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18/ENG02/066
Computer Eng.
ENG 214

1)

Using Bernoulli's equation

$$\frac{P_1}{\omega} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + Z_2 + h_L$$

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

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

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

$$= 5.41m \text{ of liquid}$$

$L = 2.0m$
$V_1 = 5m/s$
$\frac{P_1}{\omega} = 2.5m$ of liquid
$V_2 = 2m/s$
$h_L = \frac{0.35(V_1 - V_2)^2}{2g}$
$= \frac{0.35(5-2)^2}{2 \times 9.81}$
$= 0.16$
$\frac{P_2}{\omega} = ?$

2)

Discharge, Q:

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

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

$= 0.165520647$
$\simeq 0.17 m^3/s$

$D_1 = 20cm = 0.2m$
$A_1 = \frac{\pi}{4} \times 0.2^2 = 0.0314 m^2$
$D_2 = 10cm = 0.1m$
$A_2 = \frac{\pi}{4} \times 0.1^2 = 0.00785 m^2$
$P_1 = 176\,580 N/m^2$
$\simeq 177 KN/m^2$
$\frac{P_1}{\omega} = \frac{177}{9.81} = 18.04m$
$\frac{P_2}{\omega} = -30cm$ of mercury
$= -0.3m$ of mercury
$= -0.3 \times 13.6 = -4.08m$
$Cd = 0.98$
$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = 18.04 - (-4.08)$
$= 22.12m$

3)

Using,

$$h = y\left[\frac{S_{hl}}{S_o} - 1\right]$$

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

$$= 7.06\text{m of oil}$$

$D_1 = 30\text{cm} = 0.3\text{m}$

$A_1 = \frac{\pi}{4} \times 0.3^2 = 0.0707\text{m}^2$

$D_o = 15\text{cm} = 0.15\text{m}$

$A_o = \frac{\pi}{4} \times 0.15 = 0.0177\text{m}^2$

$C_d = 0.64$

$S_o = 0.9$

$y = 50\text{cm of mercury}$

$= 0.5\text{m of mercury}$

$S_{hl} = 13.6$

Then,

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

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

$$= 0.1377084021$$

$$\simeq 0.137\text{m}^3/\text{s}$$

4)

$$h = y\left[\frac{S_{hl}}{S_l} - 1\right]$$

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

$$= 2.08$$

$y = 170\text{mm} = 0.17\text{m}$

Hg, $S_{hl} = 13.6$

Seawater, $S_l = 1.026$

$$V = \sqrt{2gh}$$

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

$$= 6.388239194$$

$$\simeq 6.39\text{m/s}$$