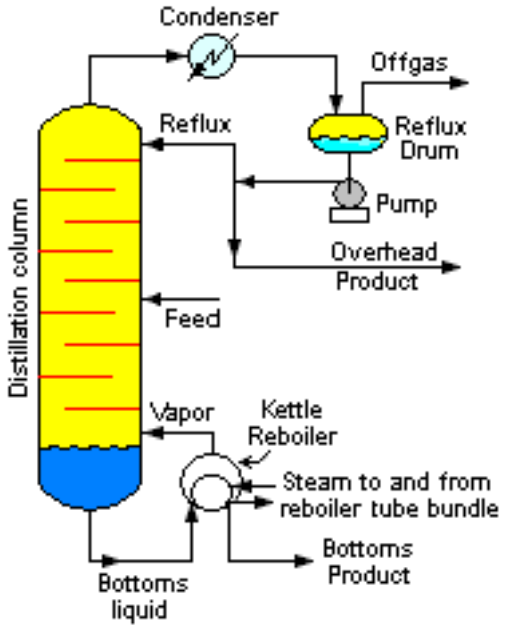
DISTILLATION/ABSORPTION COLUMN DESIGN

1800 or earlier

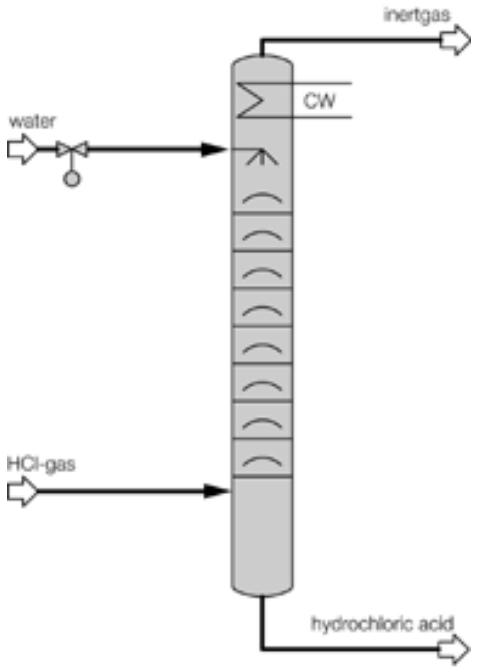
Now

DISTILLATION/ABSORPTION COLUMN DESIGN

Distillation

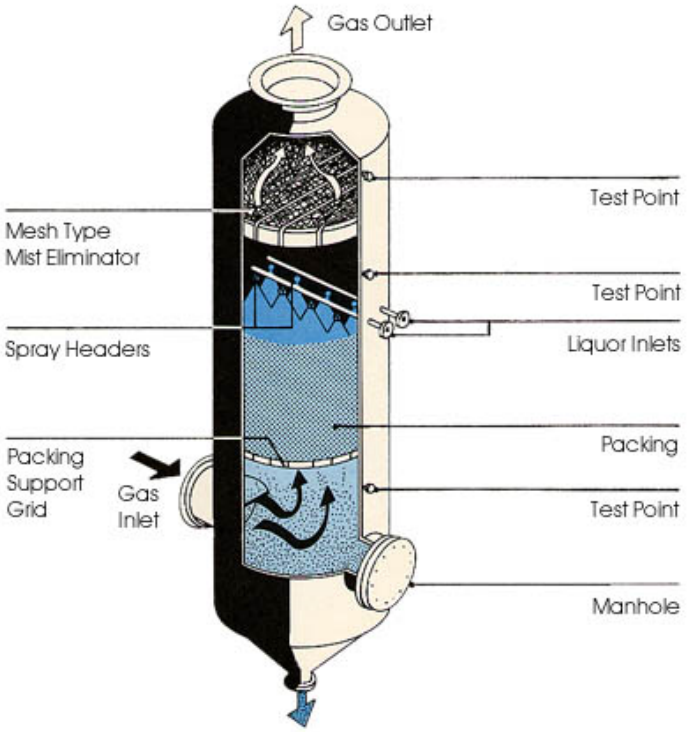


Absorption

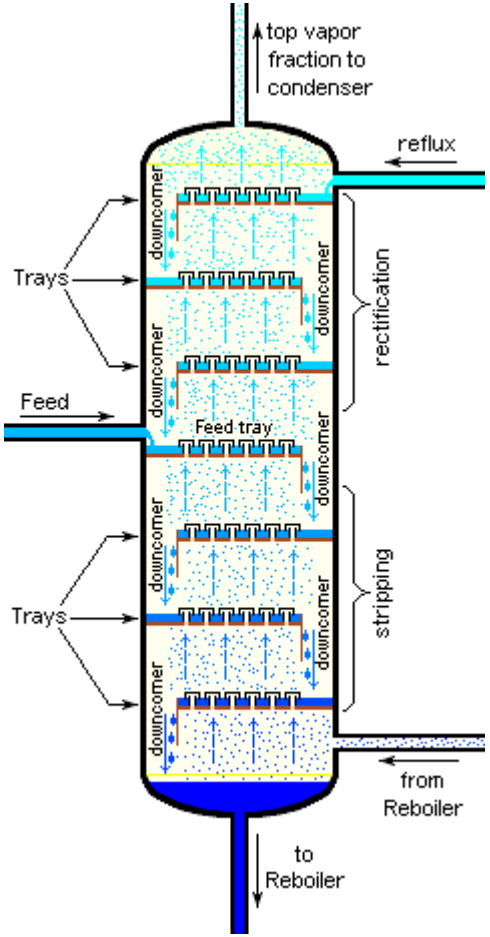


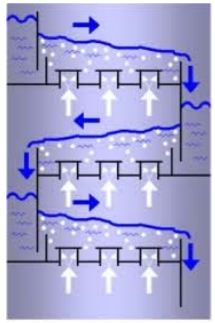
