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Civil engineering 18/ENY03/006

(1)

$V_1 = 5m/s$ $V_2 = 2m/s$
$P_1 = 2.5m$ $P_{T2} = ?$
$P_{T1} = P_{T2} =$

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

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

$= 0.161$

$P_{T1} = P_{T2} = 0.161$
$2.5 + P_1 = 0.161$
$P_{T2} = 2.67m$

(2)

Inlet diameter = 0.2m
Area at $A_1 = \frac{\pi}{4} \times 0.2^2$

$= 0.0314m^2$

Throat diameter $D_2 = 0.1m$

$A = \frac{\pi d^2}{4}$ $= \frac{\pi \times 0.1^2}{4}$

$= 0.00785m^2$

Pressure at inlet = 17.658
$= 17.658 KN/m^2$
$= 17658000 N/m^2$

$$\frac{P_1}{\omega} = \frac{17658000}{9.81}$$

$= 17658 KN/m^2$

$$\frac{P_1}{\omega} = \frac{17658}{9.81} = 1800m$$

Vacuum pressure at the throat

$\frac{P_2}{\omega} = -0.3m$ of mercury
$= -0.3 \times 13.6$
$= 4.08m$ of water

$Cd = 0.98$

Differential head $h = \frac{P_1}{\omega} - \frac{P_2}{\omega}$

$=$

Specific gravity = 13.6

$$\frac{P_1}{\omega} = \frac{17.658 \times 10^{-6}}{1000 \times 9.81}$$

$= 1.8 \times 10^{-3}$

Vacuum pressure $= \frac{P_2}{\omega} = -300mmHg$

$P_2 = -300mm$ of mercury

$= -0.3 \times 13.6 = -4.08$

$Cd = 0.98$

Differential head

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

$= 1.8 \times 10^{-3} - (-4.08)$
$= 4.0818$

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

$$\frac{0.98 \times 0.0314 \times 0.00785}{\sqrt{(0.0314)^2 - (0.00785)^2}} \times \sqrt{2 \times 9.81 \times 4.0808}$$

$= 6.793 m^3/s$

(3)

$d_0 = 15 \times 10^{-2} m$ $y = 50 \times 10^{-2} mmHg$

$d_1 = 30 \times 10^{-2} m$ Sg of oil $= 0.9$

$Cd = 0.64$

$Q = ?$

$S_m = 13.6$

$S_0 = 0.9$

$A_0 = \frac{\pi \times (15 \times 10^{-2})^2}{4}$

$= 0.01767 m^2$

$A_1 = \frac{\pi \times (30 \times 10^{-2})^2}{4} = 0.0707 m^2$

$H = 50 \times 10^{-2} \left[\frac{13.6}{0.9} - 1\right]$

$H = 7.055 m$

$Q = \frac{Cd A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}}$

$= \frac{0.64 \times 0.0176 \times 0.0707 \times \sqrt{2 \times 9.81 \times 7.055}}{0.0707^2 - 0.0176^2}$

$= 0.139 m^3/s$

(4)

$y = 170 mmHg = 170 \times 10^{-3} mHg$

Sg of mHg $= 13.6 hg$

Sg of sea water $= 1.026$

$H = y \times \frac{Sh_1}{So} - 1$

$H = 170 \times 10^{-3} \times \left(\frac{13.6}{1.026} - 1\right)$

$= 2.08 m$

$V = \sqrt{2gH}$

$V = 2 \times 9.81 \times 2.08$

$= 6.39 m/s$

(5)

Actual flowrate

$Q = 5 dm^3/min = 8.33 \times 10^{-5} m^3/s$

$P = 15 bar = 15 \times 10^{-5} N/m^2$

$N = 1700 rev/min = 28.33 m/s$

$T = 150 N/m$

Nominal displacement $= 60 cm^3/rev$

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

Volumetric efficiency

$\frac{\text{Actual flowrate}}{\text{Ideal Fr}} \times 100$

Ideal Fr = Displa...

$= 1 \times 10^{-5}$...

$= 2.833 \times$...

Volumetric Efficie...

$= \frac{8.33}{2...}$

$= $...

Fluid power $=$...

$= 8.33 \times$...

$= 12$...

Shaft Power...

$H = 2 \times \pi$...

$= 2 \times$...

$T \times$...

$= 1$...

Overall...

$\frac{\text{Fluid}}{\text{Sha...}}$

$=$...

Volumetric Efficiency

$\frac{\text{Actual Flowrate}}{\text{Theoretical Fr}} \times 100$

Theoretical Fr = Displacement × Speed

$= 1 \times 10^{-5} \times 28.33$

$= 2.833 \times 10^{-4} m^3/sec$

Volumetric Efficiency

$= \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-5}} \times 100$

$= 29.4\%$

Fluid power $= Q \times \Delta P$

$= 8.33 \times 10^{-5} \times 15 \times 10^{5}$

$= 124.95$ watts

Shaft Power $= T \times \omega$

$\omega = 2 \times \pi \times N$

$= 2 \times \pi \times 28.33$

$= 178$ rad/sec

$T \times \omega$

$= 15 \times 178 = 2670$ watts

Overall Efficiency

$\frac{\text{Fluid power}}{\text{Shaft power}} \times 100\%$

$= \frac{124.95}{2670} \times 100$

$= 4.68\%$