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Ideal flow rate = normal displacement × speed

$= 10 \times 1500$

$= 15 dm^3/min$

(i) Volumentric efficiency = $\frac{\text{Actual flow}}{\text{Ideal flow}}$

$= 10/15$

$= 0.69 = 69\%$

(ii) fluid power = ΔpQ

$\Delta p = 12 \times 10^5 = 1,200,000$

$Q = \frac{10 \times 10^{-3}}{60}$

$= 1.69 \times 10^{-4}$

$\Delta pQ = 200.4$ watts

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

$= \frac{2 \times \pi \times 1500 \times 12.5}{60}$

$= 1964.3 Nm$

(iv) Overall Efficiency = $\frac{\text{fluid power}}{\text{shaft power}}$

$= \frac{200.4}{1964.3} = 10.2\%$

2 $87\% = f.p/s.p$

fluid power = ΔpQ

$p = 100 \times 10^5 N/m^2$

$Q = 35 \times 10^{-3}$

$= 5833.3$ watts

$0.87 = \frac{5833.3}{x}$

$x = 6705 Nm$

3 Ideal flow rate = normal displacement × speed

$= 50 \times 850$

$= 42.5 dm^3/min$

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

$= \frac{35}{42.5}$

$= 0.82$

$= 82\%$

fluid power = ΔpQ

$\Delta p = 100 \times 10^5$

$Q = \frac{50 \times 10^{-3}}{60}$

$= 8.3 \times 10^{-4}$

$\Delta pQ = 8300$

Shaft = 15 Kwatt = 1500

Overall efficiency = $\frac{\text{fluid power}}{\text{Shaft power}}$

$= \frac{8300}{15,000}$

$= 0.553$

$= 55.3\%$

4 $z = 24000 cm \times 10^{-2} = 240m$

jet velocity = 66 m/sec

vol flow rate = 13 L/s

$Q = 13/100 \times 13 \times 10^{-3} m^3/sec$

$p = z = 0$

$p = \frac{\rho Q v^3}{2} = \frac{1000 \times 13 \times 10^{-3} \times 66^2}{2}$

$= 28319$ watts

(ii) $p = 0 \quad v = 0$

$P = \rho g Q z$

$= 1000 \times 9.81 \times 13 \times 10^{-3} \times 240$

$= 30607.2$ watts

$P = 30.6$ kwatt

(iii) power loss in transmission = power of reservoir − power of jet

$= 30607.2 - 28314$

$= 2293.2$ watts

(iii) $h = \frac{\text{power lost in transmission}}{\rho g Q}$

$h = \frac{2293.2}{1000 \times 9.81 \times 13 \times 10^{-3}}$

$= 17.982 m$

(iv) Efficiency

$= \frac{\text{power of jet}}{\text{power of reservoir}} \times 100$

$= \frac{28314}{30607.2} \times 100$

$= 92.5$

$\simeq 93\%$

5. · s.g = 0.89

30,000

Q = 220 cut/sec = 0.22 m^3/s

v = 7 m/s

(i) power of jet

$= \frac{1}{2} \times \rho Q v^3$

$= \frac{1}{2} \times 890 \times 0.22 \times 7^3$

$P = 4797.1$ watt

(ii) power of reservoir

$P = \rho g Q H$

$= 890 \times 9.81 \times 0.22 \times 300$

$= 576239.4$ W

(iii) power of reservoir $= \gamma Q H = 890 \times 0.22 \times 300$

$= 58740$ kg m/sec

jet $= \frac{1}{2} \rho v^2 Q$

$= \frac{1}{2} \times \frac{890}{9.81} \times 7^2 \times 0.22$

