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ASSIGNMENT 2: VENTURIMETER

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QUESTION 1

1. Diameter at Inlet $D_1 = 300\text{mm} = 0.3\text{m}$
2. Area of inlet, $A_1 = \pi/4 * 0.3^2 = 0.07\text{m}^2$
3. Diameter at throat, $D_2 = 150\text{mm} = 0.15\text{m}$
4. Area at throat, $A_2 = \pi/4 * 0.15^2 = 0.01767\text{m}^2$

A. Specific gravity of heavy liquid (mercury) in U-tube manometer $S_{hl} = 13.6$

Specific gravity of liquid (oil) flowing through pipe, $S_p = 0.9$

Reading of differential manometer, $y = 250\text{mm} = 0.25\text{m}$

The differential 'h' is given by:

$$h = (p_1/w + z_1) - (p_2/w + z_2)$$

$$= y(S_{hl}/s_y - 1) = 0.25(13.6/0.9 - 1)$$

$$= 3.53\text{m of oil}$$

Discharge of oil, Q:

Using the relation $Q = C_d \cdot A_1 A_2 / \sqrt{A_1^2 - A_2^2} \cdot \sqrt{2gh}$

$$Q = 0.98 \cdot 0.07 \cdot 0.01767 / \sqrt{0.07^2 - 0.01767^2} \cdot \sqrt{2 \cdot 9.81 \cdot 3.53}$$

$$Q = 0.1489 \text{ m}^3/\text{s}$$

B. $p_1 - p_2$

We know that $p_1/\rho - p_2/\rho + (z_1 - z_2) = 3.53$

But $z_2 - z_1 = 0.3\text{m}$

Therefore $p_1 - p_2/\rho = 3.83$

$$p_1 - p_2 = (9.81 \cdot 0.9) \cdot 3.83 = 33.8 \text{ kN/m}^2$$

QUESTION 2

$$A_1 = \pi/4 D_1^2 = 0.01767 \text{ m}^2$$

$$A_2 = \pi/4 D_2^2 = 0.00442 \text{ m}^2$$

$$Q_{act} = C_d \cdot A_1 A_2 / \sqrt{A_1^2 - A_2^2} \cdot \sqrt{2gh}$$

From this we get

$$0.04 = 0.96 \cdot 0.004565 \cdot 4.429 \sqrt{h}$$

$$\text{therefore } h = (0.04 / (0.96 \cdot 0.004565 \cdot 4.429))^2 = 4.247\text{m}$$

$$4.427 = p_1/w - p_2/w + (z_1 - z_2)$$

$$(p_1 - p_2)/\rho g - 0.15$$

$$(p_1 - p_2) = \rho g (4.247 + 0.15)$$

$$= (0.8 * 1000 * 9.81) (4.247 + 0.15) \text{ N/m}^2 = 34.51 \text{ kN/m}^2$$