

**SIMULATION OF PRESSURE SWING DISTILLATION OF ETHYL ACETATE,  
ETHANOL AND WATER.**

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**Background & Description:**

Pressure-swing distillation (PSD) is the process which is utilized to separate the pressure-sensitive mixture with close boiling point or forming azeotrope. A simple change in pressure can alter relative volatility of the mixture with close boiling point or forming azeotrope.

This flowsheet emphasizes on PSD of ethyl acetate-ethanol-water. The boiling points of ethyl acetate, ethanol and water are 77.1, 78.37 and 100 degree Celsius respectively. Hence conventional distillation becomes difficult when dealing with these azeotropic mixtures. Thus PSD proves to be extremely useful for separations of such mixtures.

OpenModelica editor is used to simulate the flowsheet here.

The feed stream containing ( 0.42389698, 0.57291582, 0.0031872071 ) mole fractions of ethyl acetate, ethanol and water, flowrate of 0.4354 mol/s, enters Distillation column-1 (Discol1) at a pressure of 500000 Pa and temperature of 298 K. The (discol1) is also called as “ High pressure Column” because of its high operating pressures around 500000 Pa.

The bottom product (b1) of 1<sup>st</sup> distillation column contains 98.7147 % pure Ethyl acetate (mass fraction = 0.993238) while top product(d1) obtained is a mixture of all the 3 feed components. This distillate is again fed to 2<sup>nd</sup> Distillation column (LPC) at 402 K. The 2<sup>nd</sup> distillation column is operating at low pressure about 101325 Pa, which is mandatory for maximum separation. The bottom product (b2) obtained contains 99.999% of pure ethanol (Mass fraction = 1.00017).

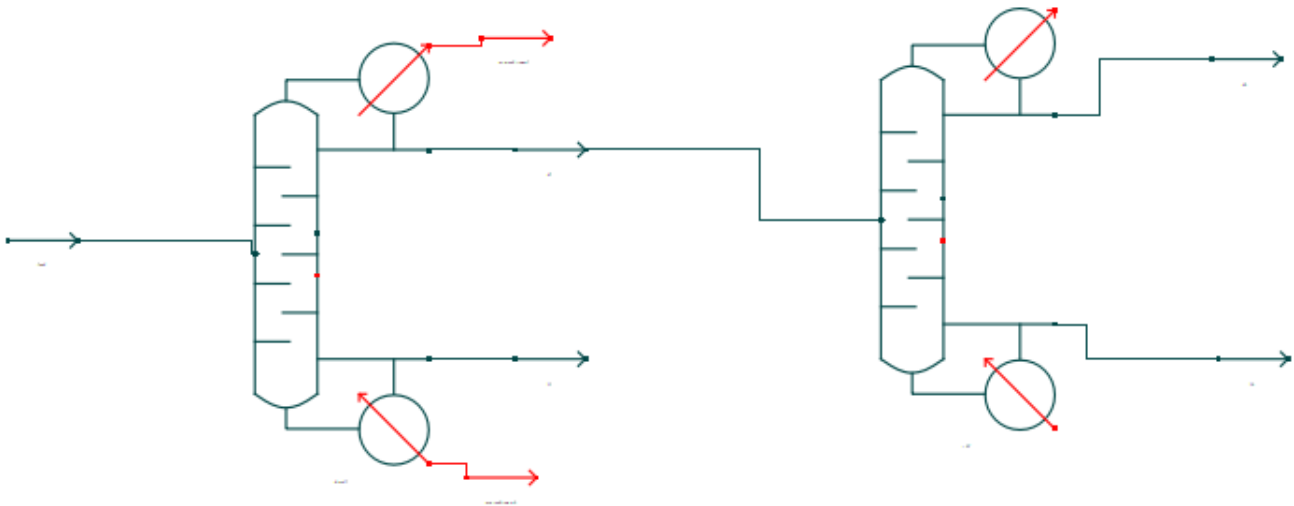
**Operating conditions for the distillation columns are given below:**

1. High pressure distillation (Discol1): Number of stages = 12, feed tray =4.
  - Reflux ratio – 1.3
  - Condenser pressure – 500000 Pa
  - Reboiler pressure – 500000 Pa
  - Bottom flowrate – 0.0210503 mol/s

2. Low pressure distillation (LPC): Number of stages = 4, feed tray = 3.

- Condenser pressure – 101325 Pa
- Reboiler pressure – 101325 Pa
- Distillate composition of ethyl acetate – 0.40026401
- Bottoms composition of ethanol – 0.9991088

**Flowsheet:**



**Results:**

Result Table				
Streams	d1	b1	d2	b2
Temperature (K)	402.238	408.273	351.321	351.823
Pressure (Pa)	500000	500000	101325	101325
MF (Ethyl acetate)	0.395278	0.987147	0.400264	0
MF (Ethanol)	0.601373	0.012853	0.59636	0.99109
MF (Water)	0.00334914	0	0.00337583	0.00123156
MAF (Ethyl acetate)	0.556409	0.993238	0.561553	0
MAF (Ethanol)	0.442627	0.0067	0.437478	1
MAF (Water)	0	0	0	0

\*\* **NOTE** : MF = Mole fraction, MAF = Mass fraction\*\*



# OpenModelica

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## Flowsheeting Project