

CEN416
PROCESS DESIGN II

- Typical Chemical Engineering Separations

Separation	Basis	Separating Agent
Distillation	Volatility difference	Energy
Absorption, stripping, extraction, leaching	Solubility difference	Mass (additional phase)
Crystallization (from melt)	Melting point difference	Energy
Crystallization (from solution)	Solubility in solution	Energy or mass (whatever changes solubility)
Adsorption, ion exchange	Difference in surface equilibrium	Solid adsorbent
Gas permeation membranes	Different rate of mass transfer through membrane	Membrane

Absorption Column Design

- **Physical Absorption**

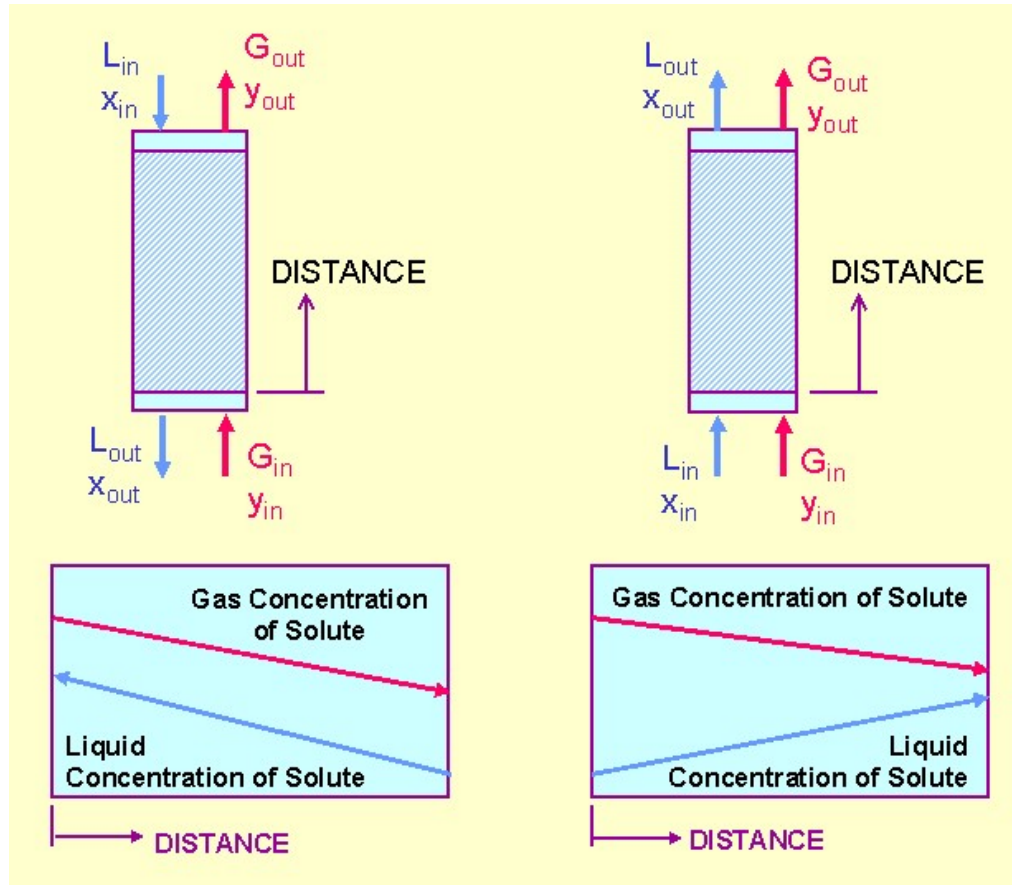
- Mass transfer takes place purely by diffusion and governed by the physical equilibria.
- No chemical reactions between the absorbent and solute.

- **Chemical Absorption**

- As soon as absorbate encounters the absorbing liquid, a chemical reaction takes place.

