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18/eng02/080
Computer Engineering
Fluid Mechanics

1 $h = 20m$

U_1 (smaller end) = 5m/s

U_2 (lower end) = 2m/s

$= \frac{0.35(U_1 - U_2)}{2g}$

Ph at smaller head: 2.5m

$\frac{P_2}{\omega} = \frac{P_1}{\omega} + \frac{(U_1^2 + U_2^2)}{2g} + (z_1 - z_2)h$

$= 2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + 2 - \frac{\langle 0.3(5 - 2^2 \rangle}{2 \times 9.81}$

$= 2.5 + 1.07 + 2 - 0.16055$

Pressure at lower head

$= 5.409$ bar $\simeq 5.41$ bar

2 Inlet diameter $= 0.2m$

Throat diameter $= 0.1m$

$Cd = 0.98$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi \times 0.2^2}{4} = 0.0314m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi \times 0.1^2}{4} = 0.785 \times 10^{-3} m^2$

$h = \frac{P_1}{\omega} - \frac{P_2}{\omega}$

$\frac{P_1}{\omega} = \frac{1.765 \times 10^{-2} N/m}{9.81}$

$= 1.799 \times 10^{-3}$

$P_2/\omega = 6.3 \times 13.6 = 4.08$

$h = P_1/\omega - P_2/\omega = 1.799 \times 10^{-3} - (-4.08)$

$= 4.082 m$

$\therefore Q = \dfrac{0.98 \times 0.0314 \times 7.85 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.85 \times 10^{-8}}} \times \sqrt{2 \times 9.81} \times 4.082$

~~$\sqrt{2gh}$.~~

$Q = \dfrac{0.0002415 \times 8.949}{\sqrt{0.00092}}$

$Q = \dfrac{0.00216}{0.0303}$

$= 0.0713 m^3/s$

3 $D_1 = 0.15 m$, $D_2 = 0.3 m$

$= 0.9$, $Cd = 0.64$

$A_1 = \dfrac{\pi d^2}{4} = \dfrac{\pi \times 0.15^2}{4} = 0.0176 m^2$

$A_2 = \dfrac{\pi d^2}{4} = \dfrac{\pi \times 0.3^2}{4} = 0.07069 m^2$

$h = 0.5\left(\dfrac{13.6}{0.9} - 1\right) = 7.05 m$

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

$= \dfrac{0.64 \times 0.0176 \times 0.07069}{\sqrt{(0.0176)^2 - (0.07069)^2}} \times \sqrt{2 \times 9.81}$

$= \dfrac{0.000796 \times 11.7609}{\sqrt{0.000309 - 0.00499}}$

4 Area $= 15 m$

170mm (0.17m)

Sg Hg 13.6

Sg of seawater = 1.026

$h = 0.17\left(\dfrac{13.6}{1.026} - 1\right)$

$= 2.083$

$v = \sqrt{2gh}$

$= \sqrt{2 \times 9.81 \times 2.083}$

$= 6.39 m/s$

OR

1 Using Bernoulli's equa

$\dfrac{P_1}{w} + \dfrac{v_1^2}{2g} + z_1$

$Z_2 = 0$; Z_1

$2.5 + \dfrac{v^2}{2g} + 2 =$

$\dfrac{P_2}{w}$

2 Discharge Q:

$Q = Cd \times A$

$\sqrt{A_1}$

0.98×0

$= 0.1655$

$\approx$

3 Using

$h = y$

0.5

7.0

Then,

$Q = Cd$

$= 0.64 \times$

=

1 Using Bernoulli's equation

$$\frac{P_1}{w} + \frac{U_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{U_2^2}{2g} + Z_2 + h_L$$

$Z_2 = 0$; $Z_1 = 2.0m$

$$2.5 + \frac{5^2}{2g} + 2 = \frac{P_2}{w} + \frac{2^2}{2g} + 0 + 0.16$$

$$\frac{P_2}{w} = 5.77 - 0.36$$

$= 5.41m$ of liquid.

2 Discharge Q:

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

$$\frac{0.98 \times 0.0314 \times 0.00785}{\sqrt{(0.0314)^2 - (0.00785)^2}} \times \sqrt{2 \times 9.81 \times 22.12}$$

$= 0.1655206407$

$\simeq 0.17 m^3/s$

3 Using

$$h = y\left[\frac{s_{in}}{s_o} - 1\right]$$

$$0.5\left[\frac{13.6}{0.9} - 1\right]$$

$7.06m$ of oil.

Then,

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

$$= 0.64 \times \frac{0.0177 \times 0.0707 \times \sqrt{2 \times 9.81 \times 7.06}}{\sqrt{(0.0707)^2 - (0.0177)^2}}$$

$= 0.1377084021$

$\simeq 0.137 m^3/s$

4 $h = y\left[\frac{S_{m}}{S_1} - 1\right]$

$0.17\left[\frac{13.6}{1.026} - 1\right]$

$= 2.08$

$v = \sqrt{2gh}$

$= \sqrt{2 \times 9.81 \times 2.08}$

$= 6.388239194$

$\simeq 6.39\ m/s$

5 Actual flowrate $= 5\ dm^3/min = 8.33 \times 10^{-5}\ m^3/sec$

$P = 15\ bar = 15 \times 10^5\ N/m^2$

$N = 1700\ rev/min = 28.33\ rev/sec$

$T =$ [illegible] $15\ Nm$ nominal displacement $= 100\ cm^3/rev$

$= 1 \times 10^{-5}\ m^3/rev$

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