DISTILLATION/ABSORPTION COLUMN DESIGN

Packed Tower



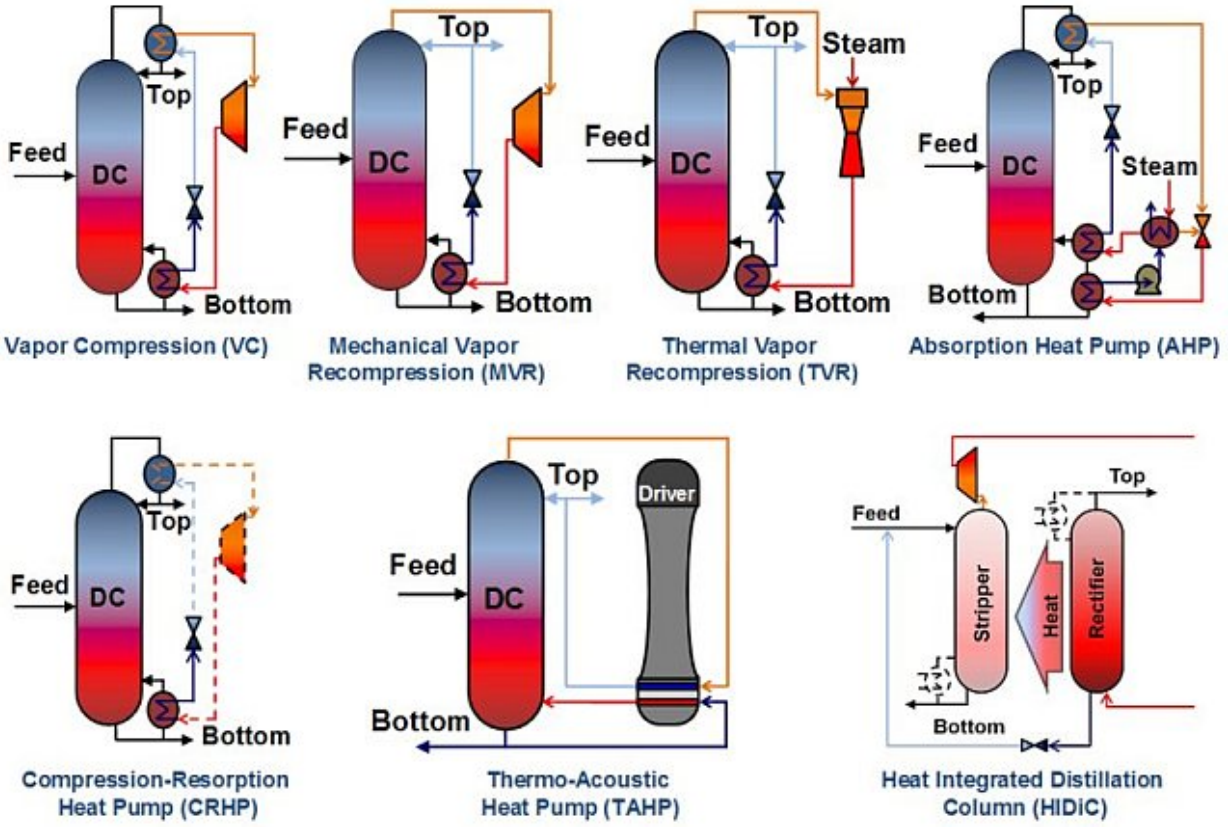
Tray tower





DISTILLATION/ABSORPTION COLUMN DESIGN

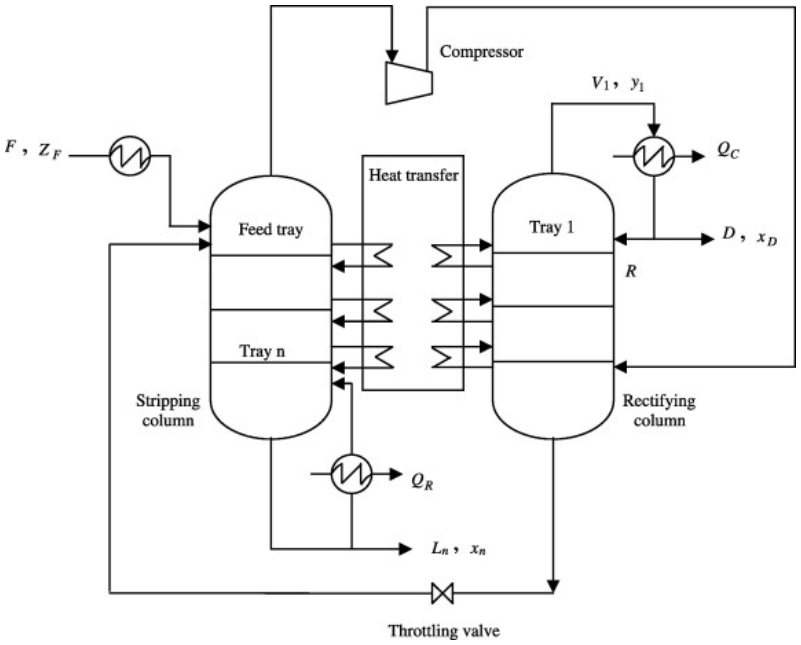
Complex Columns



DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns

Heat Integrated Distillation Columns (HIDiC)



