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<u>DEPT:</u> MECHATRONICS ENG

The velocity flow at lower end $= V_2 = 2$ m/s

Let the pressure head at the smaller end $P_2 = 2.5$ m of liquid

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

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

Let the pressure head at the lower end $= P_2 = ?$

Applying Bernoulli's equation

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

where $P_1 = \frac{P_1}{\rho g}$ and $P_2 = \frac{P_2}{\rho g}$

$Z_1 = 2.0$ and $Z_2 = 0$ (datum line passes through section 2)

Inputting values into the equation

$= 5$ m/s

$2.5 + \frac{5^2}{2 \times 9.81} + 2.0 = P_2 + \frac{2^2}{2 \times 9.81} + 0.161$

$2.5 + \frac{25}{19.62} + 2 = P_2 + \frac{4}{19.62} + 0.161$

$2.5 + \frac{25}{19.62} + 2 - \left(\frac{4}{19.62} + 0.161\right) = P_2$

$5.774 - 0.365 = P_2$

$P_2 = 5.409$ m of fluid

(2) Let inlet diameter $D_1 = 20$ cm

Let throat diameter $D_2 = 10$ cm

Let inlet area $= A_1 = \frac{\pi D_1^2}{4}$

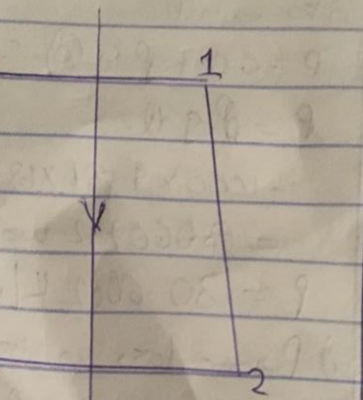
$= \frac{\pi (20)^2}{4} = 314.16$ cm²

Power at Reservoir

$$= \frac{28,314}{30609.2} \times 100\%$$

$$\Sigma = 92.5\%$$

5)



Length, L = 2m

The velocity flow at smaller end V_1 = 5m/s

= 0.35

2 x 9

Let the press

Lower end =

Applying be

$\frac{P_1}{\rho g} + \frac{V_1^2}{2g}$

+ H

where P_2 =

Z_1 = 2.0

passes throug

Inputting th

equation

Let throat Area

$A_2 = \frac{\pi D_2}{4} = \frac{\pi (10)^2}{4} = 75.54 cm^2$

Density of water, $\rho = 1000 kg/m^3$

Pressure of inlet = 17.658 m/cm^3

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

$\therefore \frac{P_1}{\rho g} = \frac{17.658}{1000 \times 9.81} = 18 m$

$\frac{P_2}{\rho g} = 30cm$ of mercury,

$S_g H_g = 13.6$

$\frac{P_2}{\rho g} = -30 \times 10^{-2} m$ of mercury $\times 1.36$

$= -4.08$

Let ~~Differential~~ ~~Head~~ $= \frac{P_1}{\rho g} - \frac{P_2}{\rho g}$

$= 18 - (-4.08)$

$= 18 + 4.08 = 22.08 m$ ~~H2O~~

$H = 2208 cm$

Using $Q = \frac{C_d\sqrt{2gH} \cdot A_1 A_2}{\sqrt{A_1^2 - A_2^2}}$

$= \frac{0.98\sqrt{2 \times 9.81 \times 2208} \times 3.14 \ldots}{\sqrt{314.16^2 - 78.54^2}}$

$= \frac{0.98 \times 2081.37 \times 24 \ldots 1264}{304.184112}$

$= 165455.3 cm^3/s$

$= \frac{165455.3}{1000} = 165.455 l/s$

3) Diameter of pipe $d_1 = 30cm$

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi (30)^2}{4} = 706.86 cm^2$

Diameter of orifice $d_2 = 15cm$

$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi (15)^2}{4} = 176.72$

Specific gravity of oil $= 0.9$

S.g of mercury . 13.6

Differential manometer, mercury $x = 50cm$ of reading

Coefficient of discharge $C_d = 0.64$

Differential head $h = x\left(\frac{S_g}{S_o} - 1\right)$

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

$h = 705.56$ cm of oil

The rate of flow of oil

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

$Q = \frac{0.64\sqrt{2 \times 9.81 \times 705.56} \times 706.86 \times 176.72}{\sqrt{(706.86)^2 - (176.72)^2}}$

$Q = 137443.29 cm^3/s$

$Q = \frac{137443.29}{1000} = 137.44 l/s$

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

Shaft power = 2670.35 watts

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

$\frac{\text{Fluid power}}{\text{Shaft power}} = \frac{1249.5}{2670.35} = 0.468$

Overall efficiency = 0.468 × 100

= 46.8%.

4) The difference of mercury level, $Y = 170mm = 170 \times 10^{-3} = 0.17m$

S.g of mercury = 13.6

S.g of sea water, $S_0 = 1.026$

The speed $V = ?$

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

$h = 2\left[\frac{S_s}{S_0} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right]$

$= 2.0834m$

$\therefore V = \sqrt{2 \times 9.81 \times 2.0834} = 6.393 m/s$

In Km/hr

$V = \frac{6.393 \times 66^2}{1000} = 28.01 Km/hr$

SOLUTION

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

$P = 15bar, 15 \times 100000 = 15 \times 10^5 N/m^2$

Speed = 1700 rev/min

$T = 15Nm$, $VO = 10cm^3/rev$

i) Volumetric efficiency

$= \frac{\text{Actual flow rate}}{\text{Ideal flow rate}}$

Ideal flow rate = Normal flow rate × speed

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

$= 17000 cm^3/min$

Ideal flow rate $= \frac{17000}{1000000} = 0.017 m^3/s$

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

$\therefore$ Volumetric efficiency

$= \frac{0.05}{0.017} = 2.94\% = 2$

$\therefore$ Fluid power = P × Q

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

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

$= 8.33 \times 10^{-4} m^3/s$

Fluid power $= 15 \times 10^5 \times 8.3 \times 10^{-4}$

$= 15 \times 10^5 = 83.3 \times 10^{-5}$

$= 1049.5 \times 10^5$

Fluid power = 1249.5 watts

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