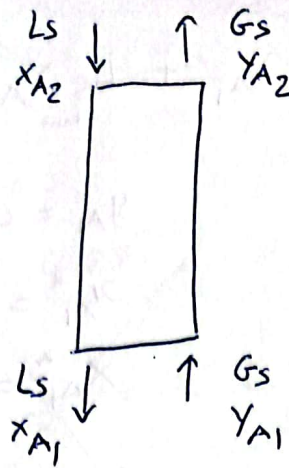Coluna enchimento

Contracorrente

Absorver 99%

$L_S = 1.5 \ L_{smin}$

$y_A = 0.5$

$G_s = 100 \ mol/h$ — base de cálculo

link equilibrio

$y_A^* = 2 x_A$

• Cálculo de Y_{A2}

$$\cancel{G_s} \ Y_{A2} = 0.01 \ \cancel{G_s} \ Y_{A1}$$

$$Y_{A2} = 0.01$$

$$Y_{A_1} = \frac{0.5}{1-0.5} = 1$$

• Verificar se $G_1 = G_2$

$$G_1 \ y_{A_1} = G_s \ Y_{A_1}$$

$$G_2 \ y_{A2} = G_s \ Y_{A2}$$

$$G_1 = \frac{100 \times 1}{0.5} = 200 \ \frac{mol}{h}$$

$$y_{A_2} = \frac{Y_{A2}}{1 + Y_{A2}} \qquad \text{Porquê?} \qquad Y_{A2} = \frac{y_{A2}}{1 - y_{A2}}$$

$$y_{A_2} = 0.01$$

$$Y_{A2} \ (1 - y_{A2}) = y_{A2}$$

$$G_2 = \frac{100 \times 0.01}{0.01} = 100 \ mol/h \qquad Y_{A2} = y_{A2} \ (1 + Y_{A2})$$

$$\boxed{y_{A2} = \frac{Y_{A2}}{1 + Y_{A2}}}$$

$$\boxed{G_1 \neq G_2}$$

④ $L_{smin} = ?$ $\qquad$ $G_s Y_{A_1} + L_{smin} X_{A_2}^{=0} = G_s Y_{A_2} + L_{smin} X_{A_1}^{*}$

$X_{A_1}^{*} = ?$ $\qquad$ $y_{A_1} = 0.5$ $\qquad$ $y_A = 2 x_A^{*}$

$\qquad\qquad\qquad$ $y_{A_1}^{*} = 0.25$ $\qquad$ $X_{A_1}^{*} = \dfrac{0.25}{0.75} = 0.33$

$$\dfrac{L_{smin}}{G_s} = \dfrac{Y_{A_1} - Y_{A_2}}{X_{A_1}^{*} - X_{A_2}} = \dfrac{1 - 0.01}{0.33} = 2.97$$

$$L_{smin} = 297 \ mol/h$$

$$\dfrac{L_s}{G_s} = 1.5 \ \dfrac{L_{smin}}{G_s} = 4.45$$

$$\dfrac{L_s}{G_s} = 4.45 = \dfrac{1 - 0.01}{X_{A_1}} \qquad X_{A_1} = 0.22$$

$$\dfrac{L_s}{G_s} = \dfrac{Y_A - Y_{A_2}}{X_A - X_{A_2}} = \dfrac{Y_A - 0.01}{X_A} = 4.45$$

$$Y_A - 0.01 = 4.45 \ X_A$$

$$\boxed{Y_A = 4.45 \ X_A + 0.01}$$

ou

linha operatória $\qquad \boxed{X_A = \dfrac{Y_A - 0.01}{4.45}}$

Curva de equilíbrio $\qquad y_A = 2 x_A \qquad \dfrac{Y_A}{1 + Y_A} = 2 \ \dfrac{X_A}{1 + X_A}$

$$Y_A (1 + X_A) = 2 X_A (1 + Y_A)$$
$$Y_A (1 + X_A - 2 X_A) = 2 X_A$$
$$Y_A (1 - X_A) = 2 X_A \qquad \boxed{Y_A^{*} = \dfrac{2 X_A}{1 - X_A}}$$

$$N_{OG} = \int_{0.01}^{1} \frac{dY_A}{Y_A - Y_A^*}$$

Y_A	X_A	Y_A^*	$\frac{1}{Y_A - Y_A^*}$
	0	0	100
0.01	0.009	0.018	31.4
0.05	0.02	0.041	16.7
0.1	0.11	0.25	3.96
0.5	0.155	0.367	3
0.7	0.222	0.564	2.3
1			

