Absorption process for dilluted solutions concentration of liquid does not exceed 10% & A, S are valids

Absorption Factor (A)

Stripping Factor (S)

For any stage:

$$A = \frac{\text{Slope of operating line}}{\text{Slope of equilibrium line}} \qquad S = \frac{1}{A}$$

Special case:

$$y = m\,x$$

$$Y \cong mX \qquad (\text{dilute solutions})$$

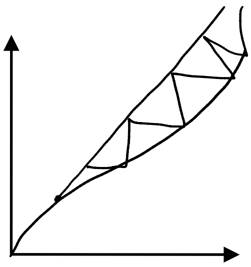
$$A = \frac{L}{Gm} \cong \frac{L_S}{G_S m} \qquad (\text{dilute solutions})$$

$\frac{Y}{X}$ → slope of the eq.

$A > 1$ — Two lines converge at top of absorber. Absorption is illlimited provided sufficient plates are available

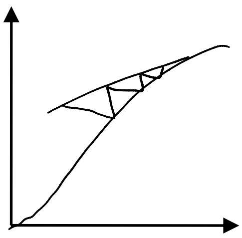
→ Absorption unlimited → ∞

قد يكون فيه trays فيه كامله التحويل مستمر



$A < 1$ — Two lines converge at bottom of absorber. Absorption is limited even if ∞ number of plates is available

عدد درج ينتهي.



فصل أسهل لأنها كانت أبعد

For a fixed degree of separation, as A is increases above unity, the number of plates decreases (operating line moves away from equilibrium curve) and more liquid will be required giving more dilute solutions.

→ why? $\frac{L_S}{G_S}$ → slope of OL, $L_S > G_S$ (above unity)

↑ $A = \frac{L_S \uparrow}{G_S m}$ (const)

Optimum A = 1.25 → 2.0

→ fixed cost + operating cost

number of plates ↑
fixed cost ↑

Minimum Liquid to Gas Ratio (Absorbers)

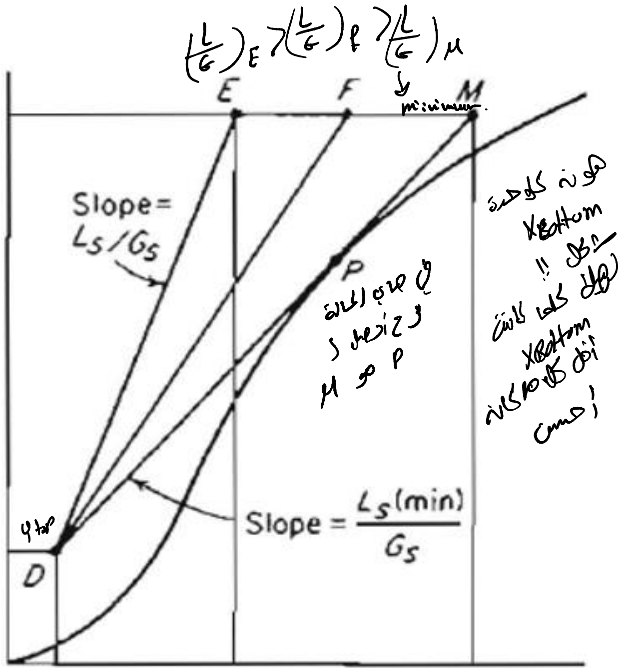
=> also infinite number of stages

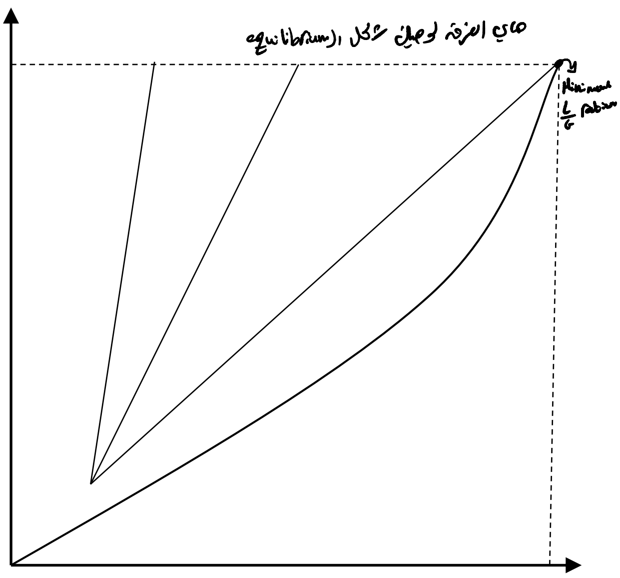
In the design of absorbers, the following quantities are usually specified:

G (G_s) , Y_{top} , Y_{Bottom} and X_{top} → fresh or recycled.

