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Dept: Mechanical Engineering
Course: ENG214 -

Assignment

1- $Q = 2m$

$V_1 = 5m/s$

$V_2 = 2m/s$

$P/w = 2.5m$

$h_L = \frac{0.35(V_1 - V_2)^2}{2g} = \frac{0.35(5-2)^2}{2\times 9.81} = 0.16m$

To get $\frac{P_2}{w}$ Comparing:

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

$Z_2 = 0$

$Z_1 = 2m$

$$2.5 + \frac{5^2}{2\times 9.81} + 2 = \frac{P_2}{w} + \frac{2^2}{2\times 9.81} + 0 + 0.161$$

$$5.77 = \frac{P_2}{w} + 0.365$$

$$\frac{P_2}{w} = 5.77 - 0.365$$

$$= 5.405m //$$

2. $d_1 = 0.2m$, $d_2 = 0.1m$; $P = 17.058 N/cm^2$; $P_2 = 30mmHg$; $Cd = 0.98$

$A_1 = \frac{\pi \times 0.2^2}{4} = 3.14\times 10^{-3} m^2$ //

$A_2 = \frac{\pi \times 0.1^2}{4} = 7.85\times 10^{-4} m^2$ //

$h = \frac{P_1 - P_2}{w}$ $P_1 = \frac{17.658}{10^{-4}} = 176.58\times 10^3 N/m^2$

$\frac{P_1}{w} = \frac{176.58 \times 10^3}{1000 \times 9.81} = 18m$

$\frac{P_2}{w} = -0.30 \times 13.6$

$= -4.08$

$h = 18 + 4.08$

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

$= \frac{0.98 \times 3.14 \times 10^{-7} \times 7.85 \times 10^{-4}}{\sqrt{(3.14 \times 10^{-5})^2 - (7.85 \times 10^{-4})^2}} \times \sqrt{2 \times 9.81 \times 22.08}$

$= 0.98 \times 8.12 \times 10^{-5} \times 19.20.81$

$= 1.512 \times 10^{-3} m^3/s$

$1.656 \times 10^{-3} M^3/s$

3. $P_2 = 15cm = 0.15m$

$P_1 = 30cm = 0.3m$

$y = 50cm Hg = 0.5m Hg$

Sg of oil $= 0.9$; Sg of mercury $= 13.6$

$Cd = 0.64$

Area of Pipe $(A_1) = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

Area of Orifice meter $(A_0) = \frac{\pi \times 0.15^2}{4} = 0.0177m^2$

$h = y\left[\frac{Sghl}{So} - 1\right]$

Sghl = Specific gravity of heavier liquid.

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

$= 7.056 m of oil$

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

$$= \frac{0.64 \times 0.0177 \times 0.071 \times \sqrt{2} \times 9.81 \times 7.056}{\sqrt{0.071^2 - 0.0177^2}}$$

$$= 0.138 m^3/s$$

4. Manometer reading $(y) = 170mm Hg = 0.17m Hg$

$Sg\ Hg = 13.6$

Sg of Seawater $(Sw) = 1.026$

$$h = 0.17\left[\frac{13.6}{1.025} - 1\right]$$

$$= 2.08$$

Velocity of the Submarine

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

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

$$= 6.39 m/s$$

5. $Q = 5 dm^3/min$

$$= \left[\frac{5}{1000} \times \frac{1}{60}\right] m^3/s$$

$$= 8.3 \times 10^{-5} m^3/s$$

$N = 1700 rev/min = \frac{1700}{60} = 28.33 revs/sec$

$Q_p = 10 cm^3/rev = 10 \times 10^{-6} m^3/rev$

Ideal flowrate = speed x displacement

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

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

i) Vol. efficiency $= \frac{\text{actual } Q}{\text{ideal } Q} \times 100$

$= \frac{8.3 \times 10^{-5}}{2.83 \times 10^{-4}} \times 100$

$= 29.33\%$

ii) Fluid power = flow rate x pressure

$= 8.3 \times 10^{-5} \times (15 \times 10^5)$

$= 124.5 W$

iii) Shaft power = torque x angular velocity

$\omega = 2\pi N$

$= 2\pi \times 28.33 = 178 \text{ rads}^{-1}$

Shaft power

$= 15 \times 178$

$= 2670 W$

iv) Overall efficiency $= \frac{\text{fluid power}}{\text{Shaft power}} \times 100$

$= \frac{124.5 \times 100}{2670}$

$= 4.66\%$