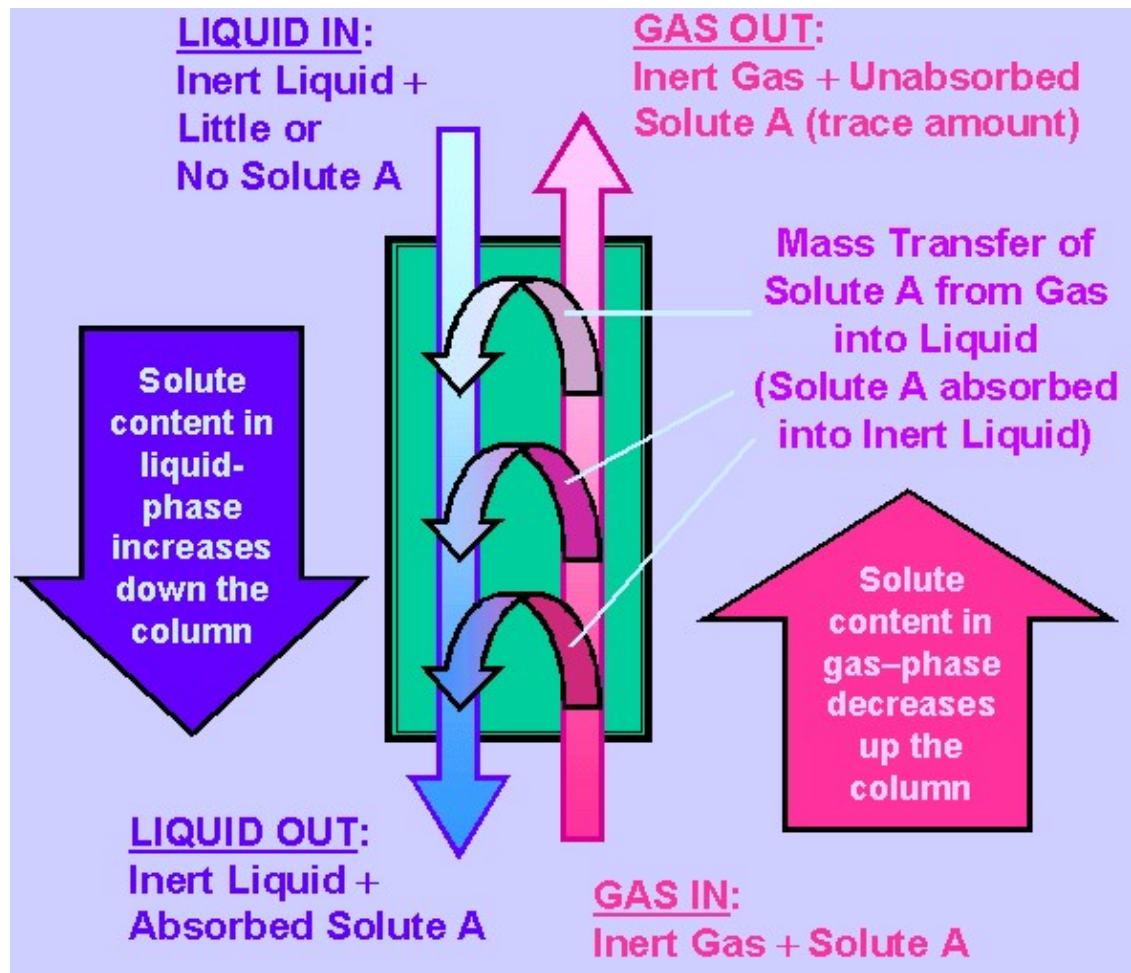
Counter-current Absorption

Co-current Absorption

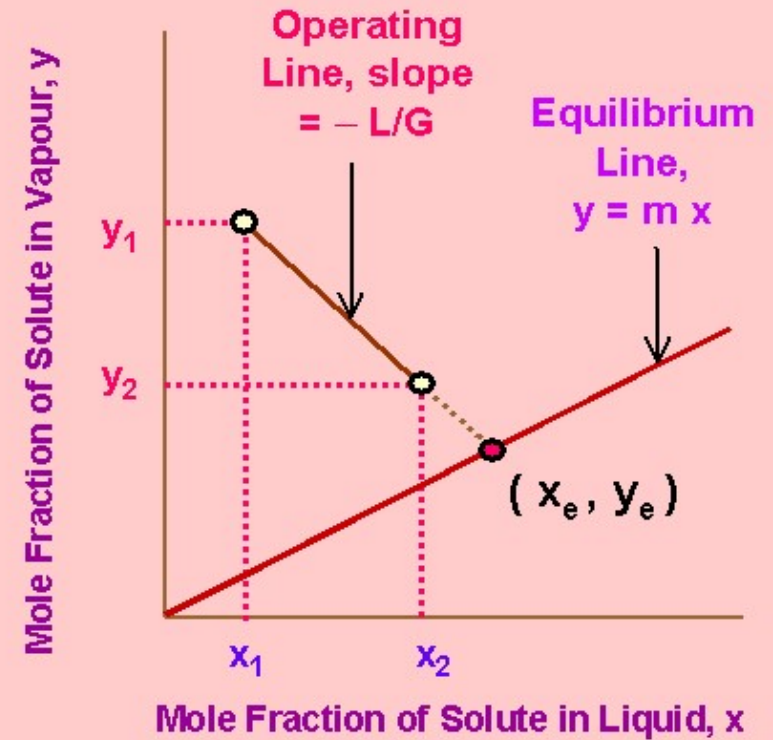
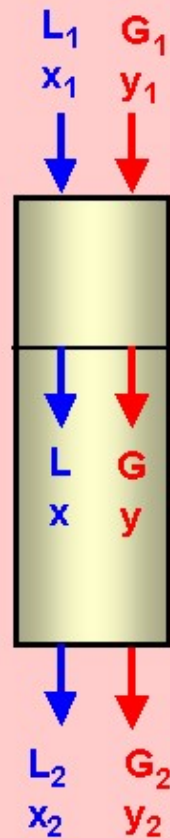


Counter-current Absorption:

- The gas is introduced from the bottom while the liquid is introduced from the top.
- As we gradually move up the column, the gas component (A) is continuously transferred from the gas phase to the liquid phase.



- **Co-current Absorption:**
- To produce an exit liquid and gas streams at equilibrium (x_e, y_e) on the equilibrium curve, an infinitely tall column must be used.



REFERENCES

1. Sinnott, R.K. 1999, *Coulson's & Richardson's Chemical Engineering, Volume 6, Chemical Engineering Design*, ButterWorth Heinemann, Oxford.
2. Turton R., Bailie R.C., Whitin W.C., Shaeiwitz J.A. 1998, *Analysis, Synthesis and Design of Chemical Processes*, Prentice Hall, New Jersey.