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DEPT - PETROLEUM - ENGINEERING.

COURSECODE - ENG 214

MATRIC NO: 181ENG07001

Assignment.

Sp. Grav. $= 0.8$ ($D_1 = 150mm$, $D_2 = 75mm$) $= D_{0.15}$, $Z_2 - Z_1 = 150mm$, $Q_{act} = 40 litres/sec = 0.04 m^3/s$, $Cd = 0.96$

Pressure difference: ? $(P_1 - P_2)$:

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

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

$$Q_{act} = Cd \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}, \text{ we get}$$

$$0.04 = 0.96 \times \frac{0.0176 \times 0.00442}{\sqrt{(0.01767)^2 - (0.00442)^2}} \times \sqrt{2 \times 9.81 \times \sqrt{h}}$$

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

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

Also, $h = \left(\frac{P_1}{\omega} + Z_1 \right) - \left(\frac{P_2}{\omega} + Z_2 \right)$ Recall $(Z_1 - Z_2) = 0.15$

or $4.247 = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega} \right) + (Z_1 - Z_2)$

$$= \left(\frac{P_1 - P_2}{Pg} \right) - 0.15$$

or, $(P_1 - P_2) = Pg(4.247 + 0.15)$

$= (0.8 \times 1000 \times 9.81)(4.247 + 0.15) N/m^2$

$= 34.51 kN/m^2$

2, Diameter of Inlet $D_2 = 300mm, 0.3m$ Inlet and throat.

Area of Inlet $A_1 = \frac{\pi \times D_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

Diameter of throat $D_2 = 150mm = 0.15m$

Area of Inlet $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.01767m^2$

Specific gravity of heavy liquid (Mercury) in U tube manometer $S_{hl} = 13.6$

Specific gravity of liquid (oil) Flowing Through Pipe $sp = 0.9$

Reading of differential manometer $y = 250mm = 0.25m$

The differential Reading of 'h' is given by

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

$$= y\left\{\frac{S_{hl}}{Sp} - 1\right\} = 0.25\left\{\frac{13.6}{0.9} - 1\right\}$$

$$= 3.53m \text{ of oil}$$

1, Discharge of oil Q

Using the relation,

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

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

$$Q = 0.1189m^3/s$$

B, Pressure difference between entrance and throat section $P_1 - P_2$

we all know that;

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

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

$z_2 - z_1 = 300mm = 0.3m$

$$\left(\frac{P_1}{w} - \frac{P_2}{w}\right) - 0.3 = 3.53 \text{ or } \frac{P_1 - P_2}{w} = 3.83$$

$$P_1 - P_2 = (9.81 \times 0.9) \times 3.83 = 33.8 kN/m^2 \text{ (Ans)}$$