McCabe and Thiele Method)

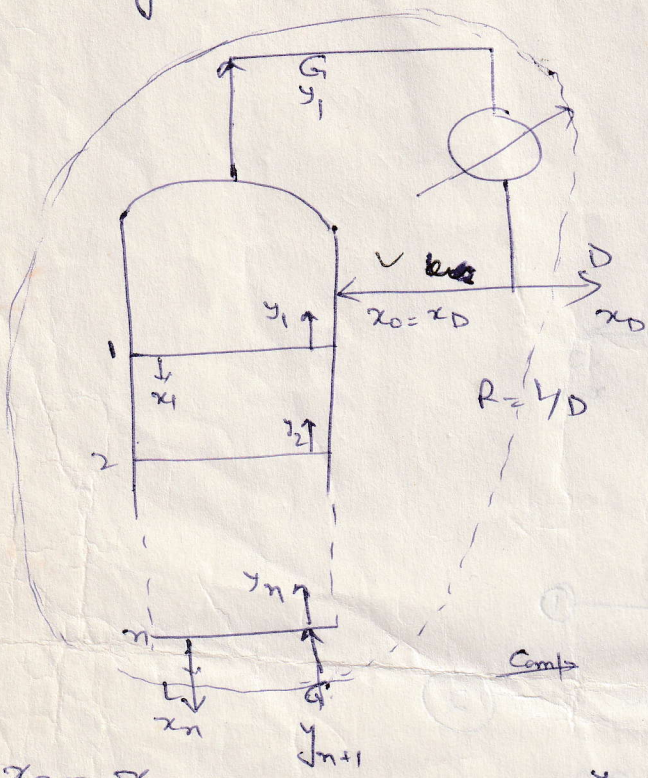
G. mol/hr rising from each tray are each const

L mol/hr. falling from

Enriching Section, total Condenser → Reflux at bubble pt.

↓↓

condenser remove all the latent heat from the overhead part.



$$\frac{L}{D} = R$$

$$L = DR$$

$R = L/D$

Total Material balance

$$G = L + D \quad — (1)$$

$$G y_{n+1} = L x_n + D x_D \quad — (2)$$

$$y_{n+1} = \frac{L}{G} x_n + \frac{D}{G} x_D$$

$y_1 = x_0 = x_D$

from (1)

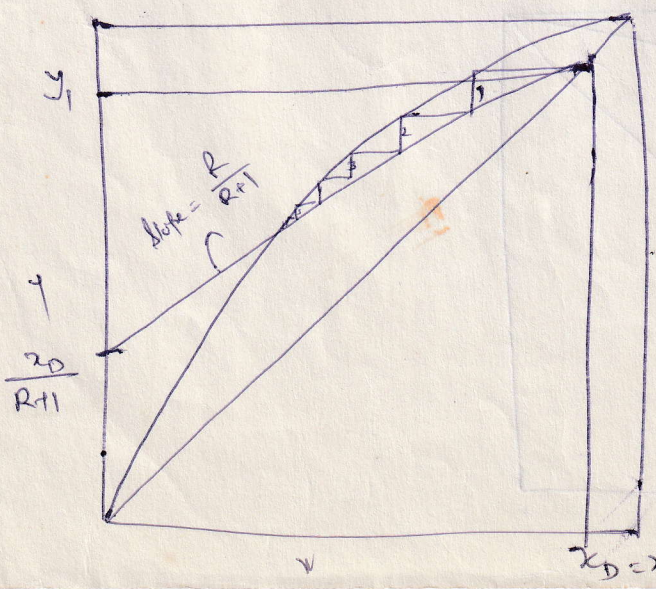
$$1 = \frac{L}{G} + \frac{D}{G}$$

$$G = D(R+1)$$

$$\frac{D}{G} = \frac{1}{R+1}, \quad \frac{L}{G} = \frac{R}{R+1}$$

Put in eq (2):

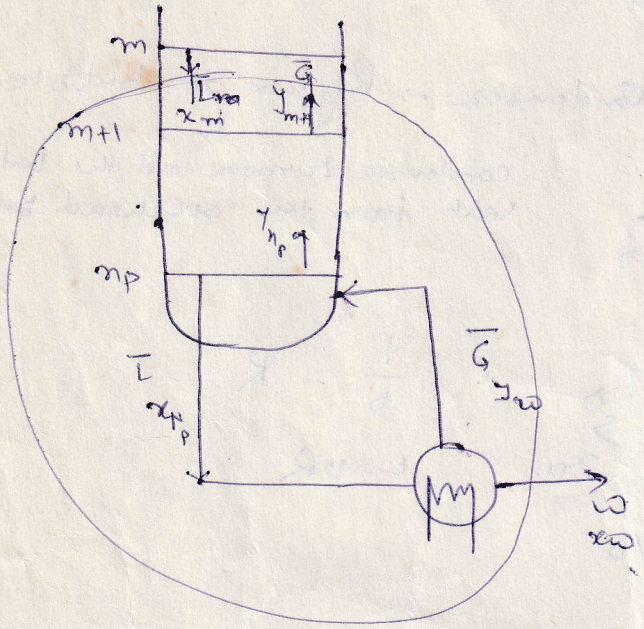
$$\boxed{y_{n+1} = \frac{R}{R+1} x_n + \frac{1}{R+1} x_D} \quad — (3)$$



⇒ at Constt P

Exhausting Section; Reboiled vap. in eqm with Residue.

