Nwosu Chidubem MCT 18/ENG05/037 28-05-2020

ENG 214

i) $Q = 10 dm^3$

$dP = 12 \times 10^{-5} N/m^2$

revolution speed = 1500 rev/min

≃ rev/sec = $\frac{1500}{60}$ = 25 rev/s

Nominal D = $10 cm^3/rev$

torque Input = 12.5 Nm

flow rate = $10 dm^3 \simeq 0.01 m^3/min$

$\frac{0.01}{60} = 1.67 \times 10^{-4} m^3/sec$

Nominal D = $10 cm^3/rev \simeq 1 \times 10^{-5} m^3/rev$

Volumetric efficiency = $\frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\%$

Actual flow rate = $1.67 \times 10^{-4} m^3/sec$

Ideal flow rate = nominal D × Speed rev

$= 25 \times 1 \times 10^{-5}$

$= 2.5 \times 10^{-4} m^3/sec$

V.E = $\frac{1.67 \times 10^{-4}}{2.5 \times 10^{-4}} \times 100\%$

= 66.8%

~~iii) Shaft Power = Q.dP~~

~~$= 1.67 \times 10^{-4} \times 12 \times 10^{-5}$~~

~~= 200.4 Nm/s~~

iii) ~~Overall efficiency~~

Shaft power = $T\omega$

T - torque input

ω - angular displacement (rad/sec)

$\omega = 2\pi N$

$= 2 \times \frac{22}{7} \times 25$

= 157.14 rad/s

S.P = 12.5 × 157.14

= 1964.25 watts

ii) overall efficiency

$\frac{\text{fluid Power}}{\text{Shaft power}} \times 100$

fluid Power = Q.dP

$= 1.67 \times 10^{-4} \times 12 \times 10^{-5}$

= 200.4 Nm/s / watts

Overall efficiency = $\frac{200.4}{1964.25} \times 100\%$

= 10.2%

2) $Q = 35 dm^3/min = 0.035 m^3/min$

$\frac{0.035}{60} = 5.83 \times 10^{-4} m^3/s$

dP = 100 bar ≃ $100 \times 10^5 N/m^2$

Overall efficiency = 87 | 81

Fluid Power = Q.dP

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

= 5830 watts

~~87~~ ~~Shaft~~

6701.15

Shaft Power = $\frac{\text{fluid Power}}{\text{overall efficiency}}$

$= 5830 \div \frac{87}{100}$

$= \frac{5830 \times 100}{87}$

$= 6701.15$ watt

3) Nominal D = $50 cm^3/rev$

$\simeq 5 \times 10^{-5} m^3/rev$

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

Shaft Power = 15×10^3 watts

$Q = 35 dm^3/min \simeq 0.035 m^3/min$

$\frac{0.035}{60} = 5.83 \times 10^{-4} m^3/s$

fluid Power = Q.dP

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

$\simeq 5830$ watts

Overall efficiency = P

$\frac{\text{fluid Power}}{\text{Shaft Power}} \times 100\%$

$= \frac{5830}{15000} \times 100$

$\simeq 38.87\%$

Volumetric effiency

$= \frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\%$

Ideal flowrate = Nominal D x Speed Rev

Ideal flowrate = $5 \times 10^{-5} \times 14.17$

$= 7.083 \times 10^{-4} m^3/s$

$V.E = \frac{5.83 \times 10^{-4}}{7.083 \times 10^{-4}} \times 100$

$V.E \simeq 82.93\%$

5) Specific G of oil = 0.89

$Z = 30,000 cm$

$\frac{30,000}{100} = 300 m$

Volumetric flow rate, Q = 220 L/s

$Q = \frac{220}{1000}$

$= 0.22 m^3/s$

Vel of jet = 7 m/s

$P = \frac{\rho Q . V^2}{2}$

$= \frac{0.89 \times 0.22 \times 7^2}{2}$

$= 4.797 \simeq 4.8$ watts

ii) Power supplied from reservoir

$P = \rho g Q z$

$= 0.89 \times 9.81 \times 0.22 \times 300$

$= 576.24$ watts

iii) Power loss in transmission = Power of reservoir − Power of jet

$= 576.24 - 4.8$

$= 571.44$ watts

iv) Head loss $= \frac{\text{Power lost in transmission}}{\rho g Q}$

$= \frac{571.4}{0.84 \times 9.81 \times 0.22}$

$= \frac{571.4}{1.921} = 297.45$ m

v) efficiency $= \frac{\text{Power of jet}}{\text{Power of reservoir}} \times 100\%$

$= \frac{4.8}{576.24} \times 100$

$= 0.83\%$

4) $Z = 24000$ cm $\simeq 240$ m

Volumetric flow rate, $Q = 13$ L/s

$Q = \frac{13}{100}$

$Q = 13 \times 10^{-3}\ m^3/sec$

Velocity of jet = 66 m/s

Jet issuing from nozzle will be at atmospheric pressure at datum level, hence $P = 0$ and $Z = 0$