$$x_A = \frac{Y_A - 0.01}{4.45}$$

$$Y_A^* = \frac{2X_A}{1 - X_A}$$

Regra dos trapézios

$$\int f(x)\,dx = \sum \frac{f_i + f_j}{2}(x_j - x_i)$$

$$N_{OG} = \frac{1}{2}\left(131.4 * 0.04 + 48.1 * 0.05 + \cdots \right)$$

$$N_{OG} = \boxed{9.5}$$

$$G_1 = 43.6 \ m^3/h$$

$$L_S = 37.5 \ kg/h$$

$$y_{A_1} = 0.0352$$

$$y_{A_2} = 0.013$$

$$Y_{A_1} = \frac{y_{A_1}}{1-y_{A_1}} = \frac{0.0352}{1-0.0352} = 0.0365$$

$$Y_{A_2} = \frac{y_{A_2}}{1-y_{A_2}} = \frac{0.013}{1-0.013} = 0.013$$

$$L_S = \frac{37.5}{18 \times 10^{-3}} = 20\,83 \ mol/h$$

$$G_S Y_{A_1} = G_1 y_{A_1} \qquad G_S = 43.6 \ \frac{y_{A_1}}{y_{A_1}} (1-y_{A_1})$$

$$G_S = \frac{43.6 \times 10^3 \times 1}{0.082 * (273.15+20)} (1 - 0.0352) = 1750 \ \frac{mol}{h}$$

$$R = 0.082 \ \frac{atm \, dm^3}{mol \ K}$$

a) $$G_S Y_{A_1} + L_S \underset{=0}{X_{A_2}} = L_S X_{A_1} + G_S Y_{A_2}$$

$$X_{A_1} = 0.0198$$

b) $$G_S Y_{A_1} = L_{S_{min}} X_{A_1}^* + G_S Y_{A_2}$$

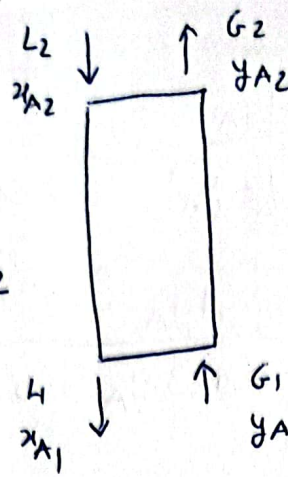$$X_{A_1}^* = \frac{Y_{A_1}}{1.3} = 0.028$$

$$L_{S_{min}} = 1469 \ mol/h$$

Absorver 95%

$L_S = 1.2 \; L_{smin}$

$G_1 = 1000 \; mol/h$ $\qquad y_{A_1} = 0.02$

$y_A^* = 2.5 \; x_A$

$L_2 \downarrow \qquad \uparrow G_2$
$x_{A_2} \qquad\quad y_{A_2}$

$4 \downarrow \qquad \uparrow G_1$
$x_{A_1} \qquad\quad y_{A_1}$

$G_1 \, y_{A_1} = G_S \, Y_{A_1}$

$1000 * 0.02 = G_S * \dfrac{0.02}{0.98}$

$G_1 \simeq G_2 = 1000 \; mol/h$

$G_S = 980 \; mol/h$
(erro 2%)

$L_1 \simeq L_2$

Linha operatória

$G \, y_{A_1} + L_{min} \overset{\leq 0}{x_{A_2}} = G \, y_{A_2} + L_{min} \, x_{A_1}^*$

$\cancel{y_{A_2}} = 0.05 \cancel{\, y_{A_1}}$

$0.02 = 2.5 \; x_{A_1}^*$

$y_{A_2} = 0.001$

$x_{A_1}^* = 0.008$

$L_{min} = \dfrac{1000 * (0.02 - 0.001)}{0.008} = 2375 \; mol/h$

$\dfrac{L_{min}}{G} = 2.375 \quad \Rightarrow \quad \dfrac{L}{G} = 1.2 * 2.375 = 2.85$

$\dfrac{L}{G} = 2.85 = \dfrac{0.02 - 0.001}{x_{A_1}} \qquad x_{A_1} = 0.0067$

$2.85 = \dfrac{y_A - 0.001}{x_A} \qquad\qquad y_A = 2.85 \, x_A + 0.001$

$x_A = \dfrac{y_A - 0.001}{2.85}$

$y_A^* = 2.5 \, x_A = \dfrac{2.5}{2.85} (y_A - 0.001)$

$y_A^* = 0.877 \, y_A - 0.000877$

$$N_{OG} = \int_{y_{As}}^{y_{Ae}} \frac{dy_A}{y_A - y_A^*} = \int_{0.001}^{0.02} \frac{dy_A}{y_A - 0.877\,y_A + 0.000877}$$

$$N_{OG} = \int_{0.001}^{0.02} \frac{dy_A}{0.123\,y_A + 0.00877} = \frac{1}{0.123}\ln\frac{0.123 * 0.02 + 0.000877}{0.123 * 0.001 + 0.000877}$$

$$N_{OG} = 9.8$$

$$y_{A_1} = 0.02 \qquad\qquad x_{A_1} = 0.0067$$

$$y_{A_2} = 0.001 \qquad\qquad x_{A_2} = 0$$

$$y_{A_1} - y_{A_1}^* = 0.02 - 2.5 * 0.0067 = 0.00325$$

$$y_{A_2} - y_{A_2}^* = 0.001$$

$$\Delta y_L = \frac{0.00325 - 0.001}{\ln\dfrac{0.00325}{0.001}} = \frac{0.00225}{1.178655} =$$

$$N_{OG} = \frac{0.02 - 0.001}{0.00191} = \frac{0.019}{0.00191} = 9.95$$