NAME: ALFA FATIMA AHMED

MATRIC NO: 18/ENG06/008.

DEPARTMENT: CHEMICAL ENGINEERING

COURSE: ENG 214.

1) Rate = 10 dm^3/min, P = 12bar

Shaft speed = 1500rev/min.

Normal displacement = 10 cm^3/rev

Torque input = 12.5 Nm

i) To find volumetric efficiency

Ideal flow rate = Norminal d x Speed

$= 10 \times 1500$

$= 15000 cm^3/min$

$= 15.0 dm^3/min$

Volumetric efficiency = $\frac{\text{Actual flow}}{\text{Ideal flow}}$

$= \frac{10}{15} = 0.66$ or 66%

ii) $Q = \frac{10 \times 10^{-3}}{60} = 16.7 \times 10^{-6} m^3/s$

$P = 12 \times 10^5 N/m^2$

Fluid power = Qp

$= 16.7 \times 10^{-6} \times 12 \times 10^5$

$= 20.04$ watts

iii) Shaft power = $2\pi NT/60$

$= \frac{2 \times 1500 \times 12.5 \times 3.142}{60.}$

$= 1963.75$ Nm

Overall efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}}$

$= 0.010$ or 1%

2) Rate = $35 dm^3/min$

P = 100bar

Overall efficiency = 87%.

Shaft power = $2\pi NT/60$

$Q = \frac{35 \times 10^{-3}}{60} = 5.83 \times 10^{-4} m^3/s$

$P = 100 \times 10^5 N/m^2$

Fluid power = QP

$= 5.83 \times 10^{-4} \times 100 \times 10^5$

$= 5833.3$ watts.

Shaft power = ?

Overal efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}}$

$\frac{87}{100} = \frac{5833.3}{S.P}$

Shaft power = 6704.9 Nm

~~3) Normal displacement = 50~~

3) Normal displacement = 50cm³/rev
Pressure = 100 bar
S.P = 15 KW
Actual flow = 35 dm³/min
Speed = 850 rev/min

Ideal flowrate = Norminal × Speed
= 50 × 850
= 42500 cm³/m
= 42.5 dm³/min

Volumetric efficiency = Acutal / Ideal flow
= 35 / 42.5 = 0.82 or 82%

$Q = \frac{35 \times 10^{-3}}{60} = 5.83 \times 10^{-4}$

$P = 100 \times 10^5 N m^3$

Fluid power = Qp
$= 5.83 \times 10^{-4} \times 100 \times 10^5$
$= 5 \times 33.3$ watts

Shaft power = $\frac{2\pi NT}{60}$

Shaft power = 15KW = 1500 000

Overall efficiency = $\frac{5833.3}{15000}$
= 0.38 or 38%

7) Entrance diameter = 0.3 m d_1
Throat diameter = 0.2m d_2
Cd = 0.96
Specific weight = 19.62 N/m³

For the manometer
$P_1 + P_q g z = P_2 + P_q g(z - R) + P_w g R_1$
$P_1 - P_2 = 19.62(z_2 - z_1) + 587.425$

For the venturimeter
$\frac{P_1}{P_q g} + \frac{u_1^2}{2g} + z_1 = \frac{P_2}{P_q g} + \frac{u_2^2}{2g} + z_s$
$P_1 - P_2 = 19.62(z_2 - z_1) + 0.8034 u_2^2$

Combining (1) and (2)
$0.8034 u_2^2 = 587.423$

u ideal = 27.047 m/s
Q ideal = $27.047 \times \pi \left(\frac{0.2}{2}\right)^2$
= 0.85 m³/s
Q = Cd Q idieal
= 0.96 × 0.85 = 0.816

a) At section (1)
D_1 = 300 mm = 0.3 m
Area $a_1 = \pi/4 \times 0.3^2 = 0.707 m^2$
$P_1 = 400 KN/m^2$
Height of upper end above the datum 2
z_1 = 10 cm
D_2 = 150 mm = 0.15 m
$A_2 = \pi/4 \times 0.15^2$
= 0.0176 m²

Height of lower end above the datum $z_2 = 6m$

Rate of flow (that is discharged)

$Q = 40/100$

$1 litre = 1m^3/sec = 0.4m^3/sec$

Intensity of pressure at section 2, P_2

As the flow is continous,

$Q = A_1V_1 = A_2V_2$

$\therefore U_1 = Q/A_1 = \frac{0.04}{0.0707} = 0.566m/sec$

6) $h = 20m$

$d = 10cm = 0.1m$

$A = \frac{\pi d^2}{4} = 0.7854$, $UF = 0$

$\omega = ?$

$V_F^2 = V_1^2 - 2gh$

$V_1 = \sqrt{V_F^2 + 2gh}$

$V_1 = \sqrt{0^2 + 2(9.8m/s^2)(20m)}$

$= 19.80m/s$

The flow rate is equal to the speed through the area

$Q = VA = (19.80m/s)(7.854 \times 10^{-5})$

$= 0.155m^3/s$

$\omega = P_g Qh$

$= (1000) \times (9.8) \times (0.155) \times (20)$

$= 30478 Kgm^2/s^2$

$= 30 \times 10^3 W$

8) $d_1 = 0.15201$

$d_2 = 0.076m$

$P = 800kg/m^3$

$Cd = 0.97$

$A_1 = 0.018\underline{1}4m$

$A_2 = 0.00454m$

Apply Bernoulli method:

$\frac{P_1}{Pg} + \frac{U_1^2}{2g} + z_1 = \frac{P^2}{Pg} + \frac{U_2^2}{2g} + z_2$

9) $P_1 = P_2$

$\frac{U_1^2}{2g} + z_1 = \frac{U_2^2}{2g} + z_2$

$Q = V_1A_1 = U_2A_2$

$V_2 = \frac{V_1A_1}{A_2} = U_1A$

$V_1 = \sqrt{\frac{0914 \times 2 \times 9.81}{15}}$

$= 1.0934m/s$

$q = C_dA_1V_1$

$Q = 0.96 \times 0.018101 \times 1.0934$

$= 0.019m^3/s$

10) Reading of manometer = 170mm

Specific gravity of mercury $Sh_1 = 13.6$

Specific gravity of water $S_1 = 1.026$

$$h = y\left[\frac{Sh_1}{S_1} - 1\right]$$

$$h = 0.17\left[\frac{13.6}{1.026} - 1\right]$$

$$h = 2.083$$

Velocity of submarine

$$V = \sqrt{2gh}$$

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

$$= 6.39 \text{ m/s}$$

2