NAME: MOKOLO STEVE CHIBUJOR
18/ENG02/058
COMPUTER ENGINEERING
ENG 214

1. Let Smaller end be represented by (1) and lower end by (2)

Given Parameters

$L = 2.0m$ $\qquad$ $P_2/\rho g = ?$

$V_1 = 5m/s$

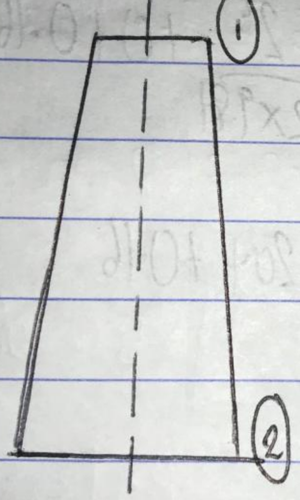
$P_1/\rho g = 2.5m$ of liquid

$V_2 = 2m/s$

loss of head $(h_L) = \frac{0.35(V_1 - V_2)^2}{2g} = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16m$

Using bernoullis equation

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



letting the line pass through the Section Then $Z_1 = 2.0, Z_2 = 0$

$$\therefore 25 + \frac{5^2}{2\times 9.81} \times 2.0 = \frac{P_2}{\rho g} + \frac{2^2}{2\times 9.81} + 0 + 0.16$$

$$2.5 + 1.27 + 2.0 = \frac{P_2}{\rho g} + 0.204 + 0.16$$

$$5.77 = \frac{P_2}{\rho g} + 0.364$$

$$\therefore \frac{P_2}{\rho g} = 5.77 - 0.364 = 5.406\text{m of liquid}$$

2. $d_{inlet} = \frac{20\text{cm}}{100} = 0.2\text{m}$

$a_{inlet} = \frac{\pi}{4} \times (0.2)^2 = 0.0314\text{m}^2$

$d_{throat} = \frac{10\text{cm}}{100} = 0.1\text{m}$

$a_{throat} = \frac{\pi}{4} \times (0.1)^2 = 7.85\times10^{-3}\text{m}^2$

ρ for water $= 1000\text{kg m}^3$

$P_1 = 17.658\text{N/cm}^2 = 17.658\times10^4\text{N/m}^2$

$\therefore \frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{1000 \times 9.81} = 18m$ of water

$\frac{P_2}{\rho g} = -30cm$ of mercury

$= -0.3m$ of mercury

$= -0.3 \times 13.6 = -4.08m$ of water

$\therefore$ Differential head $(h) = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 18 + 4.08 = 22.08m$ of water

Using discharge equation

$$Q = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

$$= 0.98 \times \frac{0.0314 \times 7.85 \times 10^{-3}}{\sqrt{0.0314^2 - (7.85 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 22.08}$$

$$= 0.98 \times 8.107 \times 10^{-3} \times 20.81$$

$$= 0.1653 m^3/s = 165.3 \text{ lit/s}$$

3. ~~Actual~~ $A_{orifice} = \frac{\pi}{4} \times (15)^2 = 176.714 cm^2$ (A_o area of orifice)

$A_{pipe} = \frac{\pi}{4} \times (30)^2 = 706.858 cm^2$ (A_p area of pipe)

Differential head $(h) = \left[\frac{13.6}{0.9} - 1\right] \times 50cm$ of oil

$= 705.556 cm$ of oil

$$Q = \frac{C_d \times A_o A_p}{\sqrt{A_p^2 - A_o^2}} \times \sqrt{2gh}$$

$$= \frac{0.64 \times 176.714 \times 706.858}{\sqrt{706.858^2 - 176.714^2}} \times \sqrt{2 \times 9.81 \times 705.556}$$

$= 0.64 \times 182.5094 \times 117.656$

$= 13742.96 cm^3/sec$

$= 13.74296$ lits/sec

4. Difference of mercury level $x = 170mm = 0.17m$

Sp.gr. of mercury $S_g = 13.6$

Sp.gr. of sea-water $S_{sw} = 1.026$

$\therefore h = x\left[\frac{S_g}{S_{sw}} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right] = 2.0834m$

Using $V = \sqrt{2gh}$

$V = \sqrt{2 \times 9.81 \times 2.0834} = 6.393 m/s$

Converting to Km/hr

$\frac{6.393 \times 60 \times 60}{1000} = 23 Km/hr$

5. Volumetric flow rate

Changing from dm³/min to m³/min

10 dm = 1m

∴ $10^3 dm^3 = 1m^3$

$1000 dm^3 = 1m^3$

$5 dm^3 = ?$

$? = \frac{5}{1000} = 0.005$

∴ Volumetric flow rate = $0.005 m^3/min$

Actual flow rate = $\frac{0.005}{60} = 8.33 \times 10^{-5} m^3/sec$

Speed = 1700rpm

Changing to rps

$\frac{1700}{60} = 28.33 rev/sec$

(a) Volume Efficiency = $\frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\% = \frac{8.33\times10^{-5}\times100}{2.833\times10^{-4}}$

$= 29.4\%$

(b) Fluid Power = $Q \cdot \Delta P = 8.33\times10^{-5}\times15\times10^{5}$

$= 124.95\ \text{N m/sec}$

(c) Shaft Power = $T \cdot \omega$

$T = 15\ \text{N}\ \omega$

$\omega = 2\times 22/7 \times 28.33 = 178.07\ \text{rad/sec}$

(d) Overall Efficiency = $\frac{\text{Fluid Power}}{\text{Shaft Power}} \times 100\% = \frac{124.95\times100}{2671.05} = 4.67\%$