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Given

$D_1 =$ 300mm

$D_2 =$ 150mm

Sg of oil = 0.9

Differential gauge reading or deflection Z = 300mm

Diff gauge reading deflection = 250mm = 0.25m

d_1 = 300mm = 0.3m

Inlet $A_1 = \frac{\pi d^2}{4} = \frac{3.14 \times 0.3^2}{4} = 0.07m^2$

Throat $A_2 = \frac{\pi d^2}{4} = \frac{3.14 \times 0.15^2}{4} = 0.01767m^2$

Specific gravity of mercury (13.6)

Sg of oil = 0.9

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

$$= y\left(\frac{\text{s.g of Hg}}{\text{sg of oil}} - 1\right)$$

$$= 0.25\left(\frac{13.6}{0.9} - 1\right)$$

$$h = 3.527m \text{ of oil}$$

ii) Discharge of oil, using $Q = cdX \frac{A_1 A_2}{\sqrt{A_1^2 - A^2}} \times \sqrt{2gh}$

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

$$= \frac{0.001212}{0.0677} \times 8.32 = 0.1489 \, m^3/s$$

(N) Pressure difference between entrance and throat section

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

$$Z = 300mm \qquad w = 9.81 \times 09$$

$$\frac{P_1 - P_2}{w} - 0.3 = 3.53$$

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

$$P_1 - P_2 = 3.83\, w$$

$$3.83(9.81 \times 09)$$

$$P_1 - P_2 = 33.8 \, KN/m^2$$

2) Given

$d_1 = 150mm = 0.15m^2$ $\quad z_1 - z_2 = 150mm = 0.15m$

$d_2 = 75mm = 0.075m^2$ $\quad Q_{act} = 0.09m$

$$A_1 = \frac{\pi d^2}{4} = \frac{3.14 \times 0.15^2}{4} = 0.01767 m^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{3.14 \times 0.075^2}{4} = 0.00442 m^2$$

$$Q_{actual} = C_d \times \frac{A_1 A_2 4}{\sqrt{A_1^2 - A_1^2}} \times \sqrt{2gh}$$

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

$$0.09 = 0.98 \times 0.004565 \times 4.429\sqrt{h}$$

$$\therefore h = \frac{0.09}{0.96 \times 0.004563 \times 4.429} = 4.247m$$

$$4.247 = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) + (z_1 - z_2)$$

$$4.247 = \left(\frac{P_1 - P_2}{\rho g}\right) - 0.15$$

$$4.247 + 0.15 = \left(\frac{P_1 - P_2}{\rho g}\right)$$

$$(P_1 - P_2) = \rho g (4.247 + 0.15)$$

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

$$(P_1 - P_2) = 34.5 \text{ kN/m}^2$$