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18/ENG06/064
MECHANICAL ENGINEERING

1) $V_1 = 5\,m/s$, $V_2 = 2\,m/s$

Pressure of the smaller end = 25m

$$h_f = \frac{(0.35(v^1 - v^2)^2)}{2g}, \quad L = 2\,m$$

Pressure at the lower end

$L = t_1 - t_2 = 2$

$$\frac{P_1}{w} + \frac{V_1^2}{2g} = \frac{P_2}{w} + \frac{V_2^2}{2g} + Z^2 + h_f$$

$$\frac{P_2}{w} = \frac{P_1}{w} + \frac{1}{2g}(V_1^2 + V_2^2) + (Z_1 - Z_2)h_f$$

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

$$= 2.5 + 1.071 + 2.16035$$

$$P_2 = 5.409\,km$$

Pressure at lower end is 5.409 km

2. Inlet diameter = 200m

throat diameter = 10cm

Pressure inlet = 17.658 N/cm²

Vacuum pressure of throat is 300m of

mercury $C_d = 0.98$

$A_1 = \frac{\pi d^2}{4} = \frac{(20/100)^2 \times 3.14}{4} = 0.0314 m$

$A_2 = \frac{\pi d^2}{4} = \frac{(10/100)^2 \times 3.14}{4} = 7.853 \times 10^{-3}$

$y = 30mm$ (0.3m of mercury)

$P_1 = 17.658$

$= \frac{17.658}{1000} = 1.7658 \times 10^{-3} N/m$

$\frac{P_1}{\omega} = \frac{1.7658 \times 10^{-3}}{9.81} = 1.8 \times 10^{-4} m$

$\frac{P_2}{\omega} = 0.3 \times 13.6 = 4.08$ of H_2O

$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = 1.8 \times 10^{-4} - (-4.08)$

$h = 4.08018 m$

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

$= \frac{0.98 \times 0.0314 \times 7.853 \times 10^{-3}}{\sqrt{0.0314 \times 7.853 (0.2)}}$

$Q = \frac{0.000241}{0.2304} \times 8.947$

$Q = 0.0709 m^3/s$

4 A × 15 = 15m

170 mm of mercury

v = ?

s.p.g of mercury is 13.6

s.p.g of sea water is 1.026

$$h = d\left(\frac{SP\ g_r\ (m)}{SP\ g_r\ (1-w)} - 1\right)$$

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

$h = 2.083\ m$

$v = \sqrt{2gh}$

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

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

5 5 dm^3

Pressure change of 15 bar

speed of rotation is 1700 rev/min while the normal displacement is given as 1000 m^3/rev

If the torque input is 15 Nm compute (1), volumetric efficiency.

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

mercury $= 50\,mm = 0.5\,m$

$S_g = 0.9$, coefficient of discharge $= 0.74$

$A_1 = \frac{\pi d^2}{4} = \frac{(15/100)^2 \times 3.14}{4} = 0.0176\,m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{(30/100)^2 \times 3.14}{4} = 0.0706\,m^2$

$h = x\left(13.6/0.9 - 1\right)$

$h = 0.5\,(13.6/0.9 - 1$

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

$Q = \frac{6.64 \times 0.0176 \times 0.706 \sqrt{2 \times 9.8 \times 7.05}}{\sqrt{(0.0706)^2 - (0.0176)^2}}$

$= \frac{9.55 \times 10^{-3}}{110.12}$

$Q = 2.33 \times 10^{-3}\,m^3/s$