ENIOLA - AJIPE OLUWATOBINU
18/ENG01/033
ENG 214
FLUID MECHANICS.

1) $L = 2.0m$
$V_1 = 5 m/s$
$V_2 = 2 m/s$
$P_1 = 2.5m$
$h_f = \frac{(0.35(V_1 - V_2)^2)}{2g}$

P at lower end

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

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

$$= 2.5 + 1.07 + 2(0.16055)$$

$$= 5.409 \text{ bar}.$$

2 Inlet diameter = 20cm = 0.2m
throat diameter = 10cm = 0.1m.
$P_1 = 17.658 N/cm^2$
$P_2 =$
$C_d = 0.98$

$$A_1 = \frac{\pi d^2}{4}$$

$$= \frac{3.142 \times (10/100)^2}{4}$$

$$= 0.0314 m^2.$$

$$A_2 = \frac{\pi d^2}{4}$$

$$= \frac{3.142 \times 0.1^2}{4}$$

$$= 0.007858 m^2.$$

$P_1 = 17.658\ N/cm^2$

$= \frac{17.658}{(100)^2}$

$= 1.7658 \times 10^{-3}\ N/m^2$

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

$= 1.8 \times 10^{-4}\ m$

$\frac{P_2}{\omega} = 0.3 \times 10^{3}$

$= 4.08\ m$

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

$= 1.8 \times 10^{-4} - (4.08)$

$h = 4.08018\ m$

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

$= \frac{0.98 \times 0.034 \times 7.8883 \times 10^{-3}}{\sqrt{(0.034)^2 - (7.8883 \times 10^{-3})}}$

$= \sqrt{2 \times 9.81 \times 4.0801}$

$Q = 0.071 m^3/s$

$Q = 0.071 m^3/s$

3 $d = 15cm = 0.15m$

$d_2 = 30cm = 0.30m$

$50cm$ of Mercury $= 0.5m$

$Q = ?$

$S.G = 0.9 \quad Sd = 0.64$

$A_1 = \pi d^2/4$

$= \frac{\pi \times (0.15)^2}{4}$

$= 0.0176 m^2$

$A_2 = \pi d^2$

$= \frac{\pi \times (0.30)^2}{4}$

$= 0.0706 m$

$h = y\left[\frac{13.6}{0.9} - 1\right]$

$h = 0.5\left[\frac{13.6}{0.9} - 1\right]$

$= 7.05m$ of 0.1

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

$= \frac{0.64 \times 0.0176 \times 0.0706}{\sqrt{(0.0176^2) - (0.0706)^2}} \times \sqrt{2 \times 9.81 \times 7.05}$

$Q = 0.32 \times 10^{-3} m^3/s$

④ Axis = 15m

diff mercury = 170mm
= 0.17m

S.G = 13.6 (mercury)
S.G = 1.026 (sea water)
S = ?

$h = y\left(\frac{S.G\ mercury}{S.G.\ sea\ water} - 1\right)$

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

h = 2.083m.

$V = \sqrt{2gh}$

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

V = 6.39m/s.

5) Q = 5dm³/min
$= \frac{0.05}{60}$
$= 8.33 \times 10^{-5} m^3/s$.

Δp = 15bar = 15×10^5

Speed rotation = 1200x80/min

displacement = 10cm³/rev
= 0.001m³/rev

torque input = 15Nm.

c) Volumetor efficiency
$= \frac{\text{Actual flowrate}}{\text{Idal flowrate}} \times 100\%$

$= \frac{8.36 \times 10^{-5}}{2.56 \times 10^{-4}} \times 100$

= 29.45%.

b)
Fluid power
$P_f = Q \times \Delta p$
$= 8.33 \times 10^{-5} \times 16 \times 10^5$
= 124.95 watts.

c) Slaft power
T x ω
ω = 2 x π x Speed of rotation
ω = 2 x π x 28.3
ω = 177.81 rad/sec

Slaft power = T x ω
= 15 x 177.81
= 2667.2 watts.

d) Overall Efficiency

$\frac{\text{fluid power}}{\text{Slaft power}} \times 100$

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

= 4.65%.