

18/ENG04/047

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Elect/Elect

- ① Diameter of inlet $D_1 = 300\text{mm} = 0.3\text{m}$
Area of inlet $A_1 = \frac{\pi}{4} \times 0.3^2 = 0.07\text{m}^2$
Diameter of throat $D_2 = 150\text{mm} = 0.15\text{m}$
Area of throat $A_2 = \frac{\pi}{4} \times 0.15^2 = 0.01767\text{m}^2$
Specific gravity of heavy liquid (Mercury) in U-tube manometer
 $= 13.6$
S.G. of liquid (oil) flowing through pipe
 $S_o = 0.9$

Radius of differential manometer
 $y = 250\text{mm} = 0.25\text{m}$

The differential height given by
 $h = \left(\frac{P_1}{\rho} + Z_1 \right) - \left(\frac{P_2}{\rho} + Z_2 \right)$

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

Using the relation

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

$$Q = 0.98 \times \frac{0.07 \times 0.01767}{\sqrt{0.07^2 - 0.01767^2}} \times \sqrt{2 \times 9.81 \times 3.53}$$

$$= 0.1489\text{ m}^3/\text{s}$$

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

$$z_1 - z_2 = 3.00$$

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

$$P_1 - P_2 = 33.8 \text{ kN/m}^2$$

$$\textcircled{2} A_1 = \frac{\pi}{4} D_1^2 = \frac{\pi}{4} \times 0.15^2 = 0.01767 \text{ m}^2$$

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

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

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

$$h = \left[\frac{0.04}{0.96 \times 0.00442 \times 4.429} \right]^2 = 4.247 \text{ m}$$

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

$$4.247 = \frac{P_1 - P_2}{w} + 0.15$$

$$P_2 - P_1 = (0.9 \times 1000 \times 9.81) (4.247 + 0.15) \text{ N/m}^2$$

$$= 34.811 \text{ kN/m}^2$$