Density of water = 1000 kg/m³

$P = 0.G + \frac{\rho Q \cdot V^2}{2} + \rho g \cdot Q \cdot 0$

$P = \frac{\rho Q \cdot V^2}{2}$

$= \frac{1000 \times 13 \times 10^{-3} \times 66^2}{2} = 28314$ watts

ii) At Power supplied from reservoir $V = 0$ and $P = 0$

$P = 0 \cdot Q + \frac{\rho Q \cdot (0)^2}{2} + \rho g Q z$

$P = \rho g Q Z$

$= 1000 \times 9.81 \times 13 \times 10^{-3} \times 240$

$= 30607.2$ watts

Power loss in transmission = Power of reservoir − Power of jet

$= 30607.2 - 28314$

$= 2293.2$ watts

iii) Head loss = ~~Power lost in tr~~ $\frac{\text{Power loss in transmission}}{\rho g h}$

$1000 \times 9.81 \times 13 \times 10^{-3}$

$h = 17.982m$

$$Efficiency = \frac{Power\ of\ Jet}{Power\ of\ reservoir} \times 100$$

$$= \frac{28314}{30607.2} \times 100$$

$E = 92.5\%$

9) $D_1 = 300mm \simeq 0.3m$

$D_2 = 150mm \simeq 0.15m$

$Q = 40l/s$

$$Q = \frac{40}{1000} = 0.04m^3/s$$

$Z_1 = 10m$

$Z_2 = 6m$

$P_1 = 400KN/m^2 \simeq 0.4N/m^2$

$P_2 = ?$

$$A_1 = \frac{\pi(0.3)^2}{4} = 0.071m^2$$

$$A_2 = \frac{\pi(0.15)^2}{4} = 0.0176m^2$$

$Q = A_1V_1$

$$V = \frac{Q}{A} = \frac{0.04}{0.071} = 0.56m/s$$

$A_1V_1 = A_2V_2$

$$V_2 = \frac{A_1V_1}{A_2}$$

$$\frac{}{0.0176}$$

$= 2.259 \simeq 2.3m/s$

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

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

$$\frac{P_2}{w} = \frac{0.4}{1000 \times 9.81} + 10 - 6 + \frac{0.56^2}{2 \times 9.81} - \frac{2.3^2}{2 \times 9.81}$$

$$\frac{P_2}{w} = 4.07 \times 10^{-5} + 4 + (-0.2536)$$

$$\frac{P_2}{w} = 4.07 \times 10^{-5} + 3.7464$$

$$\frac{P_2}{w} = 3.746$$

$P_2 = w(3.746)$

$P_2 = 1000 \times 9.81 \times 3.746$

$= 367KN/m^2$

10) Reading of manometer (y)

$= 170mm = 0.17mmHg$

Specific G of mercury $= 13.6$

Specific G of water $= 1.026$

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

1(a)) Reading of manometer (y) = 170mm = 0.17mmHg
Specific gravity of mercury = 13.6
Specific gravity of seawater = 1.026

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

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

$$h = 0.17(12.255)$$

$$h = 2.083$$

∴ Velocity of Submarine

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

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

$$V = \sqrt{40.868}$$

$$V = 6.393 m/s$$

Safety For All 8:53 AM 25%

Notes

Testimony of ear pain and inflammation healed:

I started having severe ear pain, which radiated to my neck, about 2-3weeks ago, It was also accompanied by serious inflammation of my sub-mandibular lymph nodes, that if I shifted my neck down to the right, even without touching it ,the pain was felt and lymph nodes were painfully enlarged ....
I decided to stand on the truth of GOD's WORD, I didn't take any medication. But I was praying and proclaiming GOD's WORD in Gal 3:13, how he has set me free from the curses in Deutronomy 28:22. I also prayed and proclaimed, matt8:17, col1:13, col2:15, col 2:19, Ephesians 5:30, I am grateful to joshua, I spoke to him about it and he talked about firmly rebuking the sickness from its roots and i rebuked the sickness, and also kept singing a new song on redemption I learnt

(4). Water is drawn from a reservoir in which the water level is 2,4000 cm above the datum at the rate of 13 liters/sec. The Outlet of the pipe is at datum level and is fitted a nozzle to produce a high speed jet in order to drive a turbine of pelton wheel type. If the velocity of jet is 66 m/sec. Calculate

i. Power of Jet
ii. Power Supplied from reservoir
iii. Head used to overcome Losses.
iv. Efficiency of the pipeline and nozzle in transmitting operation.

(5). Oil of specific gravity 0.89 is drawn from a reservoir in which the oil is 30,000 cm above the datum at the rate 220 Litres/sec. If the velocity of jet is 7m|sec. Calculate

i. Power of Jet
ii. Power supplied from reservoir
iii. Head used to overcome Losses
iv. Efficiency of the pipeline and nozzle in transmitting operation.

(6) A fountain sends a stream of water 20 m up into the air. If the base of the stream is 10 cm in diameter, what power is required to send the water to this height?

(7) A Venturimeter with an entrance diameter of 0.3m and a throat diameter of 0.2m is used to measure the volume of gas flowing through a pipe. The discharge coefficient of the meter is 0.96. Assuming the specific weight of the gas to be constant at 19.62 N/m^3, calculate the volume flowing when the pressure difference between the entrance and the throat is measured as 0.06m on a water U-tube manometer