BQ.C

BRIGHT CONCEPT

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Dept: Computer Engineering
Course: Fluid mechanics (ENG214)

(1) $v_1 = 5m/s$

$P_1 = \frac{P_1}{w} = 2.5m$

$v_2 = 2m/s$

$H_L = \frac{0.35(v_1 - v_2)^2}{2g}$

$\frac{P_1}{w} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{w} + \frac{v_2^2}{2g} + z_2 + H_L$

$\frac{P_2}{w} = 2.5 + \frac{5^2 - 2^2}{2(9.81)} + 2 - \frac{0.35(5-2)^2}{2(9.81)}$

$\frac{P_2}{w} = 2.5 + 1.07 + 2 - 0.161$

$\frac{P_2}{w} = 5.409m$ of liquid

(2) $d_1 = 20cm = 20 \times 10^{-2} m$

$A = \frac{\pi d^2}{4} = \pi \times \frac{(20 \times 10^{-2})^2}{4}$

$A_1 = 0.0314 m^2$

$P_1 = 17.668 N/cm$

$C_d = 0.98$

$d_2 = 10cm$

$A = \frac{\pi d^2}{4} = \pi \times \frac{(10 \times 10^{-2})^2}{4}$

$A_2 = 7.85 \times 10^{-3} m^2$

To get h,

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

$P_1 = 17.668 \times 10^4 N/m^2$

$w = 9.81 \times 10^3 N/m^3$

But we have that ~~that~~ ~~that~~ vacum pressure

$= 30cm$ of Hg

$= 0.3 m Hg$

$= 0.3 \times 13.6 = 4.08$

$\frac{P_2}{w} = -4.08$ (Since vacuum pressure)

then $\frac{P_1}{w} = \frac{17.658 \times 10^4}{9.81 \times 10^3} = 18$

$\therefore \frac{P_1}{w} - \frac{P_2}{w}$; $18 - (-4.08) = 22.08$

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

$= 0.78 \times 0.314 \times 7.85 \times 10^{-3} \times \sqrt{\frac{2 \times 9.81 - 22.08}{(0.0314^2 - (7.58 \times 10^{-3}}}$

$= 2.4156 \times 10^{-4} \times 684.57$

$= 0.1653$

Q actual $= 0.1653\ m^3/s$

(3) $d_o = 15cm = 15 \times 10^{-2} m$, $d_p = 30 \times 10^{-2} m$

$A_o = \pi \times \frac{(15 \times 10^{-2})^2}{4}$, $A_P = \pi \times \frac{(30 \times 10^{-2})^2}{4}$

$= 0.01767 m^2$ $\quad = 0.07069 m^2$

S.f.G of oil $= 0.9$

Coefficient of discharge $= 0.64$

Reading of differential $= 500mhg$

Differential head $h = y\left[\frac{S_{hl}}{S_o} - 1\right]$

$S_{hl} = 13.6$

$y = 50 \times 10^{-2}$

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

$h = 50 \times 10^{-2} \times 14.11$

$= 7.005$

$Q = \frac{C_d A_1 A_P \sqrt{2gh}}{\sqrt{A_P^2 - A_O^2}}$

$\frac{0.64 \times 0.01767 \times 0.7069 \times \sqrt{2 \times 9.81 \times 7.005}}{\sqrt{(0.02069^2) - (0.01707^2)}}$

$= \frac{7.794 \times 10^{-4}}{\sqrt{4.68 \times 10^{-3}}}$

$= 0.134$

(4) $y = 170mmHg$

S.g sw =

Δh =

Δh =

Δh

N

N

(5) $Q = 0.05 dm$

Speed of rotat

Normal displace

Torque inpu

pressure chan

Ideal flowrat

(a) Volumetric

$= \frac{8.33}{2.8}$

(b) Fluid

=

$$= \frac{7.774 \times 10^{-4} \times 11.765}{\sqrt{4.68 \times 10^{-3}}}$$

$$= 0.1374 \ m^3/s$$

(4) $y = 170 mmHg = 0.17 mHg$, $S.g_{Hg} = 13.6$,

$S.g_{sw} = 1.026$

$$\Delta h = y \left(\frac{S.g_{Hg}}{S.g_{sw}} - 1 \right)$$

$$\Delta h = 10.17 \left(\frac{13.6}{1.026} - 1 \right)$$

$$\Delta h = 2.08 m$$

$$v = \sqrt{2g\Delta h}$$

$$v = \sqrt{2 \times 9.81 \times 2.08}$$

$$v = 6.388 m/s$$

(5) $Q = 0.05 dm^3/min = 8.33 \times 10^{-5} m^3/sec$

Speed of rotation = 1700 Rev/min = 28.3 Rev/min

Normal displacement = $10 cm^3/min = 10^{-3} m^3/min$

Torque input = 15 Nm

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

Ideal flowrate = Normal displacement × speed rotation

(a) Volumetric Efficiency = $\frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100$

$$= \frac{8.33 \times 10^{-3} \times 100}{2.83 \times 10^{-4}}$$

$$= 29.45\%$$

~~[illegible]~~

(b) Fluid power, $P_F = Q \times \Delta P$

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

$$= 124.95 \text{ watts}$$

P.T.O.

(c) Shaft power, $T \times \omega$

$\omega = 2 \times \pi \times$ speed of Rotation

$\omega = 2 \times \pi \times 28.3$

$\omega = 177.81$ rad/sec

$\therefore$ Shaft power $= 15 \times 177.81$

$= 2667.2$ watts

(d) Overall Efficiency $= \dfrac{\text{fluid power}}{\text{shaft power}} \times 100$

$= \dfrac{124.95}{2667.2} \times 100$

$= 4.68\%$