ABU DAVID
18/ENG02/002
COMP. ENG

1 Flow rate = $10dm^3/min$

$10dm = 1m$

dm^3 to m^3

$1000dm^3 = 1m^3$

$10 dm^3 = x$

Volumetric flow rate $x = \frac{10}{1000}$

$= 0.01m^3/min$

$=$ 60sec $= 1min$

$\frac{0.01}{60}$

$Q = 1.67 \times 10^{-4} m^3/sec$

Speed $= 1500$ rev/min

$= \frac{1500}{60}$

25 rev/min

$=$

Pressure $\partial P = 12$ bar

$1 \text{ bar} = 1 \times 10^5 N/m^2$

$12 \text{ bar} = x$

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

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

Nominal displacement $= 10cm^3/rev$

$100cm = 1m$

$100^3cm^3 = 1m^3$

$x = \frac{10}{1000000}$

$x = 1 \times 10^{-5}\ m^3/rev$

Ideal flow rate = nominal displacement × speed

$= 1 \times 10^{-5} \times 25 = 2.5 \times 10^{-4}\ m^3/s$

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

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

$= 66.8\%$

ii Fluid power

$P_F = Q \cdot \Delta P$

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

$= 200.4$ watts

iii Shaft power = T.ω

T = Torque

ω = angular speed

T = 12.5 Nm

$\omega = \frac{2\pi N}{60}$

w=

4

②

A

P_F

C

③

Nor

$w = 2 \times \frac{22}{7} \times 25 = 157.14$ rad/s

Shaft power = $12.5 \times 157.14 = 1964.25$ watts

4 Overall efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}} \times 100\%$

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

$= 10.2\%$

(2) $\partial P = 100$ bar

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

Actual flow rate = $Q = 35 dm^3/min$

$= \frac{35}{1000} \times 60 = 5.83 \times 10^{-4} m^3/s$

$P_f = Q \cdot \partial P = 5.83 \times 10^{-4} \times 100 \times 10^5 = 5830$ watts

Overall Efficiency = $\frac{\text{Fluid power}}{\text{Shaft power}} \times 100\%$

Shaft power = $\frac{\text{fluid power} \times 100\%}{\text{overall efficiency}}$

$= \frac{5830 \times 100}{87} = 6.701 \times 10^5$ watts

(3) Sol

Nominal displacement = $50 cm^3/rev$

$x = \frac{50}{1000000} = 5 \times 10^{-5} m^3/rev$

Actual flow rate = 35 dm³/min = $\frac{35}{1000 \times 60}$ = 5.83×10⁻⁴ m³/s

δP = 100 bar = 100×10^5 N/m²

$P_F = Q \cdot \delta P = 5.83 \times 10^{-4} \times 100 \times 10^5 = 5830$ Watt

Overall efficiency = $\frac{\text{fluid power}}{\text{Fluid energy}} \times 100\%$

$= \frac{5830}{15,000} \times 100$

$= 38.87\%$

Ideal flow rate = nominal displacement × speed

Speed N = 850 rpm = $\frac{850}{60}$ = 14.17 rps

Ideal flow rate = $5 \times 10^{-5} \times 14.17 = 7.085 \times 10^{-4}$ m³/sec

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

$= \frac{5.83 \times 10^{-4}}{7.085 \times 10^{-4}} \times 100\%$

Volumetric efficiency = 82.29%

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(4) $Z = 2400\,cms$

$100cm = 1m$

$Z = 2.40m$

Volumetric flow rate, $Q = 13\ l/sec$

$1000\ litres = 1m^3$

$Q = \frac{13}{1000}$

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

Velocity of jet = 6m/sec

(i) $P = \rho \cdot Q + \frac{\rho Q v^3}{2} + \rho g \cdot Q z$

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

$= \frac{1000 \times 13 \times 10^{-3} \times (60)^2}{2}$

$P = 283.14$ watts

(ii) $P = \rho g Q z$

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

$P = 30607.2$ watt

$P = 30.6072$ kilo watts

(iii) Power loss in transmission = Power of reservoir − Reservoir power of jet

$= 30607.2 - 28314$

$= 2293.2$ watts

$h = \frac{\text{Power lost in transmission}}{\rho g Q}$

$= \frac{2293.2}{1000 \times 9.81 \times 13 \times 10^{-3}}$

$h = 17.982 m$

iv Efficiency $= \frac{\text{Power of Jet}}{\text{power of reservoir}} \times 100\%$

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

$= 92.5\%$

(5)

(i) S.g of oil = 0.84

$2 \; \frac{230000}{100} = 300 m$

Rate of flow Q = 220 Lt/sec

$\frac{220}{1000}$ m³/sec

$= 0.22 m^3/sec$

Velocity

(i) Power

P =

P =

=

ii P =

P

iii)

ii P

P

iii He

h

=

Velocity = 7m/s

(i) Power of Jet

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

$$= \frac{0.89 \times 1000 \times 0.22 \times 7^2}{2}$$

$$= \frac{9594.2}{2}$$

$$= 4797.1 \text{ watt}$$

ii $P = P Q + \frac{\rho Q v^2}{2} + \rho Q g z$

~~$P = \rho g Q z$~~

~~$1000 \times 9.81 \times 0.22 \times$~~

~~$P = 890 \times 9.81 \times 220 \times 10^{-3} \times 300$~~

~~$= 576239.4$ kgm/s~~

iii)

ii $P = \rho g Q z$

$P = 0.89 \times 1000 \times 9.81 \times 300 \times 0.22$

$= 576239.4$ watt

iii Head used to overcome losses

$$h = \frac{\text{Power lost in transmission}}{\rho g Q}$$

$= 576239.4 - 4797.1$

$= 571442.3$ watt

$$h = \frac{571442.3}{0.84 \times 1000 \times 9.81 \times 0.22}$$
$= 299.5m$

iv = Efficiency = $\frac{\text{Power of jet}}{\text{Power Supplied}} \times 100\%$

$= \frac{4797.1}{576239.4} \times 100$
$= 0.832\%$