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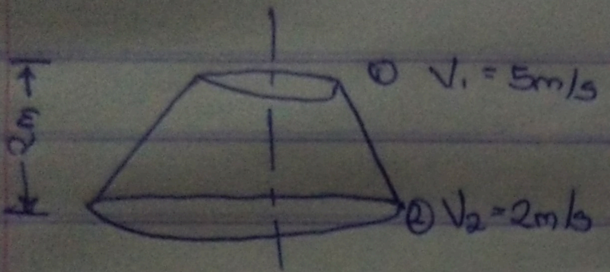
Course:

1.)



$$P_1 = P_1/w = 2.5m$$

$$H_L = \frac{0.35[V_1 - V_2]^2}{2g}$$

$$P_1/w + V_1^2/2g + Z_1 = P_2/w + V_2^2/2g + Z_2 + H_L$$

$$P_2/w = P_1/w = \frac{V_1^2 - V_2^2}{2g} + [Z_1 - Z_2] - \frac{0.35[V_1 - V_2]^2}{2g}$$

$$P_2/w = 2.5 + \frac{5^2 - 2^2}{2(9.81)} + 2 - \frac{0.35(5-2)}{2(9.81)}$$

$$P_2/w = 2.5 + 1.01 + 2 - 0.161$$

$$\therefore P_2/w = 5.409m \text{ of liquid}$$

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

Let throat diameter = $D_2 = 10cm$

Let inlet area = $A_1 = \pi D_1^2/4 = \frac{\pi(20)^2}{4} = 314.16cm^2$

Let throat area = $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi(10)^2}{4}$

$= 78.54cm^2$

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

Pressure at Inlet = $17.658 N/m^2$

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

$P_2/\rho g$ = -30cm of mercury , $S.g_{Hg} = 13.6$

$P_2/\rho g = -30 \times 10^{-2}$ m of mercury $\times 13.6$

$\Rightarrow -4.08m$

Let Differential Head = $H = P_1/\rho g - P_2/\rho g$

$= 18 - (-4.08)$

$= 18 + 4.08 = 22.08m \times 100$

$\therefore H = 2208cm$

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

$\Rightarrow \frac{0.98 \times \sqrt{2 \times 981 \times 2208} \times 314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}}$

$\Rightarrow \frac{0.98 \times 2081.37 \times 24674.1264}{304.184112}$

$= 165455.3 cm^3/s$

$= \frac{165455.3}{1000} = 165.455$ lit/sec

3:) A_o orifice $= \pi/4 \times (15)^2 = 176.714\ cm^2$ (A_o area of orifice)

A pipe $= \pi/4 \times (30)^2 = 706.858 cm^2$ (A_p area of pipe)

differential head (h) $= \left[\frac{13.6}{0.9} - 1\right] \times 50 cm$ of oil

$= 705.556\ cm$ of oil

$$Q = \frac{C_d \times A_o \cdot A_p}{\sqrt{A_p^2 - A_o^2}} \times \sqrt{2gh}$$

$$= \frac{0.64 \times 176.714 \times 706.858}{\sqrt{706.858^2 - 176.714^2}} \times \sqrt{2 \times 9.81 \times 705.556}$$

$= 0.64 \times 182.5094 \times 117.656$

$= 13742.96\ cm^3/sec$

$\Rightarrow 13.74296$ lits/sec

4:) The difference of mercury $x = 170 mm = 170 \times 10^{-3}$

$= 0.17 m$

The specific gravity of mercury, $S_g = 13.6$

The specific gravity of sea water, $S_o = 1.026$

The speed, $V = ?$

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

$h = x\left[{S_g}/{S_o} - 1\right] = 0.17\left[{13.6}/{1.026} - 1\right]$

$= 2.0834 m$

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

In Km/hr

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

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

$P_0 = 15$ bar $= 15 \times 100000 = 15 \times 10^5 \, N/m^2$

speed = 1700 rev/min

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

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

Ideal flow rate = Nominal flow rate × speed

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

$= 17000 \, cm^3/min$

Ideal flow rate $= 17000/100000 = 0.017 m^2/min$

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

∴ Volumetric Efficiency $= 0.05/0.017 = 2.94\%$ = ~~[illegible]~~

ii.) fluid Power = $P \times Q$ where $P = 15 \times 10^5 \, N/m^2$

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

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

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

$= 15 \times 10^5 \times 83.3 \times 10^{-5} = 1249.5 \times 10^{5-5}$

$\Rightarrow 1249.5$ watts

iii) Shaft power $= \frac{2\pi N T}{60} = \frac{2\pi \times 1700 \times 15}{60}$

Shaft power = 2670.35 watts

iv) Overall Efficiency = $\frac{\text{Third Power}}{\text{Shaft Power}}$

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

∴ Overall Efficiency = 0.468 × 100 = 46.8%