

5) Ex 4

$$T = 50 + 273 = 323 \text{ K}$$

$$\mu_{50^\circ\text{C}} = 0,02 \text{ cP}$$

$$\rho_{50} = \frac{PM}{RT} = 1,1 \text{ kg/m}^3$$

$$D = \frac{0,02 \cdot 10^{-3}}{1,1} = 1,82 \cdot 10^{-5} \text{ m}^2/\text{s}$$

$$D_{\text{H}_2\text{O/air}} = 0,3 \text{ cm}^2/\text{s}$$

$$Nu = \frac{v \cdot L}{D} = \frac{3 \cdot 2}{1,82 \cdot 10^{-5}} = 3,28 \cdot 10^5$$

de laminar.

$$Sh_L = 0,664 Nu_L^{1/2} Sc^{1/3}$$

$$Sc = D / D_{\text{H}_2\text{O/air}} = 1,82 \cdot 10^{-5} / 0,3 \cdot 10^{-4} = 0,62$$

$$Sh_L = 0,664 (3,28 \cdot 10^5)^{1/2} (0,62)^{1/3} = 324$$

$$\frac{k_p L}{D_{\text{H}_2\text{O}}} = 324 \Rightarrow k_p = \frac{324 \times 0,3 \cdot 10^{-4}}{2} = 4,87 \cdot 10^{-3} \text{ m/s}$$

\leftarrow $\frac{D_{\text{H}_2\text{O}}}{D_{\text{H}_2\text{O/air}}}$

$$x_{\text{H}_2\text{O}} = \frac{92}{760} = 0,121$$

$$p = \frac{P}{RT} = 3,77 \cdot 10^{-2} \frac{\text{kmol}}{\text{m}^3}$$

\leftarrow pressão molar

$$MM_i = 0,121 \cdot 18 + (1 - 0,121) \cdot 29 = 27,7$$

$$x_{\text{H}_2\text{O}} = \frac{0,121 \cdot 18}{0,121 \cdot 18 + (1 - 0,121) \cdot 29} = 0,0786$$

$$\rho_i = 27,7 \times 3,77 \cdot 10^{-2} = 1,043 \text{ kg/m}^3$$

$$\rho_{\text{H}_2\text{O}} = 0,0786 \times 1,043 = 0,082 \text{ kg/m}^3$$

$$\frac{1}{x_{\text{H}_2\text{O}}} = 0,25 \times 0,121 = 0,0305$$

$$x_{\text{H}_2\text{O}\infty} = \frac{0,0305 \cdot 18}{0,0305 \cdot 18 + (1 - 0,0305) \cdot 29} = 0,019$$

$$\rho_{\infty} = 27,66 \times 3,77 \cdot 10^{-2} = 1,08 \text{ kg/m}^3$$

$$\rho_{\text{H}_2\text{O}\infty} = 1,08 \times 0,019 = 0,0205 \text{ kg/m}^3$$

$$N_D = k_p (\rho_{\text{H}_2\text{O}\infty} - \rho_i) = 4,87 \cdot 10^{-3} (0,0205 + 0,0786) = 3 \cdot 10^{-4} \frac{\text{kg}}{\text{s m}^2}$$

$$100 \text{ kg de água} \Rightarrow \frac{100}{14} \times 4 = 28,57 \text{ kg água}$$

$$A = 4 \text{ m}^2 \rightarrow \dot{m}_{\text{H}_2\text{O}} = 12 \cdot 10^{-4} \text{ kg/s}$$

$$14,29 \text{ g água}$$

$$v_y = \frac{3 \cdot 10^{-4}}{1,05} = 3 \cdot 10^{-4} \text{ m/s}$$

$$\boxed{12000 \text{ s} = 3,3 \text{ h}}$$