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Matric No - 19/eng 08/019
Course Code : Cheg 282
Course Title: Fluid mechanics.

1) Length of tube = 2cm
Velocity of smaller flow V_1 = 5m/s
Velocity of larger, V_2 end = 2m/s
Pressure at Small = 2.5

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

$$\frac{P_2}{w} = \frac{P_1}{w} + \frac{1}{2g}(V_1^2 + V_2^2) + (Z_1 - Z_2)h_f$$

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

$$= 2.5 + 1.07 + 2 - 0.1005$$

$$P_2 = 5.407 \text{ bar}$$

2) Inlet diameter = 20cm
throat diameter = 10cm
Pressure at inlet = 17.658 N/cm²
Pressure at throat - 30 cm of Hg

$$cd = 0.98$$

$$A_1 = \frac{\pi d^2}{4} = \frac{\left(\frac{20}{100}\right)^2 \times 3.142}{4}$$

$$= 0.0314 m^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{\left(\frac{10}{100}\right)^2 \times 3.142}{4}$$

$$7.85 \times 10^{-3} m^2$$

$P_1 = 17.688 N/cm^2$

$= \frac{17.688}{1000} = 1.7688 \times 10^{-3} N/m$

$\frac{P_1}{w} = \frac{1.7658 \times 10^{-3}}{9.81}$

$= 1.8 \times 10^{-4} m$

$\frac{P_2}{w} = 0.3 \times 13.6$

$= 4.08$ of H_2O

$h = \frac{P_1}{w} - \frac{P_2}{w}$

$= 1.8 \times 10^{-4} - (-4.08)$

$h = 4.08018 m$

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

$Q = 0.98 \times \frac{0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 (7.8 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 4.08}$

$Q = 0.0709 m^3/s.$

3) diameter, $d_1 = 15cm$

$d_2 = 30cm$.

Pressure $= 50cm$ of Hg $= 0.5m$ of mercury

$Cd = 0.64$

Specific gravity $= 0.9$

$A_1 = \frac{\pi d^2}{4} = \frac{(15/10)^2 \times 3.142}{4}$

$= 0.0176m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{(30/10)^2 \times 3.142}{4}$

$= 0.0706m^2$

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

$= 7.05$

$$Q = \frac{Cd\, A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh} = \frac{0.64 \times 0.0176 \cdot 0.0706 \times \sqrt{2 \times 9.81 \times 1.05}}{\sqrt{(0.0706)^2 - (0.0176)^2}}$$

$$Q = 2.33 \times 10^{-3}\, m^3/s.$$

4). Specific gravity of Hg = 13.6.

Specific " of Sea water = 1.026

Axis = 13m

170mm of mercury (0.17m).

Sg of mercury = 13.6

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

$h = 2.083m$

$V = \sqrt{2gh}$

$V = \sqrt{2 \times 9.81 \times 2.083}$

$V = 6.39 m/s.$

5) $Q = 6.5 dm^3/min = 8.33 \times 10^{-5}\, m^3/sec.$

Speed of Rotation = 1700 Rev/min = 28.3 Rev/sec

Normal displacement = $10 cm^3/rev = 10^{-5} m^3/rev$

Torque Input = 15Nm

Pressure Change = 15 bar = $15 \times 10^{-5} N/m^2$

Ideal flow rate = Nominal displacement × Speed Rotation

$= 10^{-5} \times 28.3 = 2.83 \times 10^{-4} m^3/sec.$

a) Volumetric Efficiency = $\frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100$

$= \frac{8.38 \times 10^{-5} \times 100}{2.83 \times 10^{-4}} = 29.45\%$

b) fluid Power, $P_f = Q \times \Delta P$

$= 3.33 \times 10^{-5} \times 15 \times 10^{5} = 124.95$ watts

c) Shaft Power $= T \times \omega$

$\omega = 2 \times \pi \times$ Speed of rotation

$\omega = 2 \times \pi \times 28.3$

$\omega = 177.81$ rad/sec.

$\therefore$ shaft Power $= 15 \times 177.81 = 2667.2$ watts

d) Overall Efficiency $= \dfrac{\text{fluid Power}}{\text{Shaft Power}} \times 100$

$= \dfrac{124.95}{2667.2} \times 100$

$= 4.68\%$