

3-7

$$d = 60 \text{ mm}$$

$$t = 25^\circ\text{C}$$

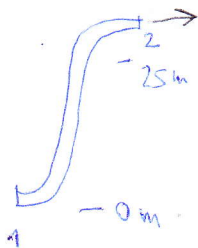
$$L = 160 \text{ m}$$

$$\dot{V} = 36 \text{ m}^3/\text{hod}$$

$$\Delta h = 25 \text{ m}$$

$$P_1 = 1.6 \text{ MPa}$$

$$P_2 = ?$$



$$\frac{v_1^2}{2} + \frac{P_1}{\rho} + h_1 g = \frac{v_2^2}{2} + \frac{P_2}{\rho} + h_2 g + e_{dis}$$

$$v_1 = v_2$$

$$h_1 = 0 \text{ m} \quad h_2 = 25 \text{ m}$$

$$\frac{P_1 - P_2}{\rho} = h_2 g + \lambda \frac{L}{d} \frac{v^2}{2}$$

$$v = \frac{\dot{V}}{S} = \frac{\dot{V} \cdot 4}{\pi d^2} = \frac{36 \cdot 4}{\pi \cdot 0.06^2} = 12732 \text{ m/h} = 3.5368 \text{ m/s}$$

$$\eta_{25^\circ\text{C}} = 0.8905 \cdot 10^{-3} \text{ Pa}\cdot\text{s}$$

$$\rho = 997.02 \text{ kg/m}^3$$

$$Re = \frac{v \cdot d \cdot \rho}{\eta} = \frac{3.5368 \cdot 0.06 \cdot 997.02}{0.8905 \cdot 10^{-3}} = 237592$$

$$\epsilon_A = 0.01 \text{ mm (plast)}$$

$$\lambda = \frac{0.25}{\left\{ \log \left[ \left( \frac{6.81}{Re} \right)^{0.9} + \frac{0.01/60}{3.7} \right] \right\}^2} = 0.01646$$

$$\rightarrow P_2 = P_1 - \rho \cdot \left( h_2 g + \lambda \frac{L}{d} \frac{v^2}{2} \right) = 1.6 \cdot 10^6 - 997.02 \cdot \left( 25 \cdot 9.81 + 0.01646 \frac{160}{0.06} \frac{3.5368^2}{2} \right)$$

$$P_2 = 1.6 \cdot 10^6 - 997.02 \cdot 519.78 = \underline{\underline{1.082 \cdot 10^6 \text{ Pa}}}$$