract

The normal boiling points of methanol and methyl acetate are 64.53 °C and 57.05 °C, respectively. At atmospheric pressure, a minimum boiling azeotrope forms with 82.27 wt % methyl acetate at 53.62°C.

Alcoholysis solution contains a ternary mixture of methyl acetate/methanol. In addition to that it also contains a very small quantity of acetaldehyde. Acetaldehyde may decrease the quality of the products which are made from alcoholysis solution, for example manufacturing of Polyvinyl Alcohol, etc.

In order to remove acetaldehyde, we use the process of pressure swing distillation with a side withdrawal. Due to this the small quantity of acetaldehyde is removed. And it cannot be further accumulated with the mixture. Using this procedure for a number of iteration we can separate methyl acetate and methanol.

Process Description

In the setup we use two distillation columns, i.e. a DC-01 (Low Pressure Column, 1 atm, 33 stages, Reflux ratio 239.763) and a DC-02 (high pressure Column, 10 atm, 31 stages, Reflux ratio 1.2996).

Feed containing 0.75 Methyl Acetate, 0.2495 Methanol and 0.0005 Acetaldehyde mass fractions respectively is sent to DC-01.

Since the normal boiling point of acetaldehyde is 21.06 °C, which is 30 °C lower than the boiling point of azeotrope, we cannot proceed with a conventional PSD process. Hence, we use a side withdrawal to remove the acetaldehyde.

A liquid side withdrawal is introduced into the DC-02, and the distillate of the DC-02 is recycled into the DC-01. Similarly, high purity products can be obtained from the bottom of the two towers, respectively. This iteration continues till the process converges.

Results

Stream Properties

Object	S-01	S-02	SD-01	S-03	S-04	S-05	S-06	
Temperature	25	52.6621	53.6823	64.6039	130.793	143.318	130.796	C
Pressure	1.01325	1.01325	1.01325	1.01325	10.1325	10.1325	10.1325	bar
Mass Flow	3000	49.6167	5632.26	739.907	3422.23	2210.01	3421.84	kg/h
Mass Fraction (Mixture) / Methyl acetate	0.75	0.802063	0.796265	4.23815E-08	0.664768	0.999928	0.664719	
Mass Fraction (Mixture) / Methanol	0.2495	0.176576	0.203395	1	0.334673	7.14376E-05	0.334849	
Mass Fraction (Mixture) / Acetaldehyde	0.0005	0.021361	0.000339517	4.92037E-12	0.00055863	1.4548E-07	0.000431667	

References:

Design and control of fully heat-integrated pressure swing distillation with a side withdrawal for separating the methanol/methyl acetate/acetaldehyde ternary mixture

Yixuan Chen, Cheng Liu, Zhongfeng Geng