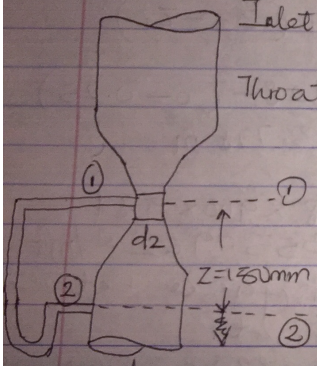
UDONSI VICTOR 18/ENG07/014 PETROLEUM) ENG 214

Assignment

1.) Data given; Discharge, $Q = 40 lit/s$
$= 0.04 m^3/s$
Relative Density $= \rho_g = 0.8$
Inlet Diameter, $d_1 = 150mm = 0.15m$
Throat Diameter, $d_2 = 75mm = 0.075m$



Inlet Area, $a_2 = \frac{\pi}{4} \times (0.15)^2$
$= 0.0177 m^2$
Throat Area, $a_1 = \frac{\pi}{4} \times (0.075)^2$
$= 0.00442 m^2$

The discharge
$$Q = Cd \times \frac{a_1 a_2 \sqrt{2gh}}{\sqrt{a_2^2 - a_1^2}}$$
Substituting Values
$$40 \times 10^{-3} = 0.96 \times \frac{0.00442 \times 0.0177 \sqrt{2gh}}{\sqrt{0.0177^2 - 0.00442^2}}$$

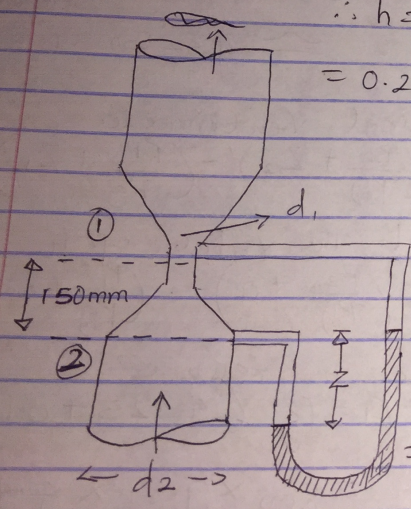
Substituting $g = 9.81$
$$4 \times 10^{-3} = \frac{0.96 \times 0.00442 \times 0.0177 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.0177^2 - 0.00442^2}}$$

On Solving, $h = 4.246m$ of liquid
$\simeq 4.25m$ of liquid

For Vertical Venturimeter
$$h = \left(\frac{P_2}{\rho g} + Z_2\right) - \left(\frac{P_1}{\rho g} + Z_1\right)$$
Substitute the value of h
$$4.25 = \left(\frac{P_2}{\rho g} + 0\right) - \left(\frac{P_1}{\rho g} + 0.15\right)$$
Difference in pressure
$$P_2 - P_1 = \rho g (4.25 + 0.15)$$
$$= 800 \times 9.81 \times 4.4$$
$$\therefore P_2 - P_1 = 34531.2 N/m^2$$

2.) Data given
Inlet diameter, $d_2 = 300mm$
Throat diameter, $d_1 = 150mm$
Sp. gravity of oil, $S = 0.9$
$Z_1 - Z_2 = 150mm$
$Cd = 0.98$
Mercury Manometer reading, $x = 250mm$

$$\therefore h = x\left[\frac{S_{Hg}}{S_{oil}} - 1\right]$$
$$= 0.25\left[\frac{13.6}{0.9} - 1\right]$$
$$= 3.528m \text{ of oil}$$



Throat area, $a_1 = \frac{\pi}{4} \times d_1^2 = \frac{\pi}{4} \times (0.15)^2$
$= 0.0177 mm^2$
Inlet area, $a_2 = \frac{\pi}{4} \times d_2^2 = \frac{\pi}{4} \times (0.3)^2$
$= 0.0707$

1) Discharge, $Q = Cd \frac{a_1 a_2 \sqrt{2gh}}{\sqrt{a_2^2 - a_1^2}}$
$$Q = \frac{0.98 \times 0.0177 \times 0.0707 \times \sqrt{2 \times 9.81 \times 3.528}}{\sqrt{0.0707^2 - 0.0177^2}}$$
$Q = 0.14906 m^3/s$
$= 149.06 Lit/s$

here, $h = \left(\frac{P_2}{\rho g} + Z_2\right) - \left(\frac{P_1}{\rho g} + Z_1\right)$
$$h = \frac{P_2 - P_1}{\rho g} + (Z_2 - Z_1)$$
$$\frac{P_2 - P_1}{\rho g} = 3.528 - (0 - 0.25)$$
$$= 3.778 m$$

$$P_2 - P_1 = 3.778 \times 900 \times 9.81$$
$$= 33355.962 N/m^2$$
∴ Pressure difference between inlet and Throat
$$P_2 - P_1 = 33355.96 N/m^2$$