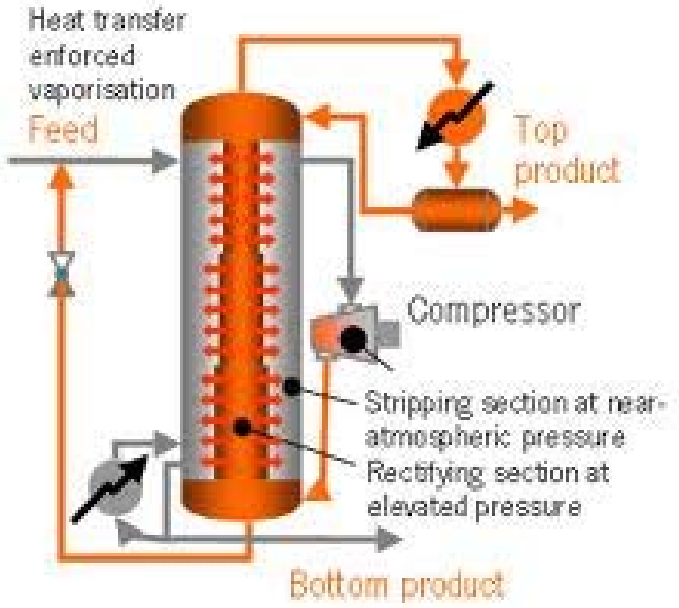
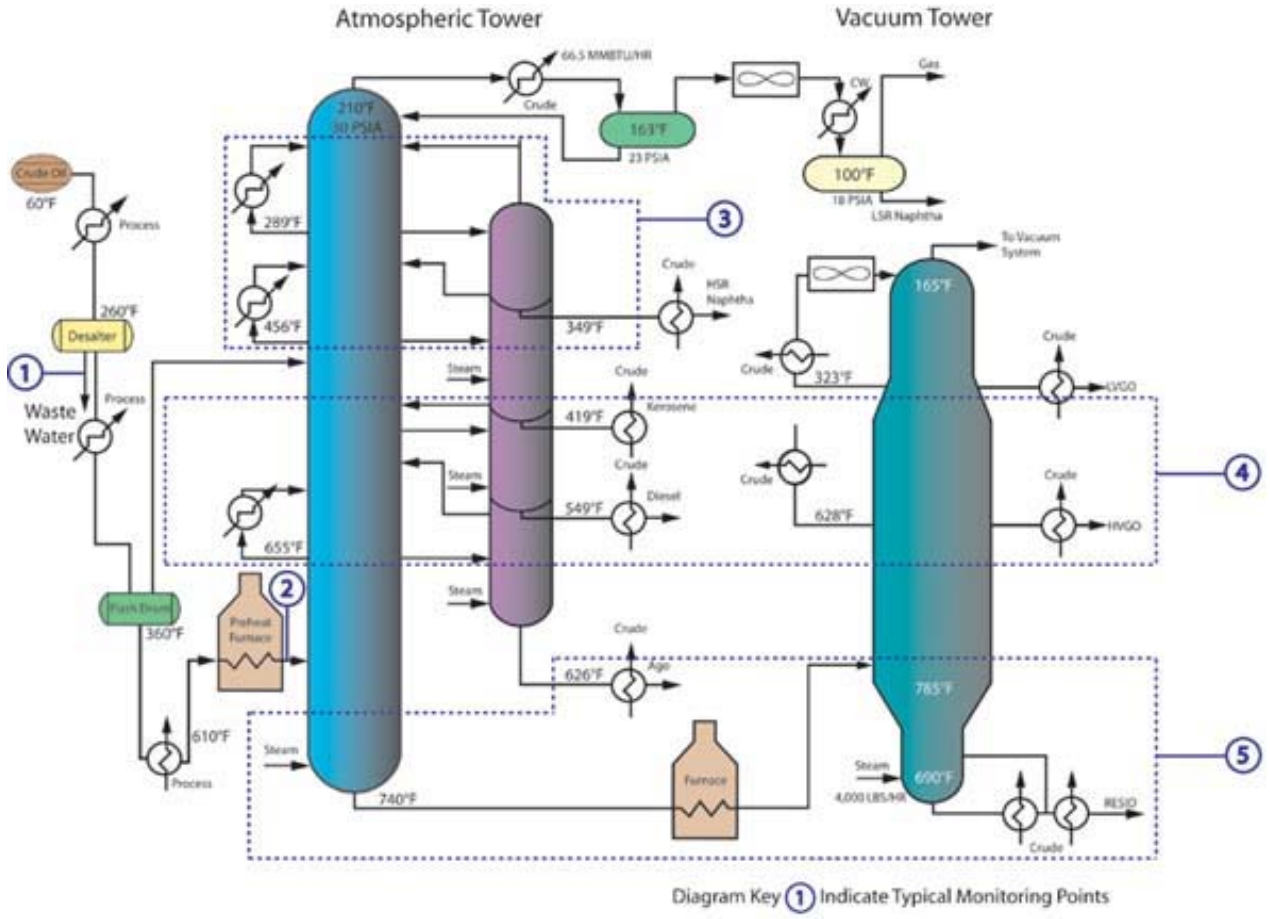


Fig. 1 HIDiC concentric tube column

DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns

