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18/ENG03/011
Civil Engineering

1) $V = 5ms^{-1}$, $V_2 = 2ms^{-1}$

$P_{T_1} = 2.5m$, $P_{T_2} = ?$

$$P_{T_1} = P_{T_2} = 0.35\frac{(V_1 - V_2)^2}{2g} = \frac{0.35 \times 3^2}{2 \times 9.81} = 0.161$$

$\therefore P_{T_1} - P_{T_2} = 0.161$

$2.5 - P_T = 0.161$

$P_{T_2} = 2.5 - 0.161$

$P_{T_2} = 2.670m$

2) 200

$= 0.20m$

$A = \pi d^2$; $P_T = \pi\frac{(0.20)^2}{4} = 0.0314m^2$

$P_1 = 17.658\ N/cm^2 = \frac{17.658}{10^{-6}} = 17658000$

Specific gravity of mercury = 13.6

$$\frac{P_1}{10} = \frac{P_1}{Pg} = \frac{17.658 \times 10^{-6}}{1000 \times 9.81} = 1.8 \times 10^{-7}$$

$$\text{Vacum pressure} = \frac{P_2}{10} = 300mm\ Hg$$

$d_2 = 100mm = 0.1$

-0.30×13.6 $A_2 = \frac{\pi d^2}{4} = \frac{\pi(0.10)^2}{4} = 7.85 \times 10^{-3}$

$P_2 = -4.08$

$h = 1.8 \times 10^{-9} + 4.08$

$= 4.080000002m$

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

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

$$= \frac{0.98 \times 0.0314 \times 7.85 \times 10^{-3}\sqrt{2 \times 9.81 \times 4.080000002}}{\sqrt{(0.0314)^2 - (7.85 \times 10^{-3})^2}}$$

$= 0.07108691665$

3) $d_1 = 150mm = 0.15m$

Pipe diameter $d_2 = 300mm = 0.30m$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{3.142 \times 0.15^2}{4} = 0.0177m^2$$

$$A_1 = \frac{\pi d_1^2}{4} = \frac{3.142 \times 0.30^2}{4} = 0.0707m^2$$

$y = 500mmHg = 0.50mHg$

$C_d = 0.64$

$$h = \frac{\text{S.G of Hg} - \text{S.G of oil}}{\text{S.G of oil}} \times y$$

$$= \frac{13.6 - 0.9}{0.9} \times 0.5$$

$$= 7.06m$$

Rate of flow, $Q_{actual} = \frac{C_d A_2 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$

$$Q_{actual} = \frac{0.64 \times 0.0707 \times 0.0177 \sqrt{2 \times 9.81 \times 7.06}}{\sqrt{(0.0707)^2 - (0.0177)^2}}$$

$$= 0.137 //$$

4) $v = \sqrt{2gh}$

$$H = y\left(\frac{\text{S.G of mecury} - \text{S.G of water}}{\text{S.G of water}}\right)$$

$$H = 0.17\left(\frac{13.6 - 1.026}{1.026}\right)$$

$$= 0.17 \times 12.26$$

$$= 2.0842m$$

$$v = \sqrt{2 \times 9.81 \times 2.0842}$$

$$= 6.39ms^{-1}$$

$\therefore$ Speed of submarine $= 6.39ms^{-1} //$

5) Actual flow rate $Q = 5dm^3/min = 8.33 \times 10^{-5} m^3/sec$

$p = 15 bar = 15 \times 10^5 N/m^2$

$V = 1700 rev/min = 28.33 rv/sec$

$T = 15 N/m$ normal displacement $= 100 cm^3/rev$

$= 1 \times 10^{-5} m^3/rev$