MATRIC NUMBER: 17/MHS01/314
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COURSE: ENG 214

1. Given pump,

rate = $10\ dm^3/min$

$= 10\ \frac{dm^3}{min} \times \frac{1\ m^3}{10^3\ dm^3} \times \frac{1\ min}{60\ s} = 1.667 \times 10^{-4}\ m^3/s$

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

displacement = $10\ cm^3/rev = 10 \times \frac{1}{10^6} = 1 \times 10^{-5}\ m^3/rev$

Speed = $1500\ rev/min \times \frac{1}{60}\ s = 25\ rev/s$

$T = 12.5\ Nm$

i. Volumetric Efficiency = ?

Vol Eff = $\frac{\text{actual flow}}{\text{theoretical flow}}$

th. flow = $1 \times 10^{-5} \times 25 = 25 \times 10^{-5}\ m^3/s$

$= \frac{1.667 \times 10^{-4}}{25 \times 10^{-5}} \times 100$

$= 66.68\%$

ii. Fluid power = ?

P_F = actual flow rate × Pressure

$= 1.667 \times 10^{-4} * 12 \times 10^5$

$= 200.04\ W$

iii. Shaft Power = ?

$P_s = T \times \omega$

$= 12.5 \times 157.0796$

$= 1963.495\ W$

Speed = 25 rev/s

1 rev = 2π rad

Thus, speed = $25 \times 2\pi$

$\omega = 157.0796\ rad/s$

iv. Overall Efficiency = ?

Ov Eff = $\frac{P_F}{P_s} \times 100$

$= \frac{200.04}{196349.5} \times 100$

$= 10.19\%$

2. Given pump,

rate $= 35 dm^3/min = 35 \times \frac{1 m^3}{10^3 dm^3} \times \frac{1 min}{60 s} = 0.05833 m^3/s$

$P = 100 bar = 100 \times 10^5 N/m^2$ Ov Eff $= 87\%$

$P_S = ?$

$Ov\ Eff = \frac{P_F}{P_S} \times 100$

$P_F = 0.05833 \times 100 \times 10^5 = 583300 = 583.3 \times 10^3 W$

$P_S = \frac{P_F \times 100}{Ov\ Eff}$

$\Rightarrow P_S = \frac{583300 \times 100}{87}$

$= 670459.77$

$\therefore P_S = 670.46 kW$

3. Given pump,

displacement $= 50 cm^3/rev = 50 \times 10^{-6} m^3/rev$ $P = 100 bar = 100 \times 10^5 N/m^2$

$P_S = 15 kW$ actual flow rate $= 35 dm^3/min = 35 \times \frac{1}{10^3} \times \frac{1}{60} = 0.05833 m^3/s$

Ov Eff $= ?$ Vol. Eff. $= ?$ Speed $= 850 rev/min = 850 \times \frac{1}{60} = 14.167 rev/s$

$Vol\ Eff = \frac{actual\ flow}{theoritical\ flow}$ th. flow $= 14.167 \times 50 \times 10^{-6}$

$= 0.0007084 = 7.084 \times 10^{-4}$

$= \frac{0.05833}{7.084 \times 10^{-4}} \times 100$

$Ov\ Eff = \frac{P_F}{P_S} \times 100$ $P_F = 0.05833 \times 100 \times 10^5 = 583300 = 583.3 \times 10^3 W$

$P_S = T \times \omega$