DEPARTM[illegible] ENGINEERING

1

$\frac{P_1}{w} = \frac{P_1}{\omega} = 2.5m$

$H_L = \frac{0.35(V_1 - V_2)^2}{2g}$

Using Bernoulli's equation. $\frac{P_2}{\omega} = ?$

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

$\frac{P_2}{\omega} = \frac{P_1}{\omega} + \left[\frac{V_1^2 - V_2^2}{2g}\right] + \left[Z_1 - Z_2\right] - H_L$

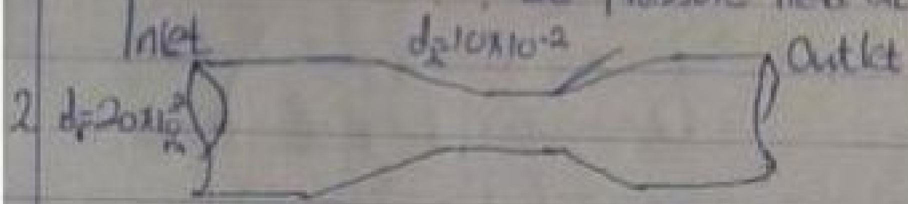
$\frac{P_2}{\omega} = 2.5 + \left[\frac{5^2 - 2^2}{2 \times 9.81}\right] + 2 - \frac{0.35(5-2)^2}{2 \times 9.81}$

$\frac{P_2}{\omega} = 2.5 + 1.07 + 2 - 0.161$

$\frac{P_2}{\omega} = 5.409m$

∴ the pressure head at the lower end is 5.409m.

2



$P_1 = 17.658 N/cm^2 = 17.658 \times 10^4 N/m^2$. $C_d = 0.98$.

$P_2 = 30cmHg = 30 \times 10^{-2} mHg$. $Q = ?$

$A_1 = \frac{\pi \times (20 \times 10^{-2})^2}{4} = 0.03m^2$

$A_2 = \frac{\pi \times (10 \times 10^{-2})^2}{4} = 7.85 \times 10^{-3} m^2$

$\frac{P_2}{\omega} = 0.3 \times 13.6 = 4.08 mHg$

$\frac{P_2}{\omega} = -4.08$ (Since vacuum pressure)

$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = 18 - -4.08$
$= 22.08$

$\frac{P_1}{\omega} = \frac{17.658 \times 10^4}{9.81 \times 10^3} = 18$

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

$$Q = \frac{0.98 \times 0.03 \times (7.85 \times 10^{-3}) \times \sqrt{2 \times 9.81 \times 22.08}}{\sqrt{(0.03^2 - (7.85 \times 10^{-3})^2}}$$

$Q = 0.166 m^3/s$

3 $d_0 = 15 \times 10^{-2} m$ $d_1 = 30 \times 10^{-2} m$ $Cd = 0.64$

$A_0 = \frac{\pi \times (15 \times 10^{-2})^2}{4} = 0.01767 m^2$ $y = 50 \times 10^{-2} mHg$ $Q = ?$

S.g of oil: 0.9 $S_{hg} = 13.6$

$A_1 = \frac{\pi \times (30 \times 10^{-2})^2}{4} = 0.0707 m^2$ $H = y\left[\frac{S_{hg}}{S_0} - 1\right]$ $S_0 = 0.9$

$$H = 50 \times 10^{-2}\left[\frac{13.6}{0.9} - 1\right]$$

$H = 7.055 m$

$$Q = \frac{Cd\, A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}}$$

$$Q = \frac{0.64 \times 0.0176 \times 0.0707 \sqrt{2 \times 9.81 \times 7.055}}{\sqrt{(0.0707^2 - 0.0176^2)}}$$

$Q = 0.137 m^3/s$

4 $y = 170 mmhg = 170 \times 10^{-3} mhg$ $H = y \times \frac{S_{hg}}{S_0} - 1$

S.g of mecury = 13.6hg

S.g of Sea water = 1.026 $H = 170 \times 10^{-3} \times \left(\frac{13.6}{1.026} - 1\right)$

$V = \sqrt{2gH}$ $H = 2.08 m$

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

$V = 6.39 m/s$

5 Actual flowrate Q = ~~0.05m³~~ $5 dm^3/min = 8.33 \times 10^{-5} m^3/Sec$

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

$V = 1700 rev/min = 28.33 rev/Sec$

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$T = 15 N/m$ Nomal displacement $= 10 cm^3/rev = 1 \times 10^{-5} m^3/rev$

i) Volumentric Efficiency

$\frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100\%$ Ideal flowrate = displacement $\times$ Spe

$q = 1 \times 10^{-5} \times 28.33$

$= 2.833 \times 10^{-4} m^3/sec$

Volumentric Efficiency $= \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100$

$= 29.4\%$

ii) fluid power $[Q \times \Delta P]$

$= 8.33 \times 10^{-5} \times 15 \times 10^5 = 124.95$ watts

iii) Shaft power $= T \times w$.

$w = 2 \times \pi \times V$

$w = 2 \times \pi \times 28.33 = 178$ rad/sec

Shaft power $= T \times w$

$= 15 \times 178$

$= 2670$ watts

iv) Overall Efficieny

$\frac{\text{fluid Power}}{\text{Shaft power}} \times 100\%$

$= \frac{124.95}{2670} \times 100$

$= 4.68\%$

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