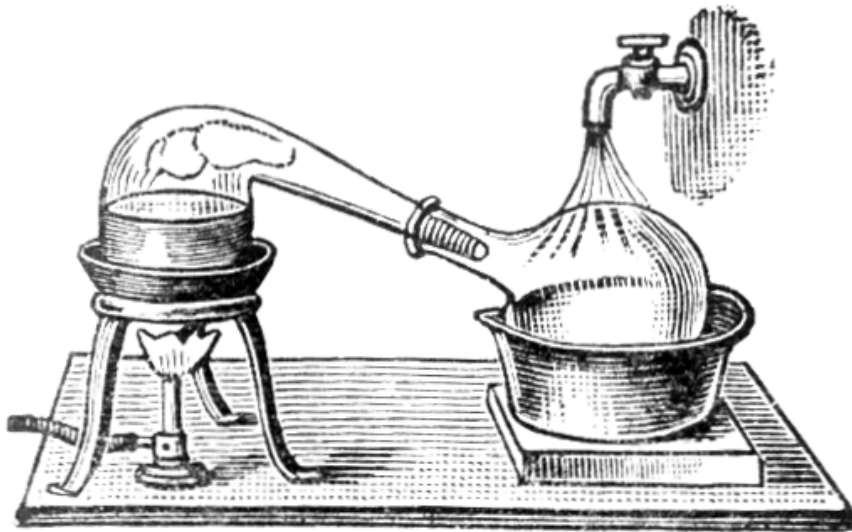


Design of Process Equipment-Distillation Column, CSTR and Adsorber

Introduction – Equipments'

Department of Chemical Engineering
SRM University

Distillation



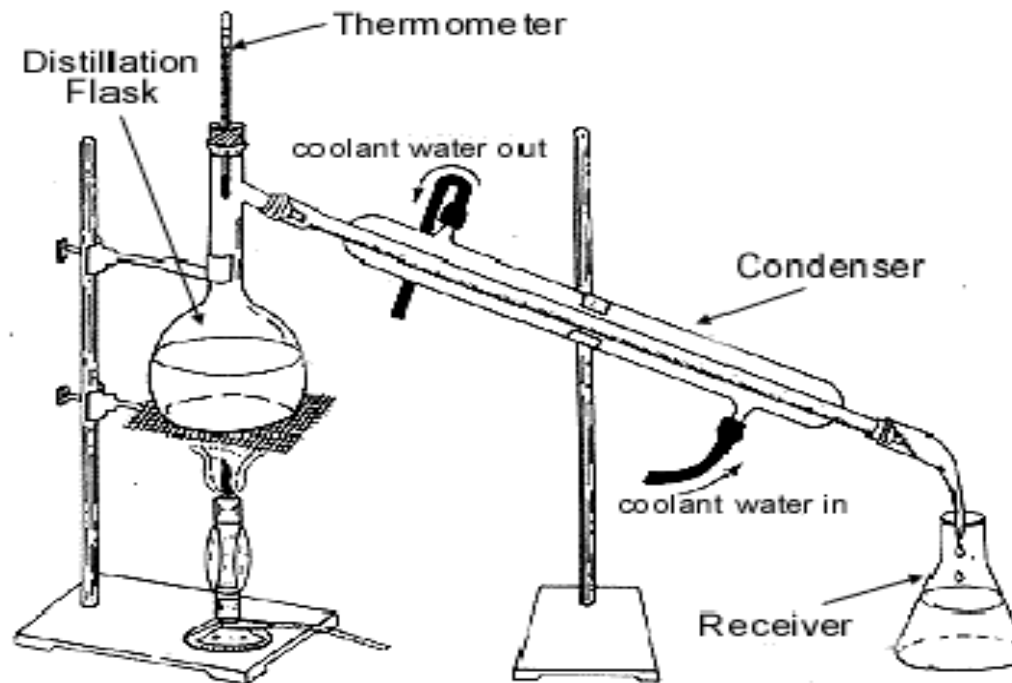
Distillation is the separation of liquid mixtures into their various components is one of the major operations in process industries and distillation is the most commonly used method of achieving this end and it is the key operation in any oil company

Distillation – Methods

There are three principal methods used in practice and all rely on the following:

