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18/ENG02/100.
COMPUTER ENGINEERING.

1) Lenght, $L = 2.0m$.

$V_1 = 5m/s$, $V_2 = 2m/s$

Pressure head at the smaller end

$P_s = 2.5m$ of liquid.

loss of head, $H = \frac{0.35(V_1 - V_2)^2}{2g}$

$$\frac{0.35(5-2)^2}{2 \times 9.81} = 0.161m$$

Pressure head at the lower end.

$P_2 = ?$

Applying Bernoulli's equation.

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2 + H.$$

$$P_s = \frac{P_1}{\rho g} \quad \text{and} \quad P_L = \frac{P_2}{\rho g}.$$

$Z_1 = 2.0$ and $Z_2 = 0$

$$2.5 + \frac{5^2}{2 \times 9.81} + 2.0 = P_L + \frac{2^2}{2 \times 9.81} + 0 + 0.161$$

$$2.5 + \frac{25}{19.62} + 2 - \left(\frac{4}{19.62} + 0.181\right) = P_L$$

$$5.774 - 0.365 = P_L.$$

$$P_L = 5.409m$$

2) $D_1 = 20cm$ $D_2 = 10cm$

$$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi (20)^2}{4}$$

$$= 314.2\ cm^2$$

$$A_2 = \frac{\pi D_2^2}{4} = 78.55cm^2$$

$\rho = 1000kg/m^3$

Pressure at inlet, P_1.

$= 17.658\ N/cm^2 = 17.658 \times 10^4 N/m^2$

$$\frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{1000 \times 9.81} = 18m$$

$$\frac{P_2}{\rho g} = -30cm \text{ of mecury} \times 13.6$$

$$= -4.08m$$

Differential head, Hd =.

$$\frac{P_1}{\rho g} = \frac{P_2}{\rho g}.$$

$= 18 - (-4.08).$

$18 + 4.08 = 22.08m \times 100$

$Hd = 2208cm$

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

$$= \frac{0.98 \times \sqrt{2 \times 9.81 \times 2208} \times 314.2 \times 78.55}{\sqrt{(314.2)^2 - (78.55)^2}}$$

$$= \frac{0.98 \times 2081.37 \times 24680.41}{304.2228418}$$

$= 165476.3441\ cm^2/s$

$$= \frac{165476.3441}{1000} = 165.476 \text{ litre}$$

3) $d_1 = 30cm$

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi(30)^2}{4} = 706.95 cm^2$

$d_2 = 15 cm.$

$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi(15)^2}{4} = 176.73 cm^2$

S.g of oil = 0.9. S.g of mercury = 13.6

$Cd = 0.64,$

differential manometer reading. $x = 50cm$ of mercury.

differential head, $h = x\left(\frac{S_m}{S_o} - 1\right)$

$h = 50\left(\frac{13.6}{0.9} - 1\right).$

$h = 705.56 cm.$

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

$Q = \frac{0.64 \times \sqrt{2 \times 9.81 \times 705.56} \times 706.95 \times 176.73}{\sqrt{(706.95)^2 - (176.73)^2}}$

$Q = 13744.21 \ cm^2/s$

$Q = \frac{13744.21}{1000} = 13.744$ lit/s

) difference of mercury $x = 170mm$

$= 170 \times 10^{-3}$

$= 0.17m.$

g of mercury, $S.g = 13.6.$

g of Sea water, $S_o = 1.026.$

speed, $V = ?$

$V = \sqrt{2gh}$, $h = ?$

$= x\left[\frac{Sg}{So} - 1\right] = 0.17\left[\frac{13.6}{1026} - 1\right].$

$= 2.0834m.$

$V = \sqrt{2 \times 9.81 \times 2.0834}$

$= 6.393 m/s.$

$V = \frac{6.393 \times 60^2}{1000} = 23.01 km/hr$

5) $Q = 0.05 m^3/min = 50 dm^3/min$

$P_1 = 15 bar = 15 \times 100000$

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

Speed = 1700 rev/min,

ND = $10 cm^3/rev.$

T = 15Nm.

i) Volumetric efficiency = $\frac{\text{Actual flow rate}}{\text{Ideal flow rate}}$

Ideal flow rate = Nominal flow rate X Speed

$= 10 cm^3/rev \times 1700 rev/min$

$= 17000 cm^3/min$

$= 0.017 m^3/min$

Actual flow rate = $0.05 m^3/min$

Volumetric efficiency $= \frac{0.05}{0.017} = 2.94\%$

ii) fluid power = P x Q

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

$Q = 0.05 m^3/min = \frac{0.05}{60}$

$= 8.33 \times 10^{-4} m/s$

fluid power $= 15 \times 10^5 \times 8.33 \times 10^{-4}$

$= 1249.5$ watts

iii) Shaft power $= \frac{2\pi NT}{60}$

$= \frac{2\pi \times 1700 \times 15}{60}$

$= 2670.35$ watts

iv) overall efficiency = $\frac{\text{fluid power}}{\text{Shaft power}}$

$= \frac{1249.5}{2670.35} = 0.468$

Overall efficiency $= 0.468 \times 100$

$= 46.8\%$