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Chimanse Ogah

Computer Engineering

1) $V_1 = 5\,m/s$

$V_2 = 2\,m/s$

$P_1 = 2.5\,m$

$= 2\,m$

$l = Z_1 - Z_2 = 2\,m$

$h_L = \frac{0.35\,(V_1 - V_2)^2}{2g}$

$\frac{P_1}{w} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + Z_2$

$\frac{P_2}{w} = \frac{P_1}{w} + \frac{V_1^2 - V_2^2}{2g} + (Z_1 - Z_2)$

$= 2.5 + \frac{(5^2 - 2^2)}{2 \times 9.81} + 2 - \frac{(0.35)(5-2)^2}{2 \times 9.81}$

$= 2.5 + 1.07 + 2 - 0.1605$

$P_2 = 5.409\,m$

2) Inlet diameter $= 20\,cm$

Throat diameter $= 10\,cm$

$C_d = 0.98$

$P_1 = 17.658\,N/cm^2$

$A_1 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{20}{100}\right)^2 \times \pi$

$= 0.0314\,m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{10}{100}\right)^2 \times \pi$

$= 7.85 \times 10^{-3}\,m^2$

If $y = 30\,cm = 0.3\,m\,Hg$

$P_1 = 17658$

$= \frac{17658}{1000} = 1.7658 \times 10^{-3}\,kN$

$\frac{P_1}{w} = \frac{17658 \times 10^{-3}}{9.81} = 1.8 \times 10$

$\frac{P_2}{w} = -0.3 \times 13.6 = -4.08$

$h = \frac{P_1}{w} - \frac{P_2}{w} = 18 \times 10^{-3}$ [illegible]

$= 4.098\,m$

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

$Q = 0.98 \times 0.0314 \times 7.85$ [illegible]

$Q = 0.98 \times \frac{0.0314 \times 7.85 \times 10^{-3} \times \sqrt{2 \times 9.81}}{\sqrt{0.0314^2 - (7.85 \times 10^{-3})^2}}$ [illegible]

$= 0.0702\,m^3/s$

3) $D_1 = 15\,cm$ $D_2 = 30\,cm$

$50\,cm = 0.5\,m\,Hg$

$s_g = 0.9$ $Q_d = 0.0$ [illegible]

$A_1 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{15}{100}\right)^2 \times \pi$

$A_1 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{30}{100}\right)^2 \times \pi$

$= 0.0176\,m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{1}{4} \left(\frac{15}{100}\right)^2 \times \pi$

$= 0.0706\,m$

$h = y\left(\frac{13.6}{0.9} - 1\right)$

$= 0.5\left(\frac{13.6}{0.9} - 1\right) = 7.05$

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

$$= 0.62 \times \frac{(0.0176 \times 0.0028) \times \sqrt{2 \times 9.81 \times 760}}{\sqrt{(0.0176)^2 - (0.0028)^2}}$$

$$\approx 1.83 \times 10^{-3} m$$

4) ~~[illegible]~~

~~[illegible]~~

Fluid 70 mm difference $= 0.17$

sg of mercury $= 13.6$

sg of fluid $= 1.026$

$$h = y\left(\frac{sg\ of\ mercury}{sg\ of\ fluid} - 1\right)$$

$$h = 0.17\left(\frac{13.6}{1.026} - 1\right)$$

$$= 2.083$$

$$v = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.083}$$

$$= 6.39 m/s$$

5) $Q = 0.05 m^3/min$

$= 8.33 \times 10^{-3} m^3/s$

Speed of rotation $= 1700$ rev/min

$= 28.3$ rev/s

Nominal displacement $= 10 cm^3/rev$

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

Torque limit $= 15 Nm$

Pressure change $= 15 bar = 15 \times 10^5 N$

Ideal Flowrate $=$ Nominal displacement $\times$ speed rotation

$= 10^{-5} \times 28.3$

$= 2.83 \times 10^{-4} m^3/s$