Assumptions:

1. Liquid hold-up at each tray is constant
2. Constant molar overflow in the column
3. Relative volatility (α) is constant
4. Number of trays = 10, Tray 1 - condenser
   Tray 10 - Reboiler

$F = 50$ mol/s

$D = 25$ mol/s

$V = 60$ mol/s

$z_f = 0.5$

Holdups

$M = 400$ mol

$M_C = 4000$ mol

$M_R = 4000$ mol

$\alpha = 2.5$

Initial condition ($t = 0$) $x_f = 0.5$

for ith tray:

$$\frac{d}{dt}(M x_i) = V_{i+1} y_{i+1} + L_{i-1} x_{i-1} - V_i y_i - L_i x_i$$

Condenser:

$$\frac{d}{dt}(M_C x_D) = V y_2 - D x_D - L x_D$$

Rectifying section:

$$\frac{d}{dt}(M_i x_i) = (V_{i+1} y_{i+1} + L_{i-1} x_{i-1}) - (V_i y_i + L_i x_i)$$

Feed Tray:

$$\frac{d}{dt}(M_f z_f) = \left(F z_f + L_{i-1} x_{i-1} + V_{i+1} y_{i+1}\right) - \left(V_i y_i + (L+F)_i x_i\right)$$

Stripping Section

$$\frac{d}{dt}(M_i x_i) = \left((L+F)_{i-1} x_{i-1}\right) + V_{i+1} y_{i+1}) - (V_i y_i + (L+F)_i x_i)$$

Reboiler:

$$\frac{d}{dt}(M_R x_R) = x_q (L+F) - y_r V - x_R (F-D)$$