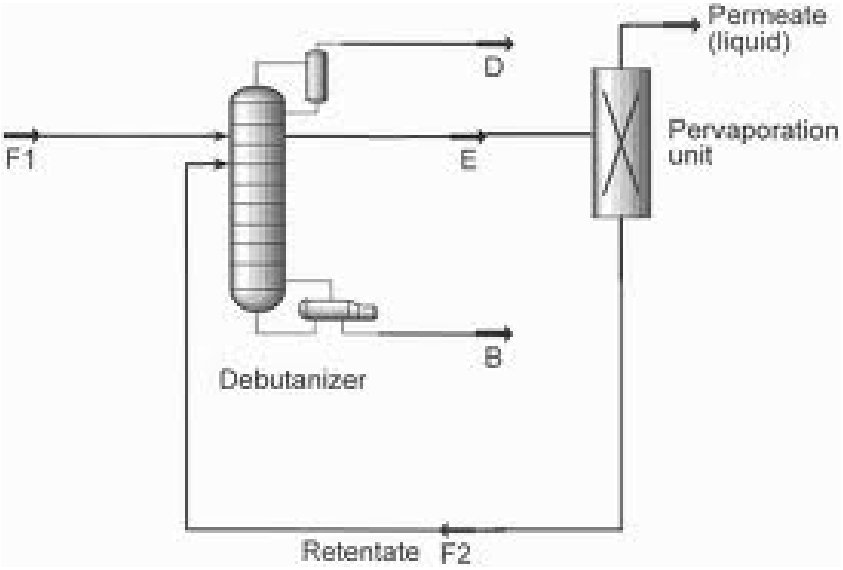
Petroleum Fractionation

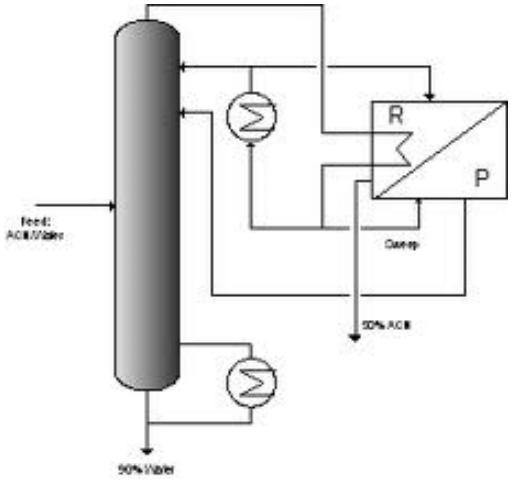


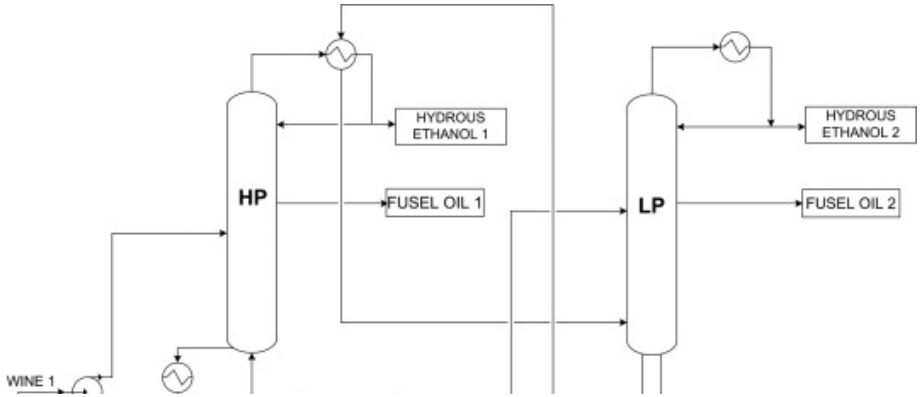
DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns

Pervaporation distillation



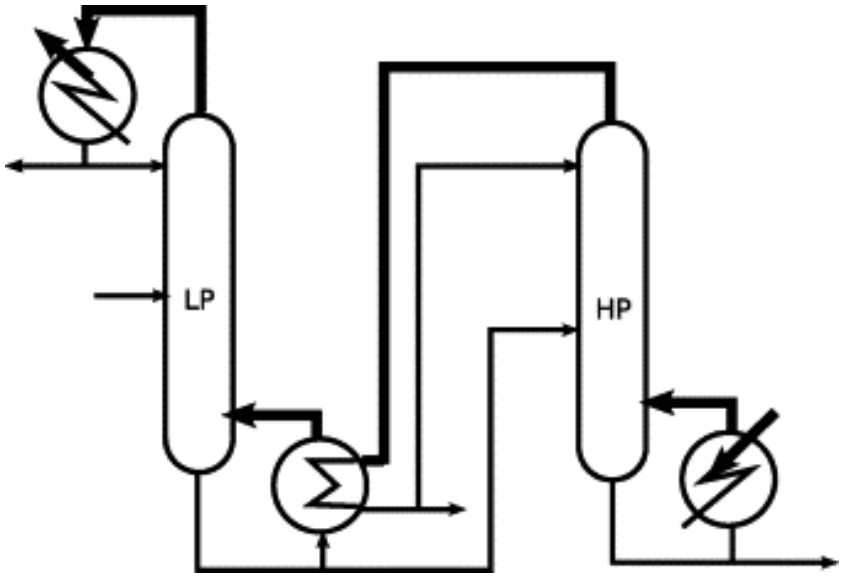




DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns

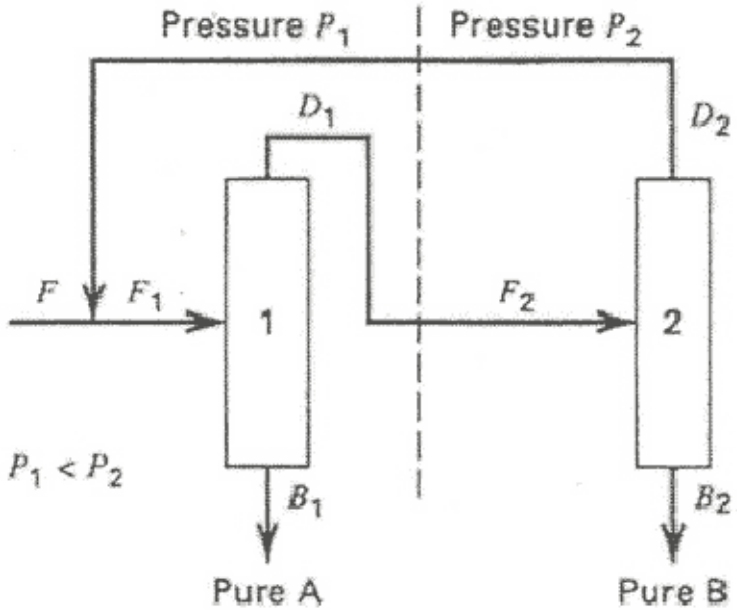
Double Effect

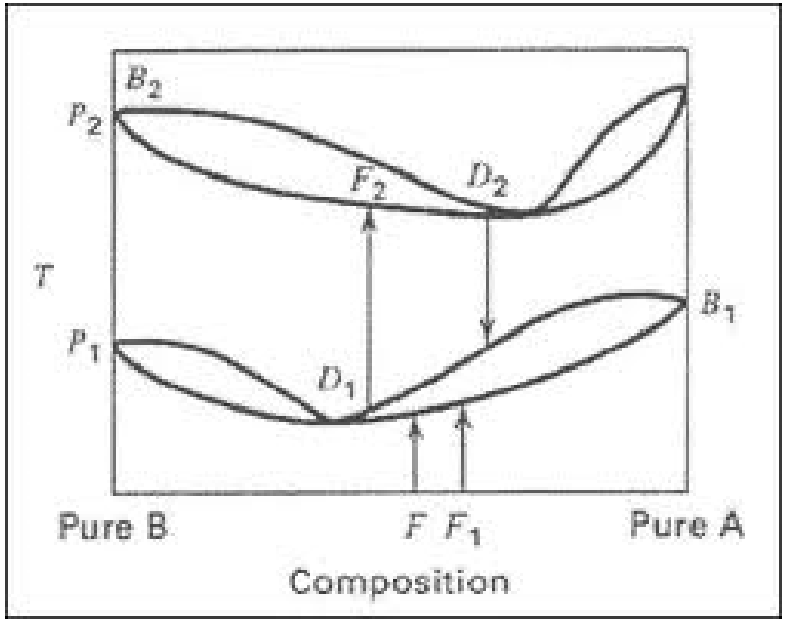


DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns

Pressure Swing Distillation

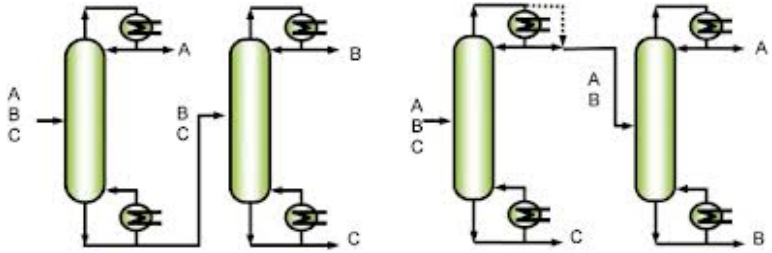


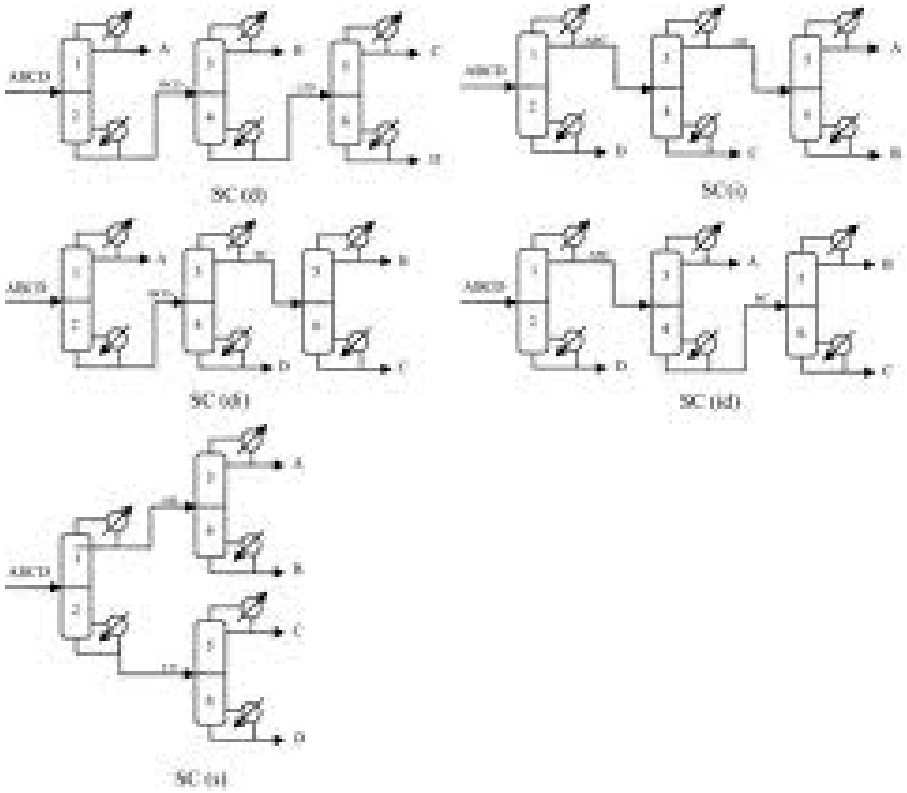


DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns Multicomponent cases

Simple Sequences

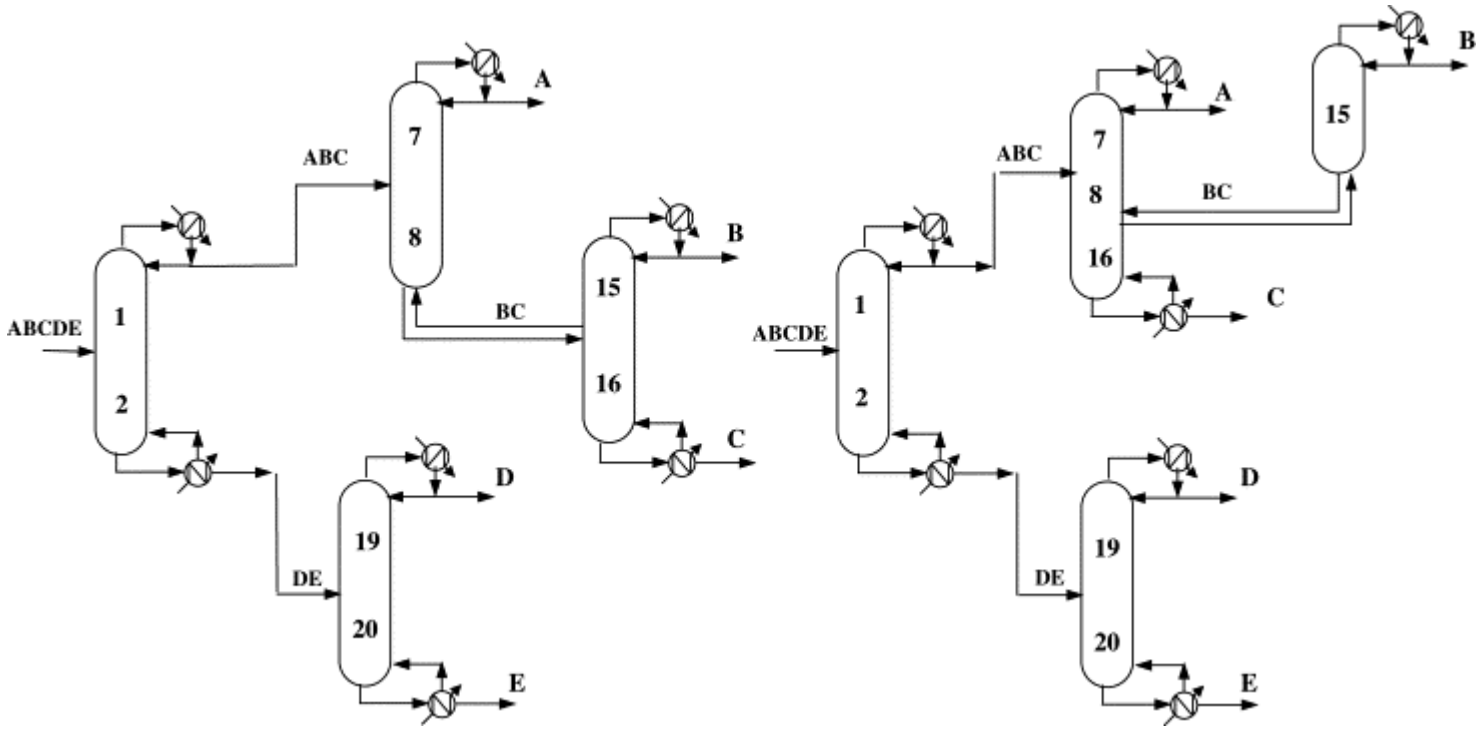




DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns Multicomponent cases

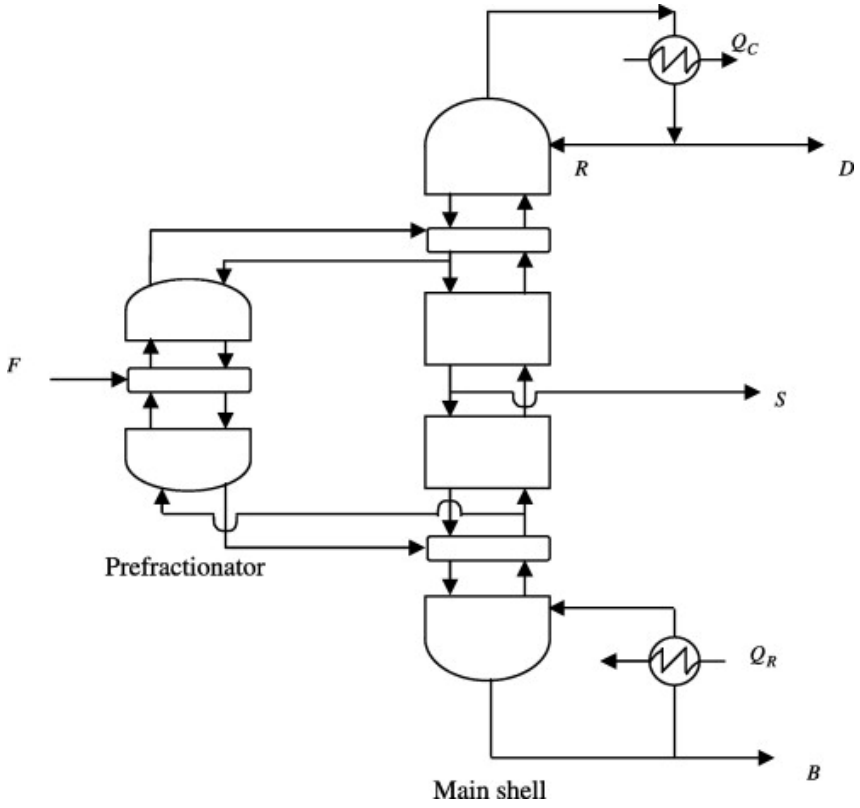
Simple Sequences



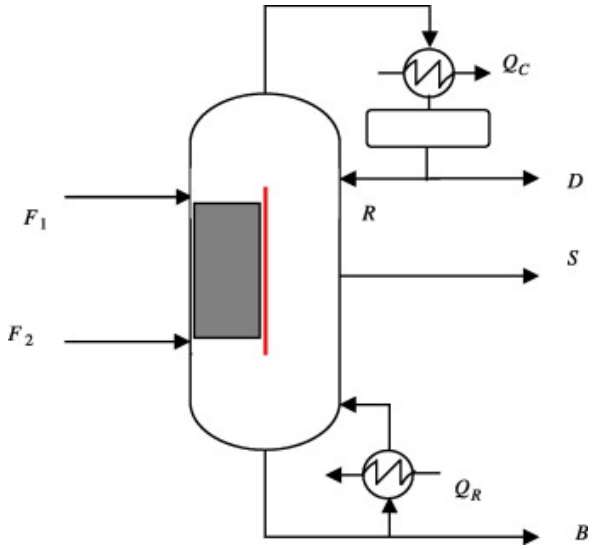
DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns

Petlyuk Colums (circa 1960)