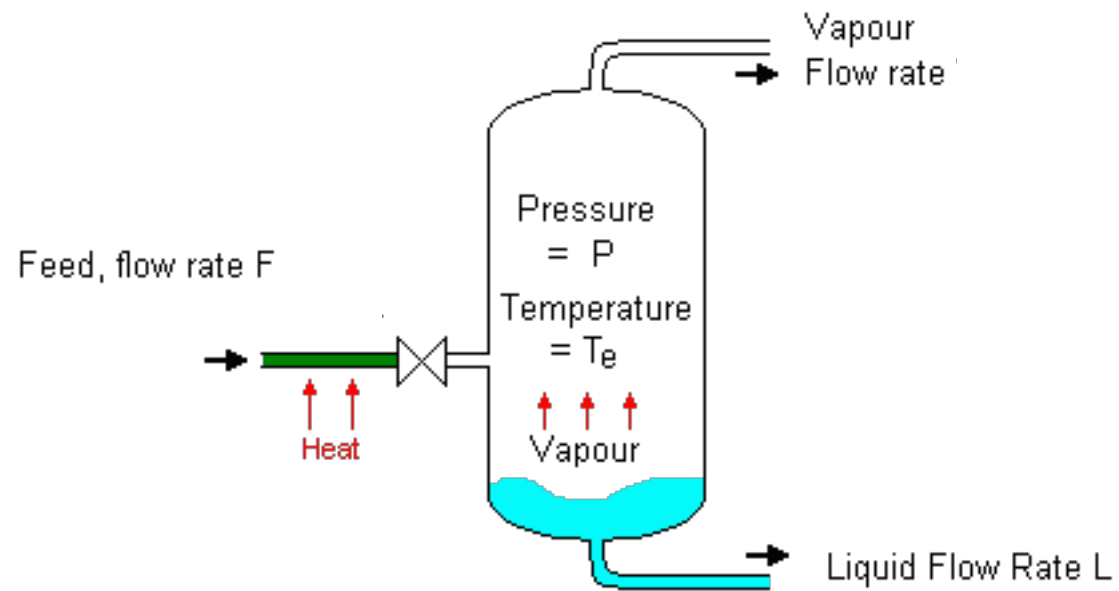
- i. Differential or Batch distillation
- ii. Flash distillation
- iii. Continuous or Rectification

Distillation - Differential (or) Batch Distillation

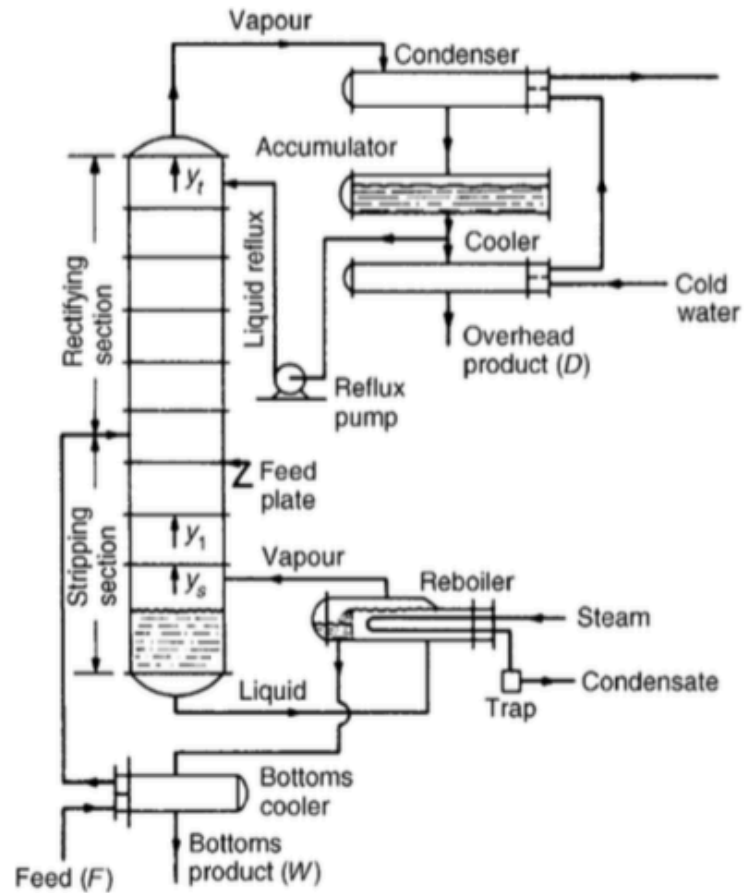


<https://en.wikipedia.org/wiki/Distillation>

Distillation - Flash Distillation



Distillation - Continuous or Rectification



Distillation - Flash distillation

Note: Of the three principal types, rectification is the most important and it differs from the other two methods in that part of vapor is condensed and returned as the liquid to the still, whereas, in the other methods, all the vapor either removed as such or condensed as product.

Distillation - Other Methods

Based on modes of operation – Batch and Continuous

Based on pressure employed – atmospheric and vacuum

Based on components – Binary and Multicomponent distillation

Reactors - types

The reactors are the heart of the chemical production process
It is the one of the main place where the raw materials are converted into products and reactor design is a vital step in the overall design of process.