$=$ ~~0.22~~ 489 kg m/s

power lost in transmission $= \gamma Q h$

$= 58740 - 489$

$= 58751$ kg m/s

$h = \frac{58751}{890 \times 0.22} = 297.5$ m

Efficiency $= \frac{\text{power of jet}}{\text{supply}}$

$= \frac{489}{58740}$

$= 0.0083$

%

6

$h = 20\,m$

$d = 10\,cm = 0.1\,m$

$A = \pi d^2/4 = 0.7854$

$V_f = 0$

$w = ?$

$v_f^2 = v_1^2 - 2gh$

$v_1 = \sqrt{v_f^2 + 2gh}$

$v_1 = \sqrt{0 + 2 \times 9.81 \times 20}$

$v_1 = 19.8\,m/s$

$Q = VA$

$= 19.80 \times 7.854 \times 10^{-3}$

$= 0.155\,m^3/s$

$w = \rho g Q h$

$= 1000 \times 9.8 \times 0.155 \times 20$

$= 30478\,kg\,m^2/s^3$

$= 30 \times 10^3\,W$

7. $P_1 g = 19.62 \times \rho l m^2$

$Cd = 0.96$

$d_1 = 0.3\,m$

$d_2 = 0.2\,m$

$u_1 = 0.0707 Q_1$, $u_2 = 0.0314 Q_1$

$P_1 = \rho_g g z = P_2 + \rho_g g (z + \rho) + \rho_w g P$

$P_1 - P_2 = 19.62 (z_2 - z_1) + 587.423$

for ther ventrimeter

$\frac{P_1}{\rho_g g} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\rho_g g} + \frac{v_2^2}{2g} + z_2$

$P_1 - P_2 = 19.62 (z_2 - z_1) + 0.803 i$

$0.803 V^2 = 587.423$

$V^2 = 27.047\,m/s$

$Q\ ideal = 27.047 \times \pi \left(\frac{0.3}{2}\right)^2$

$= 0.85\,m^3/s$

$Q = cd\ Q_{ideal}$

$= 0.96 \times 0.85$

$= 0.816\,m^3/s$

8) $d_1 = 0.152\,m$

$d_2 = 0.076\,m$

$\rho = 800\,kg/m^3$

$Cd = 0.97$

$A_1 = \pi d^2/4 = 0.01814\,m^2$

$A_2 = \pi d^2/4 = 0.00434\,m^2$

Applying Bernoulli's method

$\frac{P_1}{\rho g} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{v_2^2}{2g} + z_2$

$P_1 = P_2$

$\frac{v_1^2}{2g} + z_1 = \frac{v_2^2}{2g} + z_2$

$Q = V_1 A_1 = V_2 A_2$

$V_2 = V_1 A_1 / A_2$

$= 0.4$.

+ 0.808 $\sqrt{}$

$\left(\frac{0.3}{2}\right)^2$

814 m

0.434 m

method

$\frac{v_2^2}{2g}$

2

9. $v_1 = \sqrt{\frac{0.914 \times 2 \times 9.81}{15}}$

$= 1.0934 \, m/s$

$Q = C_d A_1 v_1$

$= 0.96 \times 0.01814 \times 1.0934$

$= 0.019 \, m^3/s$

$A_1 v_1 = A_2 v_2 = 40 \, lit/sec$

$= 40 \times 10^{-3} \, m/sec$

$v_1 = \frac{40 \times 10^{-3}}{0.707} = 0.566 \, m/s$

$v_2 = \frac{40 \times 10^{-3}}{0.01767} = 2.264 \, m/s$

$\frac{400 \times 10^3}{9800} + \frac{(0.556)^2}{2 \times 9.8} + 60 = \frac{P_2}{w} + \frac{(1.274)^2}{2 \times 9.8} + 6$

$P_2 = 436.8 \, kN/m^2$

10. Reading of the manometer = 170mm = 0.17 m.

S.g of mercury = 13.6

S.g of water = 1.026

$h = y\left(\frac{S.G_m}{S.G} - 1\right)$

$h = 0.17\left(\frac{13.6}{1.026} - 1\right)$

$h = 2.083 \, m$

Velocity of submarine

$v = \sqrt{2gh}$

$v = 2 \times 9.81 \times 2.083$

$v = 6.39 \, m/s$