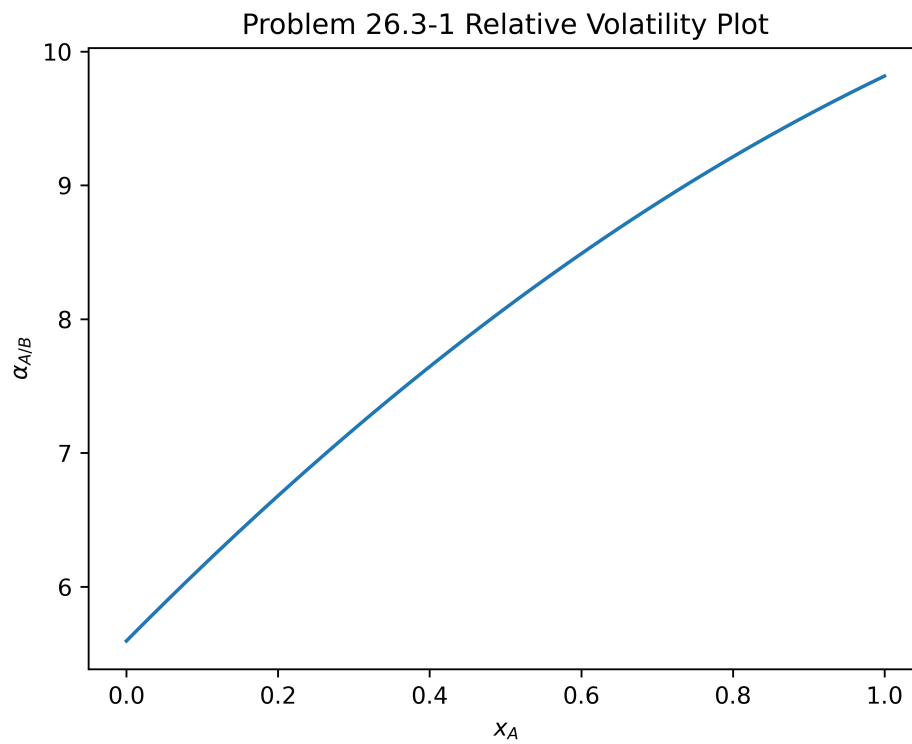1. Problem 26.3-1

$$\alpha_{A/B} = \frac{\left(\frac{y_A}{x_A}\right)}{\left(\frac{y_B}{x_B}\right)} = \frac{\left(\frac{y_A}{x_A}\right)}{\left(\frac{1-y_A}{1-x_A}\right)}$$

Plot:

Problem 26.3-1 Relative Volatility Plot

2. Problem 26.3-2

(a)

Fit equilibrium data to 4th order polynomial.

$$y(x) = -3.806x^4 + 10.185x^3 - 10.141x^2 + 4.749x + 0.0101$$

$$\ln\left(\frac{L_1}{L_2}\right) = \int_{x_2}^{x_1} \frac{dx}{y-x}$$

$$L_1 = 100$$

$$x_1 = 0.6$$

By mass balance

$$L_2 = 60$$

$$0 = \int_{x_2}^{0.6} \frac{dx}{-3.806x^4 + 10.185x^3 - 10.141x^2 + 4.749x + 0.0101 - x} - \ln\left(\frac{100}{60}\right)$$

Solve for x_2

$$\boxed{x_2 = 0.407}$$

Material balance for A

$$L_1 x_1 = L_2 x_2 + D y_{avg}$$

$$100 \cdot 0.6 = 60 \cdot 0.407 + 40 y_{avg}$$

$$\boxed{y_{avg} = 0.889}$$

(b)

Flash material balance

$$F x_F = D y_D + W x_W$$

$$y_D = -3.806x_W^4 + 10.185x_W^3 - 10.141x_W^2 + 4.749x_W + 0.0101$$

$$100 \cdot 0.6 = 40\left(-3.806x_W^4 + 10.185x_W^3 - 10.141x_W^2 + 4.749x_W + 0.0101\right) + 60x_W$$

