ADETORO MAYOWA SOLA

18/ENG04/005

ELECTRICAL/ELECTRONICS ENGINEERING

FLUID MECHANICS ASSIGNMENT 2

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Diameter at Inlet = 300mm = 0.3m

$= \frac{\pi}{4} \times 0.3^2 = 0.07m^2$

diameter at throat D_2 = 150mm

$A = \frac{\pi}{4} \times 0.15^2 = 0.01767m^2$

S.g of heavily liquid in u-tube
$S_u = 13.6$
S.g of liquid flowing through
Pipe = 0.9
reading of differential manometer
$y = 250mm = 0.25m$

The differential h^o is given by

$$h = \left(\frac{P_1}{\omega} + z_1\right) - \left(\frac{P_2}{\omega} + z_2\right)$$

$$= y\left[\frac{S_1}{S_p} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right]$$

$= 3.53m$ of oil

(i) Discharge of oil Q:

now

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

$$Q = \frac{0.98 \times 0.07 \times 0.018}{\sqrt{0.07^2 - 0.0178^2}} \times \sqrt{2 \times 9.81 \times 3.53}$$

$= 0.15m^3/s$

(ii) Pressure difference

$$h = \left(\frac{P_1}{\omega} + z_1\right) - \left(\frac{P_2}{\omega} + z_2\right)$$

$= 3.53$

$$h = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega}\right) + (z_1 - z_2) = 3.53$$

$(z_1 - z_2) = 0.3m$

Thus

$$\left(\frac{P_1}{\omega} - \frac{P_2}{\omega}\right) - 0.3 = 3.53$$

$$\frac{P_1 - P_2}{\omega} = 3.83$$

$P_1 - P_2 = (9.81 \times 0.9) \times 3.83$

$= 33.81kN/m^2$

2)

Relative density = 0.8

Inlet diameter = 0.15m

Throat diameter = 0.075

$Z_1 - Z_2 = 0.15m$

flowrate = $0.04 m^3/s$

$C_d = 0.96$

pressure difference = ??

Solution

$A_1 = \frac{\pi}{4} \times 0.15^2 = 0.01767 m^2$

$A_2 = \frac{\pi}{4} \times 0.075^2 = 0.004 m^2$

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

$$0.04 = \frac{0.96 \times 0.01767 \times 0.004}{\sqrt{0.01767^2 - 0.004^2}} \times \sqrt{2 \times 9.81 \times \sqrt{h}}$$

thus

$$h = \left(\frac{0.04}{0.96 \times 0.0046 \times 4.429} \right)^2$$

$h = 4.247m$

Recall

$$h = \left(\frac{P_1}{\omega} + Z_1 \right) - \left(\frac{P_2}{\omega} + Z_2 \right)$$

thus

$$4.247 = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega} \right) + (Z_1 - Z_2)$$

$$= \left(\frac{P_1 - P_2}{\omega} \right) - 0.15$$

$$(P_1 - P_2) = \omega (4.247 + 0.15)$$

$$= (0.8 \times 1000 \times 9.81)(4.397)$$

$$= 34507 N/m^2$$