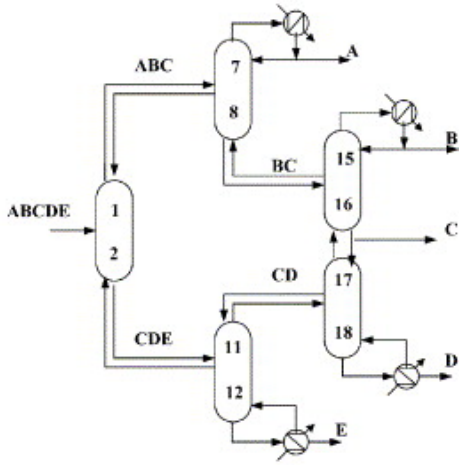
Divided wall column

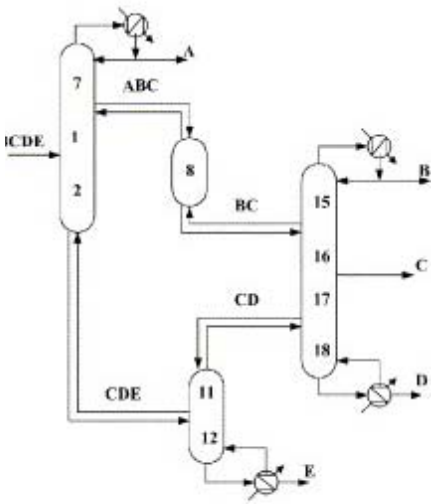


DISTILLATION/ABSORPTION COLUMN DESIGN

Complex Columns Multicomponent cases

Complex Sequences

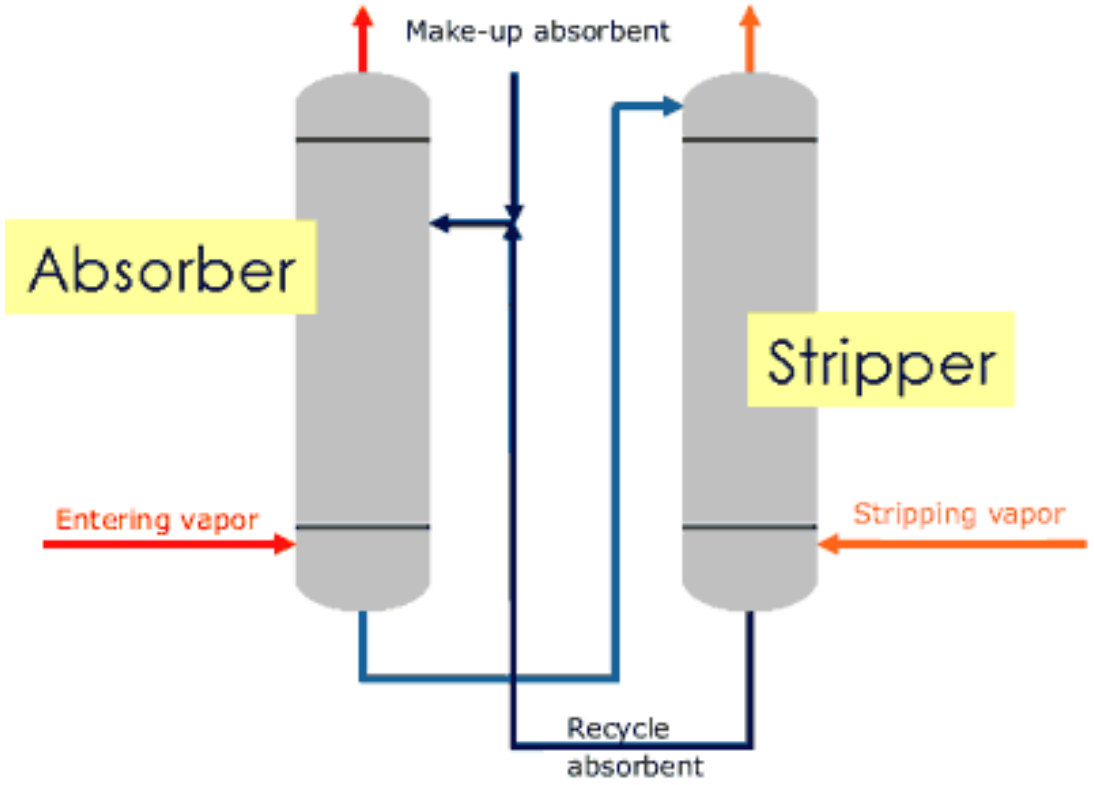




(b2)

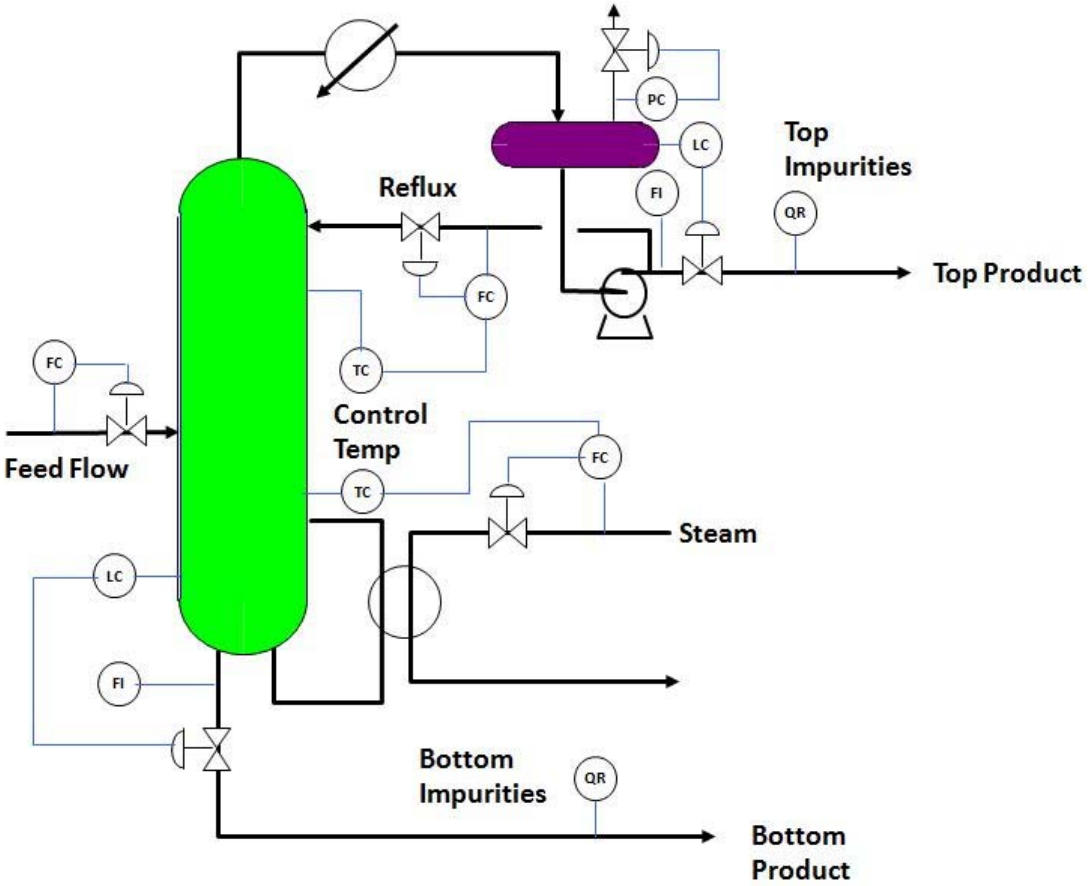
DISTILLATION/ABSORPTION COLUMN DESIGN

Absorber/stripper typical arrangement.