Reactors – types

Mode of operation : Batch and Continuous

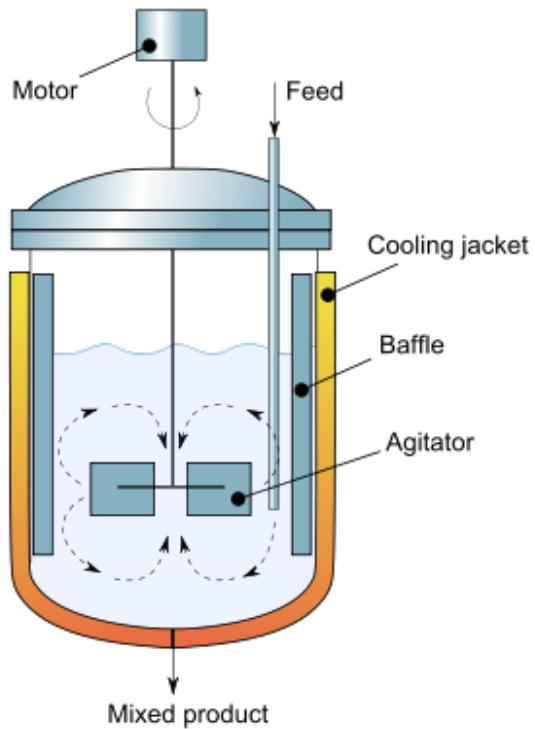
Phases present : homogeneous or heterogeneous

Based ideality : ideal and non-ideal

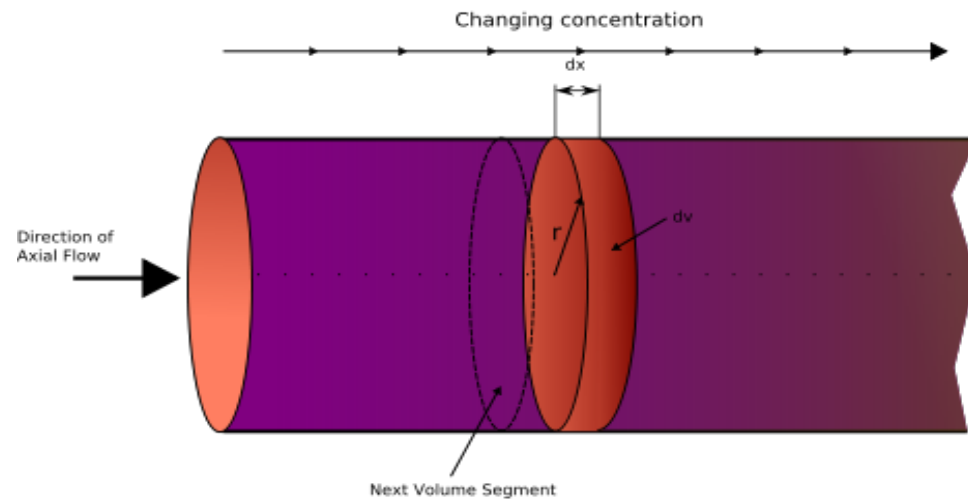
Based on catalyst use and contact pattern:

- i. Continuous stirred tank reactor
- ii. Tubular or plug flow reactor
- iii. Packed bed reactor
- iv. Fixed and moving bed reactor
- v. Fluidized bed reactor

