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18/ENG02/072
Computer Engineering
Fluid mechanics - ENG 214

1. $D_1 = \frac{300mm}{1000} = 0.3m$

$A_1 = \frac{\pi d^2}{4}$

$A_1 = \frac{(0.3)^2}{4} = 0.07m^2$

$D_2 = \frac{150mm}{1000} = 0.15$

$A_2 = \frac{\pi d^2}{4}$

$= \frac{\pi (0.15)^2}{4}$

$A_2 = 0.0176m^2$

S.G of mercury = 15.6
S.G of oil = 0.9
$y = 250mm = 0.25m$
Head difference

$y\left[\frac{SHL}{SP} - 1\right]$

$= 0.25\left[\frac{15.6}{0.9} - 1\right]$

Discharge of oil Q

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

$Q = \frac{0.98 \times 2.07 \times 0.01764}{\sqrt{0.07^2 - 0.01762^2}} \times \sqrt{2 \times 9.81 \times 3.53}$

$= 0.1489 m^3/s$

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

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

$P_1 - P_2 = 3.83 N/m$

$w = (9.81 \times 0.9) = 8.829$

$P_1 - P_2 = 3.83 \times 8.829$
$= 33.8 kN/m^2$

2) SP gravity = 0.8

$D_1 = 150mm = \frac{150}{1000} = 0.15m$

$D_2 = 75mm = \frac{75}{1000} = 0.075m$

$z_1 - z_2 = 150mm = 0.15m$

$Q = 40.45 = \frac{40.45}{1000} = 0.04m^3/s$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi (0.15)^2}{4}$

$A_1 = 0.1767$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi (0.075)^2}{4}$

$A_2 = 4.4178 \times 10^{-2}$

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

$0.04 = \frac{0.96 \times 0.1767 \times 4.4178 \times 10^{-2}}{\sqrt{0.1767 \times 4.4178 \times 10^{-2}}} \times 2.981 \sqrt{h}$

$0.04 = 0.96 \times 0.0279 \times 4.429 \times \sqrt{h}$

$\sqrt{h} = \frac{0.04}{0.96 \times 0.0249 \times 4.429}$

$\sqrt{h} = 0.3778$

$h = 0.3778^2$

$h = 0.1429m$

Recall;

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

$0.1429 = \left(\frac{P_1 - P_2}{w}\right) - 0.15$

$\left(\frac{P_1 - P_2}{w}\right) = 0.1429 + 0.15$

$\left(\frac{P_1 - P_2}{w}\right) = 0.2927$

$\therefore (P_1 - P_2) = 0.2927 \times w$

$= 0.2927 \times (0.8 \times 1000 \times 9.81)$

$= 2297.1 KN/m^2$