Approximate Shortcut Methods for Multicomponent Distillation

1- Calculate N_{min} (Fenske Equation)

$$N_{min} = \frac{\ln\left\{\frac{(FR_A)_{dist}\,(FR_B)_{bot}}{[1-(FR_A)_{dist}][1-(FR_B)_{bot}]}\right\}}{\ln \alpha_{AB}}$$

For non Key

$$(FR_C) = \frac{\alpha_{CB}^{N_{min}}}{\frac{(FR_B)_{bot}}{1-(FR_B)_{bot}} + \alpha_{CB}^{N_{min}}}$$

2- Calculate $\left(\frac{L}{D}\right)_{min}$ (Underwood Equation)

* $F(1-q) = \sum_{i=1}^{C} \frac{\alpha_i F z_i}{\alpha_i - \phi}$, 1st underwood equation used to evaluate ϕ

* $V_{min} = \sum_{i=1}^{C} \frac{\alpha_i (D x_{i,D})}{\alpha_i - \phi}$ 2nd underwood equation used to find V_{min}

* $L_{min} = V_{min} - D \longrightarrow$ Find $\left(\frac{L}{D}\right)_{min}$

3- $\left(\frac{L}{D}\right)_{actual}$ usually $\# * \left(\frac{L}{D}\right)_{min}$, or it will be given

4- Calculate $\frac{\left[\frac{L}{D} - \left(\frac{L}{D}\right)_{min}\right]}{1+\left(\frac{L}{D}\right)}$ Abussaud

5- Find $\left(\frac{N-N_{min}}{N+1}\right)$ From Gilliland Correlation

6- Calculate N

7- Optimum feed location (N_F)

$$N_F = \frac{N}{N_{min}} * \frac{\ln\left\{\left(\frac{X_{LK}}{X_{HK}}\right)_D \Big/ \left(\frac{Z_{LK}}{Z_{HK}}\right)\right\}}{\ln \alpha_{LK-HK}}$$

Abussaud