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Assignment

1) $V_1 = 5 m/s$, $V_2 = 2 m/s$ $l = Z_1 - Z_2 = 2m$ $\frac{P_1}{\omega} = 2.5m$ of water

Using $hf = \frac{0.35(V_1 - V_2)^2}{2g}$ & Bernolli's

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

$$hf = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16m$$

$$\frac{P_2}{\omega} = 2.5 + \frac{1}{2(981)} + (5^2 - 2^2) + 2.0 - 0.16$$

$$\frac{P_2}{\omega} = 5.41m$$

∴ the pressure will be 5.41m

2) $A_1 = \pi/4 \times 0.2^2 = 0.0314m^2$, $D_1 = 20cm = 0.2m$ $D_2 = 10cm = 0.1m$

$A_2 = \pi/4 \times 0.1^2 = 0.00785m^2$ $P_1 = 17.65 N/cm^2 = 1.77 \times 10^5 N/cm^2$

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

$$h = \frac{P_1 - P_2}{\omega} = \frac{176580 - 3997.67}{1000 \times 9.81}$$

$$= 17.59m$$

$$A_1 = \frac{\pi(0.2)^2}{4} = 0.0314m^2$$

$$A_2 = \frac{\pi(0.1)^2}{4} = 7.854 \times 10^{-3} m^2$$

$$Q = \frac{0.98 \times 0.0314 \times 7.85 \times 10^{-3} \times \sqrt{2 \times 9.81 \times 17.59}}{\sqrt{0.0314^2 - (7.854 \times 10^{-3})^2}}$$

$Q = 0.149 \approx 0.15 m^3/s$

3 $$Q = \frac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}}$$

solving for ~~initial Ao~~ Area $= \frac{\pi (15 \times 10^{-2})^2}{4} = 0.017$

" " " Area $= \frac{\pi \times (30 \times 10^{-2})^2}{4} = 0.071$

Specific gravity $= \frac{w}{1000g}$

$w = 8829$

$h = \frac{P_1 - P_2}{w} = \frac{6668.12}{8829}$

$h = 0.755m$

$$Q = \frac{0.64 \times 0.017 \times 0.071 \times \sqrt{2 \times 9.81 \times 0.755}}{\sqrt{0.071^2 - 0.017^2}}$$

$Q = 0.045 m^3/sec$

4) mercury level $= 170mm = 0.17m$. S.g of mercury $= 13.6$

$C_v = 1$ S.g of ocean $= 1.026$

$$h = \left[\frac{\text{Sg of mercury}}{\text{S.g of liquid}} - 1\right] y$$

$$h = 0.17 \left[\frac{13.6}{1.026} - 1\right] = 2.083$$

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

$= 1 \times \sqrt{2 \times 9.81 \times 2.08}$

$V = 6.39 m/s$

5) torque = 15 Nm , normal displacement = 10cm³/rev

pressure = 15 bar = ~~1.5~~ 15×10^5 N/m² = 1×10^{-5} m³/rev

Volmetric flow rate = 0.05 m³/min = 8.33×10^{-5} m/s

speed : 1700 rev/min = 28.3 rev/s

a) Vol efficiency

theoretical flowrate = speed of rotation × displacement

$= 28.333 \times 1 \times 10^{-5}$

$= 2.83 \times 10^{-4}$

hence = $\frac{\text{Actual Flowrate}}{\text{theoretical Flowrate}} \times 100$

$= \frac{8.33 \times 10^{-5}}{2.83 \times 10^{-4}} \times 100 = 29.5\%$ //

b) fluid power

$Q(P_2 - P_1) = 8.333 \times 10^{-5}(15 \times 10^5)$

$= 124.95 \simeq 125$ watts //

c) shaft power = $T\omega$

$\omega = 2 \times \pi \times$ speed of rotation

$\omega = 2 \times \pi \times 28.3 = 177.8$ r/sec

hence $T\omega = 15 \times 177.81$

$= 2667.2$ watts //

d) total efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}} \times 100$

$= \frac{~~124.95~~}{~~2667~~} = \frac{125}{2667.2} \times 100$

$= 4.686 \simeq 4.7\%$ //