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(1) 1 litre/sec = $0.001 m^2/sec$.
40 litres/sec = x

40×0.001

$= 0.04 m^3/se$.

$Q = 0.04 m^3/sec$.

$Cd = 0.96$, Specific gravity = 0.8

$d_1 = \frac{156}{1000} = 0.15m$. $A_1 = \frac{\pi d^2}{4} = \frac{3.142(0.15)^2}{4}$

$= 0.0177 m^2$

$d_2 = \frac{75}{1000} = 0.075m$. $A_2 = \frac{\pi d^2}{4} = \frac{3.142(0.075)^2}{4}$

$= 0.0044 m^2$

$Q = Cd \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$

$0.04 = 0.96 \left[\frac{0.0177 \times 0.0044}{(0.0177)^2 - (0.0044)^2}\right] \times \sqrt{2 \times 9.81 \times h}$

$0.04 = 0.96 \left[\frac{7.78 \times 10^{-5}}{0.0171}\right] \times 4.429\sqrt{h}$.

$0.04 = 0.96 \times 4.554 \times 10^{-3} \times 4.429\sqrt{h}$.

$0.04 = 0.01936\sqrt{h}$

$2.066 = \sqrt{h}$.

$h = 4.26m$.

$h = (P_1/w + Z_1) - (P_2/w + Z_2)$

$426 = (P_1/w) - P_2/w) - (Z_2 - Z_1)$

$4.26 - (P_1/w - P_2/w) - (0.015)$

$P_1/\rho g - P_2/\rho g = 4.410$

$P_1 - P_2 = 4.410 \times 0.8 \times 9810$

$P_1 - P_2 = 34609.68\ N/m^2$

$P_1 - P_2 = 34610\ N/m^2$ or $34.610\ kN/m^2$

2) Diameter at Inlet $d_1 = 300$, $A = \frac{\pi d^2}{4} = \frac{3.142 \times (0.30)^2}{4}$

$= 0.3m$

$= 0.0706\ m^2$

Diameter at throat $d_1 = 150$ $A = \frac{\pi d^2}{4} = \frac{3.142 \times (0.15)^2}{4}$

$= 0.15m$

$= 0.0176\ m^2$

Let section (1) represent Inlet and section (2) throat.

Then $Z_2 - Z_1 = 300m = 0.3m$.

Specific gravity of oil $= 0.90$

" " " $Hg = 13.6$

Reading of different manometer $x = 250mm = 0.25m$.

Differential head h.

$$h = \left[\frac{P_1}{\rho g} + Z_1\right] - \left[\frac{P_2}{\rho g} + Z_2\right]$$

$$h = x\left[\frac{S_g}{S_o} - 1\right] = 0.25\left[\left(\frac{13.6}{0.9}\right) - 1\right] = 3.527m.$$

The discharge of oil $= C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$.

$$Q = 0.98 \frac{0.0706 \times 0.0176}{\sqrt{(0.0706)^2 - (0.0176)^2}} \times \sqrt{2 \times 9.81 \times 3.527}$$

$$Q = 0.98 \frac{(1.2425 \times 10^{-3})}{(0.0683)} \times \sqrt{69.19}$$

$$Q = 0.98 \times 0.018 \times 8.318$$

$Q = 0.1467 \ m^3/sec$

ii) Pressure difference.

$$h = \left[\frac{P_1}{\rho g} + z_1\right] - \left[\frac{P_2}{\rho g} + z_2\right] - 3.527$$

But $z_1 - z_2 = 0.3m$.

$$\left(\frac{P_1}{\rho g} - \frac{P_2}{\rho g}\right) - (z_1 - z_2) = 3.527$$

$$\left[\frac{P_1}{\rho g} - \frac{P_2}{\rho g}\right] - 0.3 = 3.527$$

$$\frac{P_1 - P_2}{\rho g} = 3.527 + 0.3$$

$$P_1 - P_2 = 3.827 \rho g$$

Density of oil = Specific gravity of oil $\times 1000 \ kg/m^3$

$= 0.9 \times 1000$ ~~$\times 9.81$~~

$= 900 \ kg/m^3$

$$P_1 - P_2 = 3.827 \times 900 \times 9.81$$

$= 33788.583 \ N/m^2$