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14/ENG01/066
chemical engineering

1. $A_1 = \frac{\pi D_1^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.07767 m^2$

$A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.075^2}{4} = 0.00442$

$$Q = \frac{C_d \times A_1 \cdot A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$0.04 = \frac{0.96 \times 0.01767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.07767^2 - 0.00442^2}}$$

$$0.04 = 0.96 \times 0.004565 \times 4.429\sqrt{h}$$

$$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429}\right)^2 = 4.247 m$$

$$h = \left(\frac{P_1}{\omega} + Z_1\right) - \left(\frac{P_2}{\omega} + Z_2\right)$$

$$h = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega}\right) + \left(Z_1 - Z_2\right)$$

$$4.247 = \left(\frac{P_1 - P_1}{P_g}\right) + 0.15$$

$$(4.247 + 0.15) = \frac{P_1 - P_2}{P_g}$$

$$(4.247 + 0.15) P_g = P_1 - P_2$$

$$P_1 - P_2 = (0.8 \times 1000 \times 9.81)(4.247 + 0.15)$$

$$P_1 - P_2 = 34.51 \, Kpa/m^2$$

3. $D_1 = 0.3m$ $A_1 = \frac{\pi D_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07 m^2$

$D_2 = 0.15m$ $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.07767 m^2$

S.g of mecury = 13.6

differential 'h' is given by

$$h = \left(\frac{P_1}{w} + z_1\right) - \left(\frac{P_2}{w} + z_2\right)$$

$$= y\left(\frac{S_m}{S_p} - 1\right) = 0.25\left(\frac{13.6}{0.9} - 1\right) = 3.53m \text{ of oil}$$

a. Discharge of oil

$$Q = \frac{C_d \times A_1 A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$Q = \frac{0.98 \times 0.07 \times 0.07767 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{0.07^2 - 0.07767^2}}$$

$$= 0.1489 m^3/s$$

b. Pressure difference between entrance and throat at section $P_1 - P_2$

$$h = \left(\frac{P_1}{w} + z_1\right) - \left(\frac{P_2}{w} + z_2\right) = 3.53$$

$$h = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) + \left(z_1 - z_2\right) = 3.53$$

$$z_2 - z_1 = 0.3m$$

$$\left(\frac{P_1 - P_2}{w}\right) - 0.3 = 3.53$$

$$\frac{P_1 - P_2}{w} = 3.83$$

$$P_1 - P_2 = 3.83 \times 9.81 \times 0.9$$

$$= 33.8 KN/m^2$$