Solve for x_W

$$\boxed{x_W = 0.429}$$

$$y_D = f(0.429)$$

$$\boxed{y_D = 0.856}$$

3. Problem 26.3-3

Fit equilibrium data to 4th order polynomial.

$$y(x) = -0.417x^4 + 1.493x^3 - 2.361x^2 + 2.285x$$

$$\ln\left(\frac{L_1}{L_2}\right) = \int_{x_2}^{x_1} \frac{dx}{y - x}$$

$$L_1 = 100$$

$$x_1 = 0.7$$

By mass balance

$$L_2 = 66.7$$

$$0 = \int_{x_2}^{0.7} \frac{dx}{-0.417x^4 + 1.493x^3 - 2.361x^2 + 2.285x - x} - \ln\left(\frac{100}{66.7}\right)$$

Solve for x_2

$$\boxed{x_2 = 0.632}$$

Material balance for A

$$L_1x_1 = L_2x_2 + Dy_{avg}$$

$$100 \cdot 0.7 = 66.7 \cdot 0.632 + 33.3y_{avg}$$

$$\boxed{y_{avg} = 0.836}$$

4. Problem 26.4-3

    (a)

$$y(x) = -0.417x^4 + 1.493x^3 - 2.361x^2 + 2.285x$$
$$x' = 0.5$$
$$y' = y(x')$$
$$y' = 0.713$$
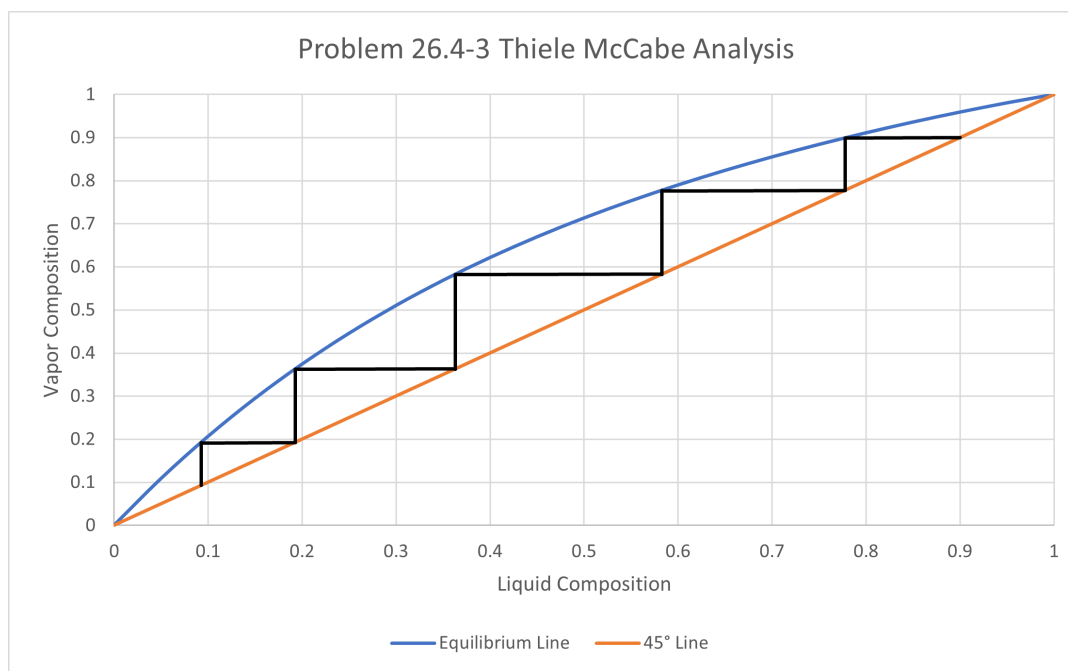$$R_m = \frac{y_D - y'}{y' - x'}$$
$$y_D = 0.9$$
$$R_m = \frac{0.9 - 0.713}{0.9 - 0.5}$$
$$\boxed{R_m = 0.876}$$

    (b) Plot equilibrium line and 45° line. The operting lines are parallel to the 45° line at infinite reflux.

Problem 26.4-3 Thiele McCabe Analysis

The total number of stages is 5. The minimum number of trays is 4 plus a reboiler.