L can be varied and consequently X_{bottom} can be determined (it is function of L)

When less liquid is used (relatively smaller Ls/Gs), the concentration of exit liquid will be greater and the driving force will be smaller. This means that longer time of contact is required for the operation and consequently the tower must be taller.





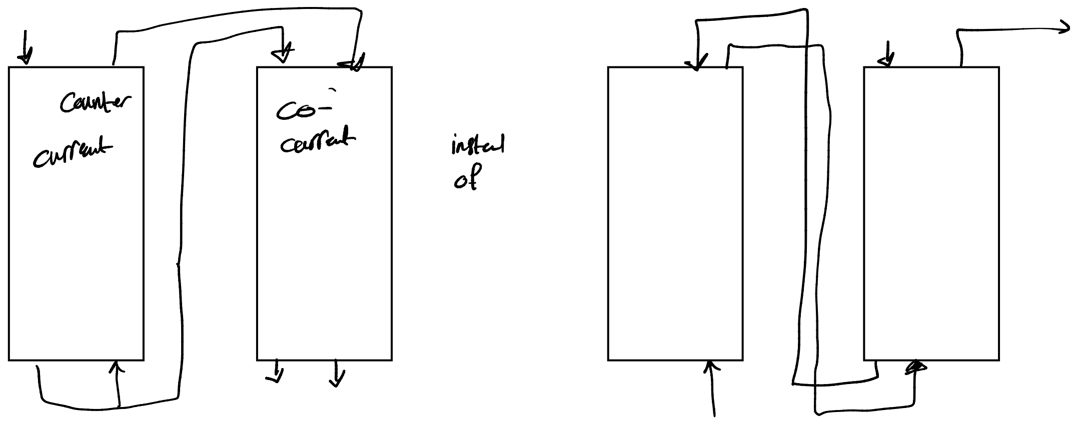
The minimum liquid that can be used corresponds to the slope of the operating line when touches the equilibrium curve (tangentially or intersection). At this ratio an infinite number plates (or height) will be required to obtain $(X_{bottom})_{max}$.

Driving force ↓
more time to reach eq

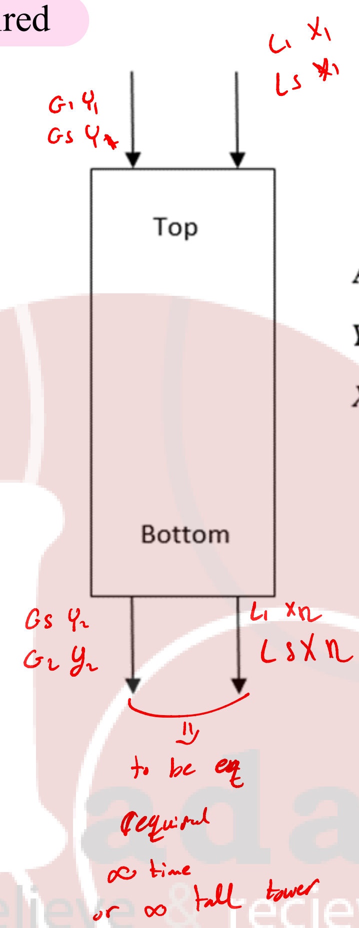
Co-current Flow:

Features:

1. Used when exceptionally tall column is required, the column is split into two sections: one counter current; the other concurrent resulting in savings in large diameter pipes.



2. Used for absorption of pure substances
3. Used for rapid irreversible reactions
4. Only equivalent to one theoretical stage is required



Absorption

$Y_1 > Y_2$

$X_2 > X_1$

Material Balance:

$$G_s\,(Y_1 - Y_2) = L_s\,(X_2 - X_1)$$

$$-\frac{L_s}{G_s} = \frac{Y_1 - Y_2}{X_1 - X_2}$$

- This is a straight line with slope $-\frac{L_s}{G_s}$
- There is no limit on $\frac{L_s}{G_s}$
- Infinitely tall tower is required to produce vapour And liquid streams in equilibrium