# Pressure-Swing-Distillation Process for Separation of Tetrahydrofuran/Methanol

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## Background

Tetrahydrofuran (THF) is one of the most commonly used solvents in the chemical and the pharmaceutical industries due to its excellent dissolution ability. The production of steroid drugs faces the problem of separating solvent which contains THF and methanol. The separation and recycle of THF and methanol are of high economic significance and environmental importance. However, difficulty occur in the separation process because a minimum-boiling azeotrope is formed in the binary system.

The pressure-swing-distillation (PSD) process, commonly used to separate azeotropic mixtures based on the shift of the relative volatilities and azeotropic compositions by changing the system's pressure, is another suitable separation method for the separation of azeotropes. Efficient separation is achieved by two columns operating at two different pressure.

## Azeotropic data of Tetrahydrofuran/Methanol
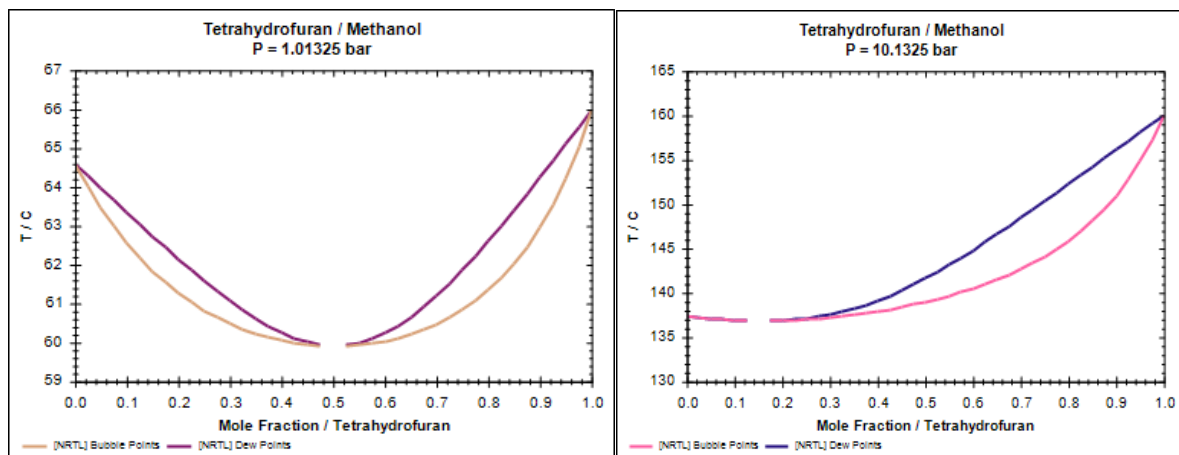


Figures: Effect of pressure on azeotropic composition and temperature.

As shown in the figure, at atmospheric pressure (1 atm) azeotropic composition is near 45 mol% of Tetrahydrofuran and  and 55 mol% Methanol. At 10 atm the azeotropic composition is changed to near 21 mol% of Tetrahydrofuran and 79 mol% of Methanol.

## Description of Flow-Sheet

In this flow-sheet We use two distillation column with different pressure (1 atm and 10 atm). In low pressure column we enter a feed; This feed are concentrated near the azeotropic composition at 1 atm,and the 99.9 mol% Methanol are collected from the bottom. The top stream of low pressure column are now enter to the high pressure column where it's composition are changed with the azeotropic composition at 10 atm, and the pure Tetrahydrofuran are collected from the bottom of that column and the top stream of high pressure column are recycled to the low pressure column. The composition of feed and other data of columns are given in the result section.

## Result

Feed stage
  i. For feed  : 24 from top
  ii. For D2   : 34 from top
  iii. For D1   : 30 from top

| STREAM | | | | |
|---|---|---|---|---|
| Object feed | Feed | B1 | B2 | |
| Temperature | 46.85 | 64.5788 | 159.904 | C |
| Molar Flow | 100 | 75.4459 | 25.0528 | kmol/h |
| Molar Fraction (Mixture) / Tetrahydrofuran | 0.25 | 0.001 | 0.999 | |
| Molar Fraction (Mixture) / Methanol | 0.75 | 0.999 | 0.001 | |

Table:Result data

## References

1. Yinglong Wang,* Peizhe Cui, and Zhen Zhang. "Heat-Integrated Pressure-Swing-Distillation Process for Separation of Tetrahydrofuran/Methanol with Different Feed Compositions."Ind. Eng. Chem. Res. 2014, 53, 7186-7194.
2. Zheng, Z.; Li, F.; Wen, Y.; Liu, X. "Recovery of Tetrahydrofuran and Methanol from Pharmaceutical Wastewater by the Extractive Distillation." Chem. World 2010, 12, 734-737.