AFOLABI HABER
15ENG07008
PETROLEUM ENGINEERING

1

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

$$\frac{P_2}{w} = \frac{P_1}{w} + \frac{v_1^2 - v_2^2}{2g} + (z_1 - z_2) - \frac{0.35(v_1 - v_2)^2}{2g}$$

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

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

2

inlet = $d = 20cm$

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

$$= 0.0314m^2$$

$P_1 = 17.668 N/cm^2$

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

$C_d = 0.98$

Throat diameter $d = 10$

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

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

To get h

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

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

$W = 9.81 \times 10^3 N/m^2$

Final vaccum pressure

= 30cm of Hg

= 0.3Hg

$\frac{P_2}{w} = -4.08$ (Given vaccum pressure)

Then $\frac{P_1}{w} = \frac{17.658\times10^4}{9.81\times10^3} = 18$

$\frac{P_1}{w} - \frac{P_2}{w} = 18 - -4.08 = 22.08$

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

$= 2.4156\times10^{-4} \times 684.59$

$= 0.1655 m^3/s$

3 $d_o = 15cm$ Pipe diameter $= 30cm$

$A_o = \frac{\pi\times(15\times10^{-2})^2}{4}$ $A_P = \frac{\pi\times(30\times10^{-2})^2}{4}$

S.P Gr of oil = 0.9 Sol

Coefficient of discharge 0.64

Reading of differential = 50cmHg

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

$S_{hg} = 13.6$

$y = 50\times10^{-2}$

$h = 50\times10^{-2}\left[\frac{13.6}{0.9} - 1\right]$

$h = 7.055m$

$$Q = \frac{C_d A_0 A_P \sqrt{2gh}}{\sqrt{A_P^2 - A_0^2}}$$

$$= \frac{0.69 \times 0.01767 \times 0.07069 \times \sqrt{2 \times 9.81 \times 7.065}}{\sqrt{(0.07069^2) - (0.01767^2)}}$$

$$= 0.1574\ m^3/s$$

4 $y = 170mmHg = 0.17mHg$, $S.g\ Hg = 13.6$, $S.g\ Sw = 1.026$

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

$$\Delta h = 2.08m$$

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

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

$$V = 6.388\ m/s$$

5 $Q = 8.33 \times 10^{-5} m^3/sec$

Speed Of Rotation = 28.3 Rev/sec

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

Torque input = 15Nm

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

Ideal flow rate = normal displacement × speed Rotation $= 2.83 \times 10^{-4} m^3/sec$

a Volumetric efficiency $= \frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100$

$= 29.43\%$

b fluid Power, $P_f = Q \times \Delta P$

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

$= 124.95$ watts

c Shaft Power = $\tau \times \omega$

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

$\omega = 177.81$ rad/sec

Shaft Power = 15×177.81

$= 2667.2$ Watts

d Overall Efficiency = $\dfrac{\text{Fluid Power}}{\text{Shaft Power}} \times 100$

$= \dfrac{124.85}{2667.2} \times 100$

$= 4.68\%$