y_w^* with x_w



Total material balance

$$\bar{L} = \bar{G} + W \quad \rightarrow (1)$$

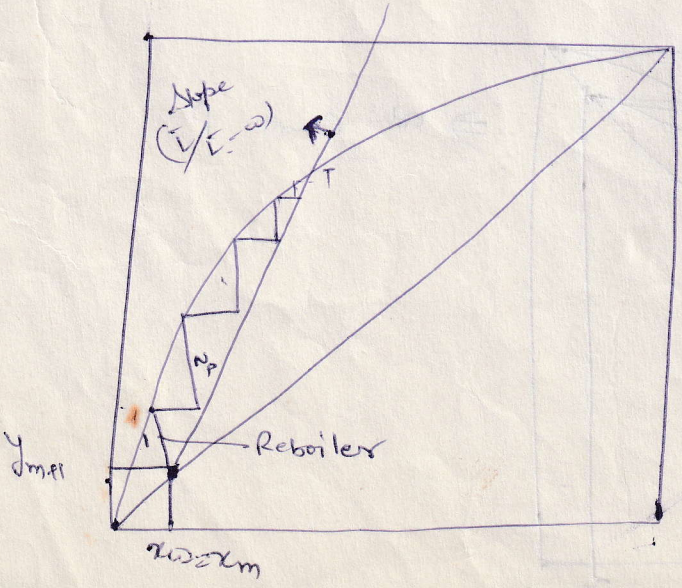
$$\bar{L} x_m = \bar{G} y_{m+1} + W x_w \quad \rightarrow (2)$$

$$y_{m+1} = \frac{\bar{L}}{\bar{G}} x_m - \frac{W}{\bar{G}} x_w$$

$$y_{m+1} = \left(\frac{\bar{L}}{\bar{L}-W}\right) x_m - \left(\frac{W}{\bar{L}-W} x_w\right)$$

↓ Slope.

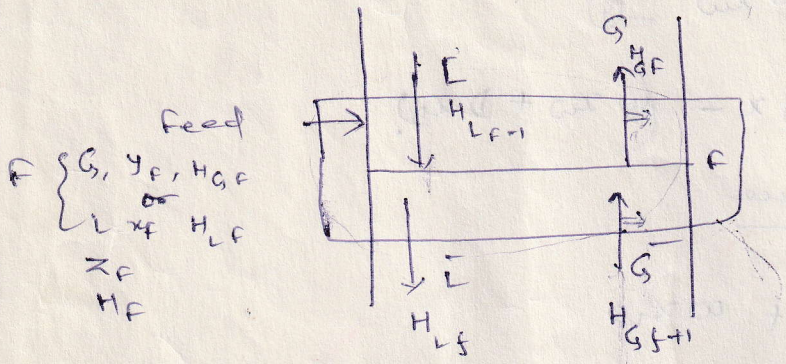
when $x_m = x_w$, $\Rightarrow y_{m+1} = x_w$ $\Rightarrow$ by eqn (1) and (2)



Introduction of feed > How the introduction of the feed influences the change in slope

$H_L = C_L(t_L - t_0)M_{AV} + \Delta H_S$

$H_G = y\{C_{LA}M_A(t_G - t_0) + \lambda_A M_A\} + (1-y)\{C_{LB}M_B(t_G - t_0) + \lambda_B M_B\}$



Total balance >

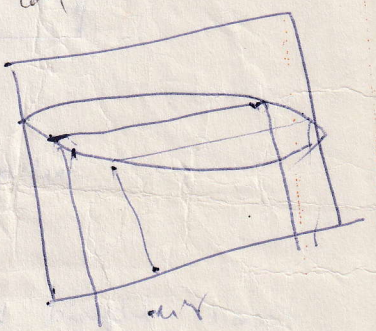
$$F + L + \bar{G} = \bar{L} + G \Rightarrow \frac{\bar{L} - L}{F} = \frac{\bar{G} - G}{F} + 1 \quad \text{— (1)}$$

Enthalpy balance

$$F H_F + L H_{Lf-1} + \bar{G} H_{Gf+1} = G H_G + \bar{L} H_{Lf} \quad \text{— (2)}$$

All vap and liquids are sat. So enthalpy is same for and change in composition is small so

$H_{Gf} = H_{Gf+1}$, & $H_{Lf-1} = H_{Lf}$



$$(\bar{L} - L) H_L = (\bar{G} - G) H_G + F H_F$$

$$\left(\frac{\bar{L} - L}{F}\right) H_L = \left(\frac{\bar{G} - G}{F}\right) H_G + H_F$$

$$= \left[\frac{\bar{L} - L}{F} - 1\right] H_G + H_F$$

$$\left(\frac{\bar{L} - L}{F}\right)[H_L - H_G] = (H_F - H_G)$$

$$\boxed{\frac{\bar{L} - L}{F} = \left(\frac{H_F - H_G}{H_L - H_G}\right) = q_V}$$

$H_G \Rightarrow$ Sat vap

$H_F =$ Feed

$H_L =$ Sat Liq.

$q_V \Rightarrow$ heat required to convert 1mol of feed from its condition H_F to H_G (Sat vap)

molal latent heat of vaporisation.

from (1):

$$\frac{\bar{G} - G}{F} = q_V - 1$$

$$\bar{G} - G = F(q_V - 1)$$

$$y_{m+1} = \frac{L}{G} x_n + \frac{D}{G} x_D \quad \text{— (3)}$$

$$y_{m+1} = \frac{\bar{L}}{\bar{G}} x_m - \frac{W}{G} x_W \quad \text{— (4)}$$