

Assignment 1: A Distillation Tower Excel Simulator DUE DATE: 28 February 2021

Using excel, design a distillation column simulator that operates with a total condenser with reflux, as well as a reboiler for the binary acetone-water separation. Acetone is the more volatile component of the system. The feed to the process is an Acetone-Water liquid mixture at 25°C. The feed flowrate is fixed at 100kmol/h. The feed composition (x_F) is fixed at 55mol% acetone. The distillate product at the top is variable starting at a minimum of 96mol% acetone mole fraction (x_D). The bottoms product can be variable up to a maximum of 2mol% acetone mol fraction (x_B). A table for the equilibrium data for the acetone-water system is provided below.

The tasks of the assignment are:

- To design a simulator using the McCabe-Thiele method
- To determine the optimized column design variables for the required separation
- To estimate the capital and operating costs of the optimized column.
- Your submission must be both an **excel** simulator and **word** explanations on how the simulator works as you change some variables for optimization. State all assumptions & choices made and indicate the necessary justifications.

Given parameters:

- feed flow rate ($F=100\text{kmol/h}$)
- feed composition ($x_F = 0.55$)
- minimum concentration of the most volatile in the distillate (minimum $x_D = 0.96$)
- maximum concentration of the most volatile in the bottoms (maximum $x_B = 0.02$)
- A total condenser is used
- The column operates at atmospheric pressure
- The feed to the process is liquid at 25°C

Variable parameters:

- number of trays
- type of trays
- feed tray
- feed temperature (entering the column)
- reflux ratio.
- condenser duty
- reboiler duty
- distillate flow rate

Vapor-liquid Equilibrium Data for Acetone and Water at 1.00 Atm

Boiling Temperature, $T(^{\circ}\text{C})$	Mol Fraction Acetone in Liquid, x_{acetone}	Mol Fraction Acetone in Vapor, y_{acetone}
100	0	0
74.8	0.05	0.6381
68.53	0.1	0.7301
65.26	0.15	0.7716
63.59	0.2	0.7916
61.87	0.3	0.8124
60.75	0.4	0.8269
59.95	0.5	0.8387
59.12	0.6	0.8532
58.29	0.7	0.8712
57.49	0.8	0.895
56.68	0.9	0.9335
56.3	0.95	0.9627
56.15	1	1