1.

$$K'_{G SO_2} = 0.768 \ \frac{kmol}{h \, m^2 atm} \qquad \qquad \frac{1}{k_G} = \frac{H}{k_L}$$

$$K_{G NH_3} = 2.217 \ \frac{kmol}{h \, m^2 atm}$$

$$k_G = A \, \mathcal{D}^\alpha \qquad \qquad \mathcal{D}_{SO_2} = 0.041 \ m/h$$

$$\mathcal{D}_{NH_3} = 0.083 \ m/h$$

$$\frac{H_{SO_2}}{H_{NH_3}} = \frac{1}{0.018} \qquad \qquad \mathcal{D}_{SO_2 - H_2O} \stackrel{?}{=} \mathcal{D}_{NH_3 - H_2O}$$

$$\Downarrow$$

(SO₂)

$$k_{L SO_2} = k_{L NH_3}$$

$$\frac{1}{0.768} = \frac{1}{k_{G SO_2}} + \frac{H_{SO_2}}{k_L} \qquad \qquad 1.302 = 0.651 + 0.651$$

(NH₃)

$$\frac{1}{2.217} = \frac{1}{k_{G NH_3}} + \frac{H_{NH_3}}{k_L} \qquad \qquad \frac{H_{SO_2}}{k_L} = 0.651$$

$$H_{NH_3} = 0.018 \ H_{SO_2}$$

$$\frac{1}{2.217} = \frac{1}{k_{G NH_3}} + \frac{0.018 \ H_{SO_2}}{H_{SO_2}/0.651}$$

$$\boxed{k_{G NH_3} = 2.276 \ \frac{kmol}{h \, m^2 atm}}$$

$$\frac{1}{k_{G SO_2}} = 0.651 \qquad \boxed{k_{G SO_2} = 1.536 \ \frac{kmol}{h \, m^2 atm}}$$

$$\frac{1.536}{2.276} = \left(\frac{0.041}{0.083}\right)^\alpha \qquad \boxed{\alpha = 0.56}$$

$$Sh = 0.023 \ Re^{0.8} \ Sc^{0.44} \qquad k_G \propto \mathcal{D}^{1-0.44} \quad \propto \boxed{\mathcal{D}^{0.56}}$$

2.

$$k_G'(p_{A_G} - p_A^*) = \underbrace{k_G' RT}_{k_{GC}} (c_{A_G} - c_{A_G}^*)$$

$$k_L (c_{Ai} - c_{AL}) = k_L c_L (x_{Ai} - x_A)$$

$$p_{Ai} = H x_{Ai} = 10^5 H x_{Ai}$$

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$$k_L \propto \sqrt{\mathcal{D}_L} \qquad\qquad k_{L O_2} = 0.2 \times 10^{-3} \; m/s$$

$$\boxed{k_L = \frac{k_{L O_2}}{\sqrt{\mathcal{D}_{O_2}}} \cdot \sqrt{\mathcal{D}_L}}$$

$$\boxed{k_L = \frac{0.2 \times 10^{-3} \sqrt{\mathcal{D}_L}}{\sqrt{2.1 \times 10^{-9}}} = 4.364 \sqrt{\mathcal{D}_L}}$$

$$b = \frac{10^5}{c_L RT} = 7.39 \times 10^{-4}$$

$$\rho_{ar} = \frac{P \, M_{ar}}{RT}$$

$$\rho_{ar} = \frac{5 \times 10^5 \ast 29 \times 10^{-3}}{8.314 \ast 293.15}$$

$$\boxed{\rho_{ar} = 5.94 \; kg/m^3}$$

$$Sh = 0.023 \, Re^{0.8} \, Sc^{0.44}$$

$$\frac{k_G \, d}{\mathcal{D}?} = \boxed{0.023 \left(\frac{u d}{\mathcal{D}.}\right)^{0.8}} Sc^{0.44}$$

$$Sc = \frac{\nu}{\mathcal{D}}$$

$$\boxed{\mathcal{D}_G = \frac{\nu}{Sc}}$$

$$\nu = \frac{\mu}{\rho}$$

$$Re = \frac{5.94 \ast 0.4 \times 3 \times 10^{-2}}{1.84 \times 10^{-5}}$$

$$Re = 3880$$

$$k_G = \frac{17.1}{0.03} Sc^{0.44} \mathcal{D}_G$$

$$\boxed{k_G = 56.97 \, Sc^{0.44} \mathcal{D}_G}$$

ver ficheiro Excel

3.

| $G$ (kmol/s) | $K_G$ (kmol/m²s Pa) |
|---|---|
| 0.04 | $8.4 \times 10^{-5}$ |
| 0.10 | $10 \times 10^{-5}$ |

$$\frac{1}{K_G} = \frac{1}{k_G} + \frac{H}{k_L}$$

$$\frac{1}{K_G} = \frac{1}{a\,G^{0.8}} + b \qquad\qquad y = \frac{1}{a}\,G^{-0.8} + b$$

$$1.19 \times 10^4 = \frac{1}{a} * 13.13 + b \qquad b = \frac{y = a x + b}{}$$

$$\qquad\qquad\qquad b = 1.19 \times 10^4 - \frac{13.13}{a}$$

$$1 \times 10^4 = \frac{1}{a}\,6.31 + b$$

$$1 \times 10^4 = \frac{6.31}{a} + 1.19 \times 10^4 - \frac{13.13}{a}$$

$$\frac{13.13 - 6.31}{a} = 0.19 \times 10^4 \qquad a = \frac{13.13 - 6.31}{0.19 \times 10^4} = 3.58 \times 10^{3}$$

$$b = 1.19 \times 10^4 - \frac{13.13}{3.58 \times 10^3} = 8.24 \times 10^{3}$$

$G = 0.5$ kmol/s

$$k_G = a\,G^{0.8} = 2.06 \times 10^{-3}\ \frac{kmol}{m^2 s\ Pa}$$

$$\frac{H}{k_L} = b \qquad k_L = \frac{H}{b} = \frac{20}{8.24 \times 10^3} = 2.43 \times 10^{-3}\ m/s$$

$$K_G = 11.5 \times 10^{-5}\ \frac{kmol}{m^2 s\ Pa}$$