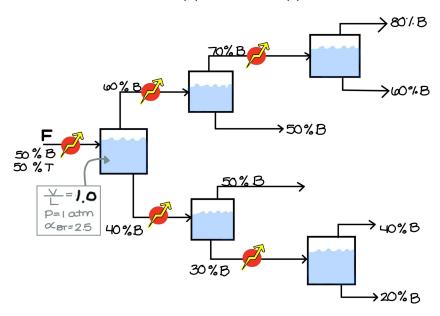
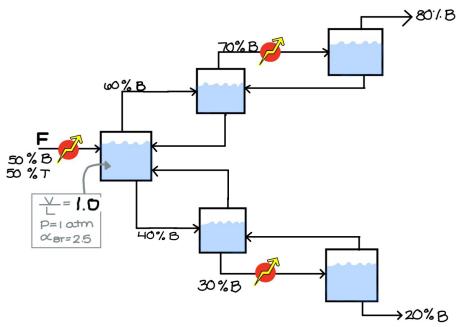
Chapter 6

Staging of Separation Processes

Consider the fractionation of a benzene (B) and toluene (T) mixture:



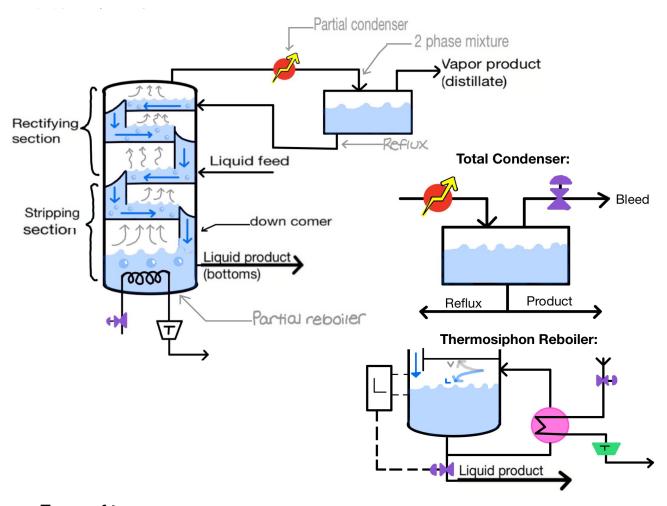
Recycle intermediate products from previous stage



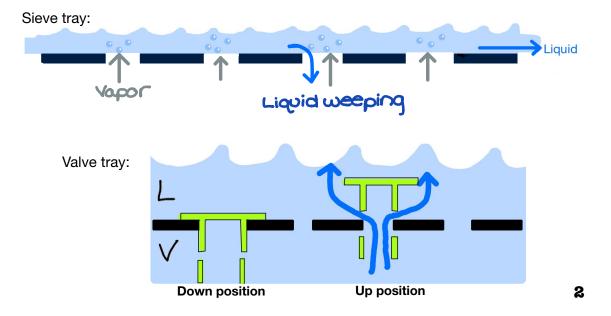
Points to remember:

- 1. Intermediate heating and cooling are only needed on the last stages when recycle is used
- 2. Recycle to previous stage is easiest in practice and the most "reversible" since there is relatively little mixing

Multistage Distillation Column



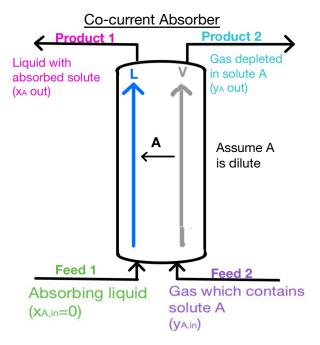
Types of trays:

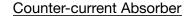


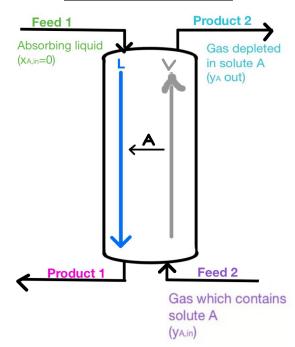
Can also employ "packed" columns. External piping is the same as a plate column.



Why use counter current contacting?





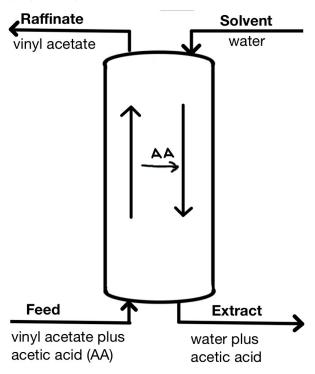


Assume dilute solute $y_A = K_A X_A$ (equilibrium) $y_{A,in} V = feed amount = A$

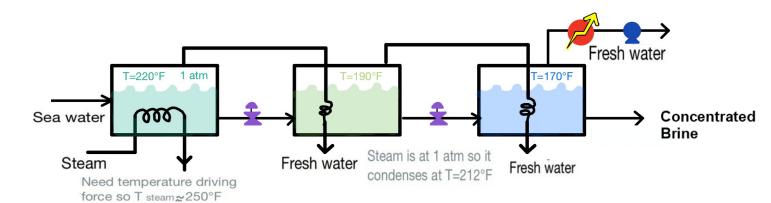
$$y_{A,out} = \frac{A}{V + L} = \frac{y_{A,in}}{K_A}$$

Methods to produce counter current flow:

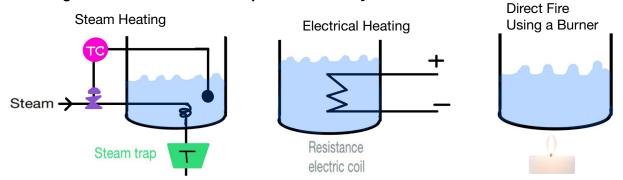
- 1. Convert a product stream into the counter current stream. This usually requires energy consumption, e.g. distillation
- 2. Add a mass separating agent e.g. liquid-liquid extraction



A second reason for staging is to increase energy efficiency, e.g. multi effect evaporation to product fresh water from sea water



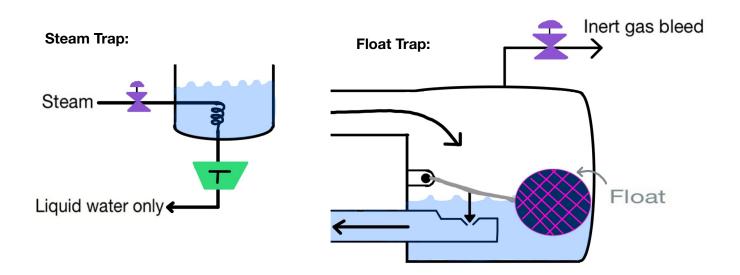
Heating methods in the chemical process industry:



Why is steam heating most often used? Because of control, safety and economic considerations

Electrical Heating: constant heat source

Steam Heating:



Calculation: amount of heat transfer when using steam

