ADETORO MAYOWA SOLA
18/ENG04/005
ELECTRICAL | ELECTRONICS ENGINEERING

1) length = 2.0
v at Smaller end is 5m/s
v at lower end is 2m/s
P at Smaller end is 2.5m

$$\text{loss of head} = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16$$

From Bernoulli's equation

$$\frac{P_1}{\omega} + \frac{v^2}{2g} + Z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + Z_2 + h_f$$

$$\frac{P_2}{\omega} = \frac{P_1}{\omega} + \frac{1}{2g}(v_1^2 - v_2^2) + (Z_1 - Z_2) - h_f$$

$$= 2.5 + \frac{(5^2 - 2^2)}{2 \times 9.81} + 2.0 - 0.16$$

$$= (2.5 + 1.07 + 2.0) - 0.16$$

$$= 5.41 \text{ bar}$$

2) Inlet diameter = 20cm = 0.2 $A_1 = 0.0314 m^2$
Throat diameter = 10cm = 0.1 $A_2 = 7.85 \times 10^{-3} m^2$
Pressure at Inlet = 17.658 N/cm²
Vacuum pressure at throat = 30cm of mercury
Take $C_d = 0.98$
discharge through Venturimeter

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

$$Q = \frac{0.98 \times 0.0314 \times 7.85 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.85 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 18.03}$$

$$Q = 0.149 m^3/s$$

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③ Orifice diameter = 15cm (A_0) = 0.017
Inserted to a pipe of 30cm diameter (A_1) = 0.07
Change in pressure = 500mm Hg
SG = 0.9
Co-efficient of discharge = 0.64

$$Q = \frac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}}$$

$$Q = 0.64 \times \frac{0.017 \times 0.07 \times \sqrt{2 \times 9.81 \times 500}}{\sqrt{0.07^2 - 0.017^2}}$$

$Q = 1.08\ m^3/sec$

④ Reading of the differential manometer (y) 170mm = 0.17m
Specific gravity of mercury = ~~13.6~~ 13.6
Specific gravity of sea water = 1.025

$$head = y\left[\frac{S.g_{Hg}}{S.g_w} - 1\right]$$

$$= 0.17\left[\frac{13.6}{1.025} - 1\right]$$

$= 2.09$

velocity of Submarine $= \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.09}$

$= 6.403 m/s$

5.) Pump delivers at rate of $0.05 m^3/min$ AT

Pressure change = 15bar

Speed of rotation = 1700rev/min N

displacement = $10cm^3/rev$

Torque input = 15 Nm

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(i) Volumetric Efficiency (η_p) $= \frac{Q_A}{Q_T} = \frac{0.00083}{17000} = 4.9 \times 10^{-8}$

$Q_A = 0.05m^3/min = 0.00083m^3/s$

Q_T = displacement × Speed = 10 × 1700 = 17000

∴ $\eta_p = 4.8824 \times 10^{-8}$

(ii) Shaft power = rpm × Torque Input or ~~2πN~~ $\frac{2\pi\sqrt{T}}{60}$

$= (2\pi \times 1700 \times 15)/60$

= 2670.4Nm

(iii) Fluid power = flow rate × change in pressure

$= 0.00083 \times 15 \times 10^5$

= 1245 watts

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

$\eta = \frac{1245}{2670.4}$

η = 0.466 or 46.6%