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COURSE: FLUID MECHANICS
DEPT: COMPUTER ENG

Question 1

Solution

Pressure head at smaller end = 2.5m P_1/w

length of tube = 2.0m

velocity of flow at lower end = $5ms^{-1}$ V_1

velocity of flow at higher end = $2ms^{-1}$ V_2

loss of head $= \frac{0.35(V_1 - V_2)^2}{2g}$ h_2

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

Pressure head at higher ~~end~~ end, $\frac{P_2}{w}$

$$\frac{P_1}{w} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + z_2 + h_2$$

$z_2 = 0$, $z_1 = 2.0m$

$$2.5 + \frac{5^2}{2\times 9.8} + 2 = \frac{P_2}{w} + \frac{2^2}{2\times 9.8} + 0.016$$

$$5.775 = \frac{P_2}{w} + 0.364$$

$$\frac{P_2}{w} = 5.775 - 0.364 = 5.411m \text{ of liquid}$$

Pressure head at higher end = 5.411m

Thanks For Coming

2

inlet diameter = 20cm = 0.2m

throat diameter = 10cm = 0.1m

Pressure of inlet = 17.65N/cm² = 17653kN/m

30cm of mercury

Coefficient of discharge = 0.98

Solution

Area of inlet = $A_1 = \frac{\pi}{4} \times 0.2^2 = 0.0314m^2$

Area of throat = $\frac{\pi}{4} \times 0.1^2 = 0.00785m^2$

$\frac{P_1}{w} = \frac{176.58}{9.8} = 18.01m$

Vacuum Pressure at the throat

$\frac{P_2}{w} = -300mm = -0.3 \times 13.6 - 4.08m$ of water

Differential head, $h = \frac{P_1}{w} - \frac{P_2}{w} = 18.01 - (-4.08) = 22.09m$

Rate of flow Q

Using the relation, $Q = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A^2}} \times \sqrt{2gh}$

$$Q = 0.98 \times \frac{0.0314 \times 0.00785}{\sqrt{(0.0314)^2 - (0.00785)^2}} \times \sqrt{2 \times 981 \times 22.09}$$

$$= \frac{0.000241}{0.0304} \times 20.82$$

$Q = 0.165 m^3/s$

Distcharge of water through senturimeter $= 0.165 m^3/s$

3

Orifice diameter $A_o = 15cm = 0.15m^2$

Pipe diameter $= 30cm = 0.3m^2$

Manometer reading $= 0.5m$ of mercury

S.g of oil $= 0.9$ $C_d = 0.64$

Solution

Area of orifine, $\frac{\pi}{4} \times 0.15^2 = 0.01767m^2 = A_o$

Area of pipe $\frac{\pi}{4} \times 0.30^2 = 0.707m^2 = A_1$

Differential head, $h = y\left[\frac{S_h}{S_o} - 1\right]$

$= 0.5\left[\frac{13.6}{0.9} - 1\right] = 7.06m$ of oil

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Actual flow rate = 0.05m³/min = 0.05/60 = 8.3x10⁻⁴ m³/sec

Pressure Charge = 15 bar = 15 x 10⁵ N/m²

Speed of rotation = 1700 rev/min = 1700/60 = 28.3 rps

Normal displacement = 10cm3/rev = 1 x 10⁻⁵ m3/rev

Torque input = 15Nm

Ideal flow rate = normal x speed displacement

= 28.3 x 1 x 10⁻⁵

= 2.83 x 10⁻⁴ m³/sec

(i) volumetric of efficiency = $\frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\%$

$= \frac{8.3 \times 10^{-4}}{2.83 \times 10^{-4}} \times 100$

= 296 %

(b) Fluid Power = Q . dp

= 8.3x10⁻⁴ x 15 x 10⁵

= 1245 watts or Nm/sec

(iii) Shaft Power = T.W

Where T = Torque input

W = angular speed

$T = 15Nm$

$\omega = 2\pi N$ for rps

$\omega = \frac{2\pi N}{60}$ for rpm

$\omega = 2 \times \frac{32}{7} \times 28.3 = 177.59$ rad/sec

Shaft Power = ~~1.5~~ $15 \times 177.89 = 2668.35$ Watts