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Mat No: 18/ENG08/011

1) $L = 2.0m$
$V_1 = 5m/s$
$\frac{P_1}{\rho g} = 2.5m$ of liquid
$V_2 = 2m/s$

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

Pressure head $\left(\frac{P_2}{\rho g}\right)$
By Bernoulli's equation
$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2 + h_L$
$Z_2 = 0, Z_1 = 2$
$2.5 + \frac{5^2}{9.81} + 2.0 =$
$\frac{P_2}{\rho g} + \frac{2^2}{2 \times 9.81} + 0 + 0.16$
$2.5 + 1.274 + 2.0 =$
$\frac{P_2}{\rho g} + 0.20 + 0 + 0.016$
$5.774 - 0.36 = \frac{P_2}{\rho g}$
$5.414m$ of fluid $\frac{P_2}{\rho g}$

2) $d_1 = 20cm = 0.2m$
$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi(0.2)^2}{4}$
$= 0.0314m^2$
$A_2 = \frac{\pi d_2^2}{4} = 7.85 \times 10^{-3} m^2$
Note $P_1 = 17.658 N/cm^2$
$= 17.658 \times 10^4 N/m^2$
$\frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{9.81 \times 1000}$
$= 18m$ of water
$\frac{P_2}{\rho g} = 30cm$ of mercury
$= 0.30m \times 13.6$
$= 4.08$ of water
Note:
$h = \frac{P_1}{\rho g} - \frac{P_2}{\rho g}$
$h = 18 - (-4.08)$
$h = 22.08$ of water
$Q = \frac{C_d A_1 \times A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$
$Q = \frac{0.98 \times 0.0314 \times 7.85 \times 10^{-3} \times \sqrt{2 \times 9.81 \times 22.08}}{\sqrt{(0.0314)^2 - (7.85 \times 10^{-3})^2}}$
$Q = \frac{5.02688 \times 10^{-3}}{0.0304}$
$Q = 0.165 m^3/s$
$Q = 165.5$ lit/s

3) $d_0 = 0$
$A_0 = \frac{\pi ...}{4}$
$A_2 = \frac{\pi ...}{...}$
$= ...$
$y = 50...$
S_0 oil
$C_d = ...$
$h = [\frac{S_g}{S_o}...$
$0.5 [...$
$0.5 [...$
$= ...$
$Q = \frac{C_d A ...}{\sqrt{A_1^2 ...}}$
$Q = 0.6...$
$\times \sqrt{2 ...}$
$\sqrt{(0.0707...}$
$= 9.4...$
$0.0...$
$Q = 0....$

4) $r = 100...$
$S_m = 13....$
$C = 1$
$V = C\sqrt{...}$
$V = 1\sqrt{2...}$
$V = \sqrt{3...}$
$V = 6...$

$dr = 0.30$

Q) $d_0 = 0.15m$ ~~$d_1 = 0$~~

$A_0 = \frac{\pi d_0^2}{4} = \frac{\pi (0.15)^2}{4}$

$= 0.01767m^2$

$A_1 = \frac{\pi d_1^2}{4}$

$= 0.07067m^2$ - D

$y = 50cm\ Hg = 0.5m\ Hg$

Sg Oil $= 0.9$

$Cd = 0.64$

$h = \left[\frac{Sg\ hg}{Sg\ oil} - 1\right]$

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

$0.5\ [14.1]$

$= 7.056m$

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

$Q = 0.64 \times 0.07067 \times 0.01767 \times \sqrt{2 \times 9.81 \times 7.056}$ / $\sqrt{(0.07067)^2 - (0.01767)^2}$

$= \frac{9.4 \times 10^{-3}}{0.068}$

$Q = 0.138\ m^3/sec$

4) $r = 170mm = 0.17m$

$S_m = 13.6$, $S = 1.026$

$C = 1$, $V = ?$

$V = C\sqrt{2gr\left(\frac{S_m}{S} - 1\right)}$

$V = 1\sqrt{2 \times 9.81 \times 0.17\left(\frac{13.6}{1.026} - 1\right)}$

$V = \sqrt{3.3354 \times (12.255)}$

$V = 6.39\ m/s$

5) $Q = 0.05\ dm^3/min = 8.335 \times 10^{-5}$

Pressure change $= 15 bar$

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

Normal dis $= 10 cm^3/rev = 1 \times 10^{-5}$

Speed of rotation $= 1700\ rev/min$

$= 28.39$ rev/sec

Torque Input $= 15 Nm$

i) Vol efficiency $= \frac{A.F}{I.F} \times 100$ rotation

$I.F =$ Normal dis $\times$ speed of n

$= 1 \times 10^{-5} \times 28.39$

$= 2.839 \times 10^{-4} m^3/sec$

$V.E = \frac{8.33 \times 10^{-5}}{2.39 \times 10^{-4}} \times 100$

$= 0.294 \times 100 = 29.4\%$

ii) Fluid power

$= A.F \times$ change in pressure

$= 8335 \times 10^{-5} \times 15 \times 10^5$

$= 125.025W = 0.125\ KW$

iii) Shaft power

$=$ Torque $\times$ Angular speed

Angular speed $= 2 \times \pi \times$ speed of r

$= 178.38$

Shaft power $= 15 \times 178.38$

$= 2675.7W$

$= 2.675\ KW$

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

$\frac{125.025}{2675.7} \times 100$

~~$= 0.0467 \times 100 = 0.0467\%$~~

$= 0.047 \times 100 = 4.7\%$