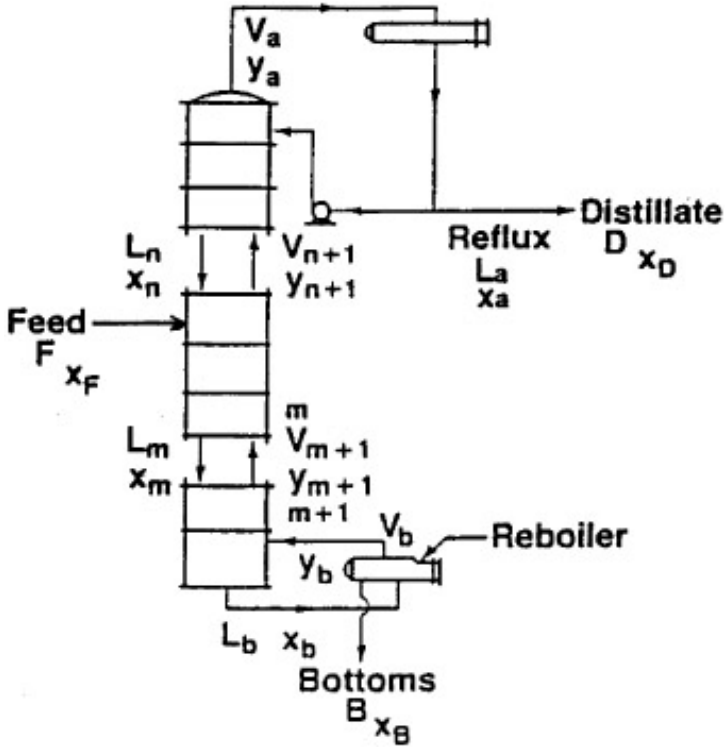
DISTILLATION/ABSORPTION COLUMN DESIGN

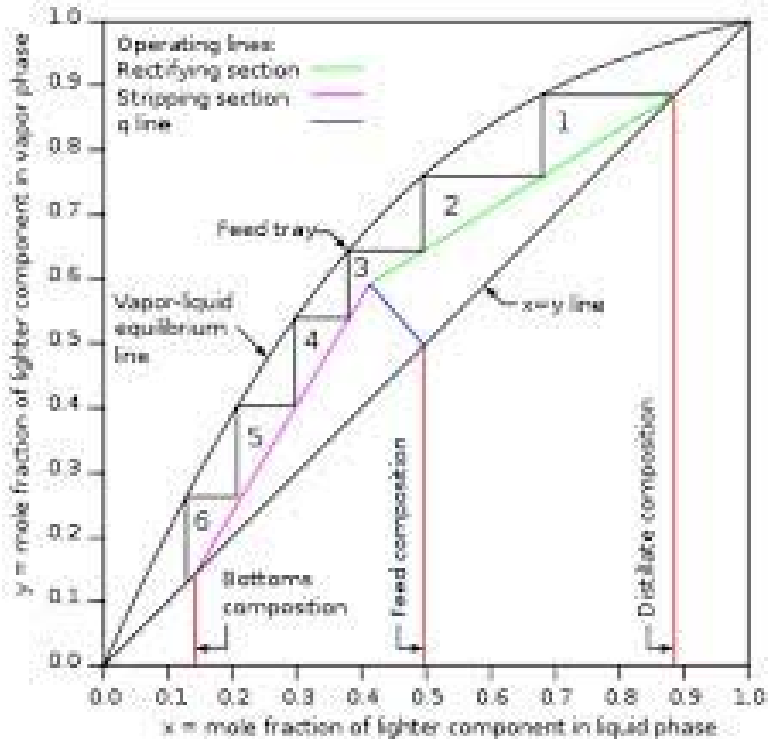
Distillation Control



DISTILLATION/ABSORPTION COLUMN DESIGN

BINARY SYSTEMS: Use McCabe Thiele





Given $x_{B \text{ and }} x_D$ → calculate RR, #trays, Feed tray, D, B → Design

Given $x_{D \text{ and}}$ RR (for fixed #trays and feed tray) → x_B , D, B → Operations

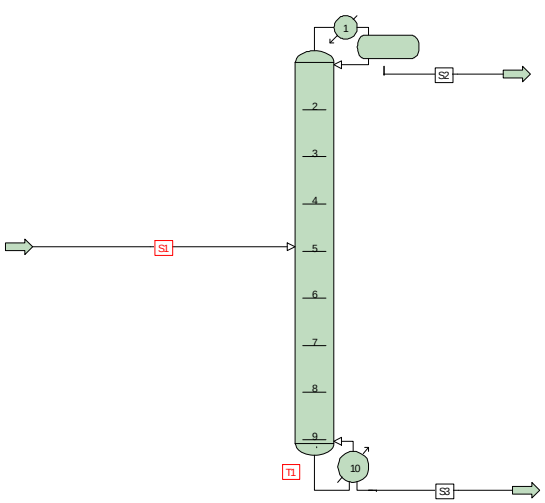
Given **2** operating values (for fixed #trays and feed tray) → the rest → Operations

DISTILLATION/ABSORPTION COLUMN DESIGN

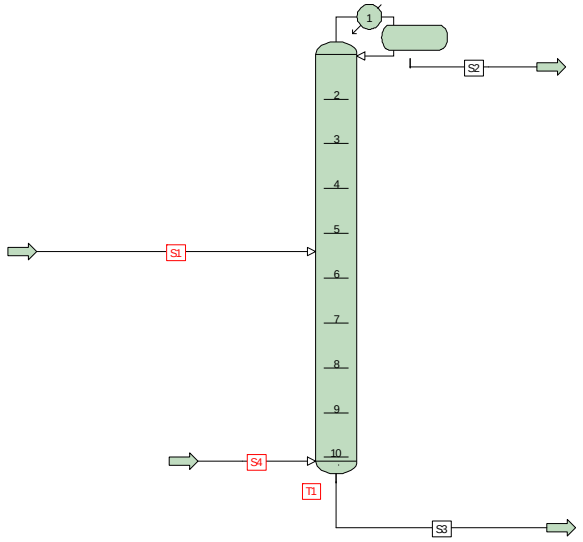
MULTICOMPONENT SYSTEMS : Use Computers!!!

Degree of Freedom= Number of unknowns – Number of equations

One per each condenser, reboiler or draw. See notes.



2



1

DISTILLATION/ABSORPTION COLUMN DESIGN

MULTICOMPONENT SYSTEMS : Use Pro II

Case 2: You know number of trays and feed tray location

You need to fix variables or add equations.

- Add Equations (The easiest), e.g. Reflux ratio and Recovery ratio
- Fix variables, e.g. Compositions, temperatures, flows, etc.

DISTILLATION/ABSORPTION COLUMN DESIGN

MULTICOMPONENT SYSTEMS :

Case 2: You know nothing, not even the number of trays needed.

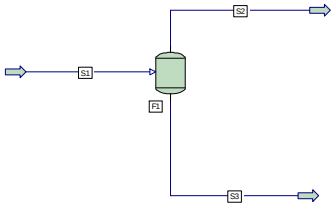
Use Fenske-Underwood Gilliland (see Separation Class Book) to get an idea

$$N = \frac{\log\left[\left(\frac{x_d}{1-x_d}\right)\left(\frac{1-x_b}{x_b}\right)\right]}{\log \alpha_{avg}}$$

Pro II has this shortcut

…. or if you are too lazy use Pro II as follows

1. Do not try blindly specs and number of trays. it won't work most of the time.
2. If you have many components do not include them all at the beginning. start with a few of the most abundant components.
3. Put an adiabatic flash first. if the feed is not two phase at the desired pressure, use an isothermal flash. Change the temperature until you get some separation in the direction you want.



To do this list the components in increasing boiling point and determine key components. Light key goes mostly to the top. Heavy key goes mostly to bottom.

Continues in next slide…

DISTILLATION/ABSORPTION COLUMN DESIGN

MULTICOMPONENT SYSTEMS : Use Pro II

Case 2: You know nothing, not even the number of trays needed.

Continued…

4. Replace the flash by a three plates column, with similar specs as those given by the flash outlet streams. It should not be a big problem to get it.

5. Add the components that are missing. Do it slowly, increasing their concentration until you reach the desired values.

6. Keep tightening the specs and increasing the number of plates accordingly, so that you meet the separation you want.