Reactors - types

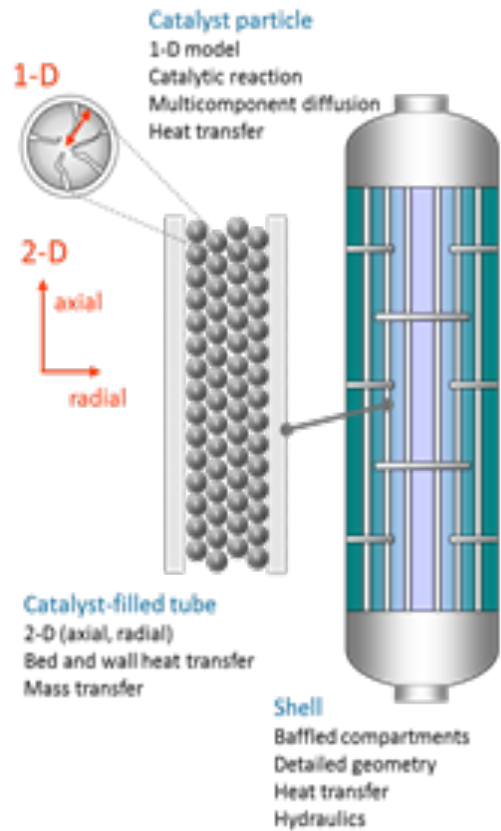


Constant Stirred Tank Reactor

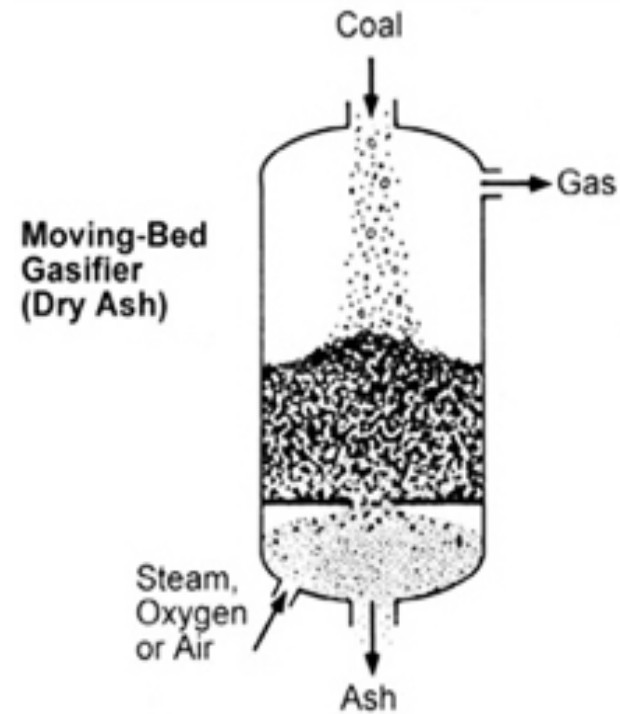


Plug flow or Tubular reactors

Reactors - types

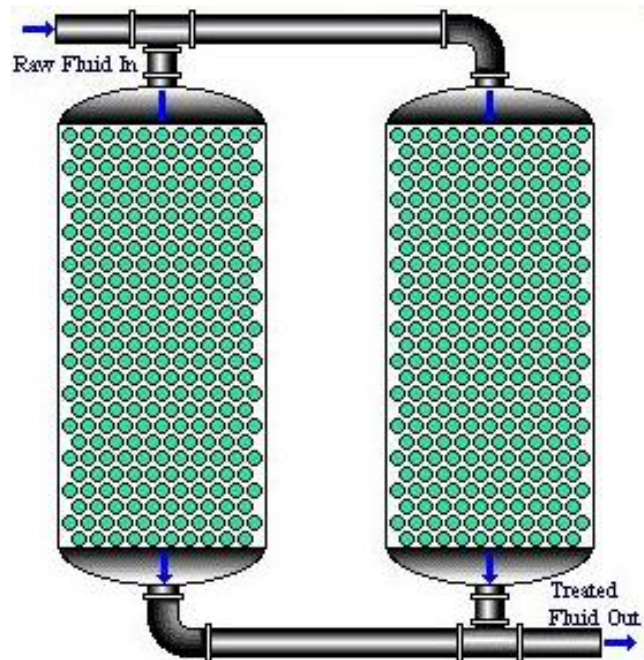


Packed bed reactor



Fixed and moving bed reactor

Adsorption



It is a process in which molecules of *adsorbate* attached to the surface of a solid adsorbant.

In otherwords, the ability of certain solids preferentially to concentrate specific substances from solution onto their solid surfaces

In this manner, the components of either liquid or gaseous solutions can be separated from each other.

Adsorption-Classification

Modes of operation – Batch and Continuous

Based on phenomena – Physical or Chemical adsorption

Based on contact pattern – Single and Multi stage contactors

Adsorption-Applications

Liquid Separations

- Decolorization of petroleum products and aqueous sugar solutions
- Removal of objectionable color and odor from water
- Fractionation of mixtures of aromatic and parafinic hydrocarbons

Adsorption-Applications

Gaseous Separations

- Used to dehumidify air and other gases
- Removal of objectionable color and impurities from industrial gases such as CO₂
- To recover valuable solvent vapors from dilute mixtures with air and other gases.
- To fractionate the mixtures of hydrocarbon gases containing substances as methane, ethylene, ethane, propylene and propane

Adsorption-Applications

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References

Coulson and Richardson, (2002) Particle Technology and Separation Science, Vol. – 2, 5th edition, Butterworth-Heinemann

<https://en.wikipedia.org/wiki/Distillation>

<http://jpkc.zzu.edu.cn/ehgrlx/109-thermodynamics/blackboard/lesson18/distillation.html>

http://www.psenterprise.com/processbuilder/libraries/aml_fbcr.html

<http://www.netl.doe.gov/research/coal/energy-systems/gasification/gasifipedia/fmb>

<http://encyclopedia.che.engin.umich.edu/Pages/SeparationsChemical/Adsorbers/Adsorbers.html>