18/ENG04/024
CHARLES-ANACHREE PRINCE

Inlet diameter $= 300mm = 0.3m$
Area of Inlet $= \pi/4 \times 0.3^2 = 0.07m^2$
Specific gravity of oil $S.G_{oil} = 0.9$ $\rho_{oil} = 900 kg/m^3$

Diameter of throat $D_2 = 150mm = 0.15m$

Specific gravity of mercury $= 13.6$

Reading on differential manometer $y = 250mm = 0.25m$

The differential 'h' is given by

$$h\left[\frac{\rho_1}{\mu} + z_1\right] - \left[\frac{\rho_2}{\mu} + z_2\right] = y\left[\frac{S_h}{S_{oil}} - 1\right]$$

$$\Rightarrow 0.25\left[\frac{13.6}{0.9} - 1\right] = 3.59m \text{ of oil}$$

(i) Discharge of oil $(Q) = C_d * \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} * \sqrt{2gh}$

$$Q = 0.98 \times 0.0707 \times 0.0127 \times \sqrt{2 \times 9.81 \times 3.53} \Big/ \sqrt{0.0707^2 - 0.0177^2}$$

$$Q = \frac{0.0102}{0.0684} = 0.1491 m^3/s$$

(iv) Pressure difference between entrance and throat section $P_1 - P_2$

$$h = \left(\frac{P_2}{m} - t_1\right)\left(\frac{P_2}{w} - t_2\right) = 3.53$$

But $z_2 - z_1 = 300mm = 0.3m$

$$\frac{P_1}{m} - \frac{P_2}{w} - 0.3 = 3.53$$

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

$$= 33.8 kN/m^2$$

2 Pressure difference $(P_1 - P_2)$

$A_1 = \frac{\pi}{4} D_1^2 \quad P_1^2 = \pi/4 \times 0.15^2 = 0.01767 m^2$

$A_2 = \frac{\pi}{4} D_2^2 = \pi/4 (0.075)^2 = 0.0042 m^2$

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

$0.04 = 0.97 \times \frac{0.01767 \times 0.0042}{\sqrt{0.01767} \times \sqrt{0.0042}}$

$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429} \right) = 4.247 m$

$\Rightarrow$ Also $h = \left(\frac{P_1}{w} + z_1 \right) \left(\frac{P_2}{w} + z_2 \right)$

$4.247 = \left(\frac{P_1}{w} - \frac{P_2}{w} \right) (z_1 - z_2)$

$(P_1 - P_2) = P_g (4.247 + 0.15)$

$= (0.8 \times 1000 \times 9.81)(4.247 + 0.15)$

$= 34.51 KN/m^2$ //