

## EJERCICIO 6

$$\eta = 80\% \quad @ \quad N_s = 2000 \text{ (en rpm, gpm y pie)}$$

$$D = 8''$$

$$\text{Cond. de diseño: } Q_1 = 30 \text{ gpm}$$

$$n_1 = 1170 \text{ rpm}$$

$$n_2 = 1750 \text{ rpm}$$

$$Q_2 = ? ; H_2 = ?$$

Comprobar que  $N_{s_1} = N_{s_2}$

$$\dot{W} = ?$$

Ec. básicas

$$\left(\frac{H}{\omega^2 D^2}\right)_1 = \left(\frac{H}{\omega^2 D^2}\right)_2 ; \left(\frac{P}{\rho \omega^3 D^5}\right)_1 = \left(\frac{P}{\rho \omega^3 D^5}\right)_2 ; \left(\frac{Q}{\omega D^3}\right)_1 = \left(\frac{Q}{\omega D^3}\right)_2 ; N_s = \frac{\omega Q^{1/2}}{H^{3/4}}$$

Con las cond. de diseño:

$$\frac{Q_1}{\omega_1 D_1^3} = \frac{Q_2}{\omega_2 D_2^3} \Rightarrow Q_2 = Q_1 \left(\frac{\omega_2}{\omega_1}\right) \left(\frac{D_2}{D_1}\right)^3 = 30 \text{ gpm} \left(\frac{1750}{1170}\right) (1)^3$$

$$\Rightarrow Q_2 = 44,87 \text{ gpm}$$

$$\frac{H_1}{\omega_1^2 D_1^2} = \frac{H_2}{\omega_2^2 D_2^2} ; H_1 = ? \Rightarrow N_{s_1} = \frac{\omega_1 Q_1^{1/2}}{H_1^{3/4}}$$

$$\Rightarrow H_1 = \left[\frac{\omega_1 Q_1^{1/2}}{N_{s_1}}\right]^{4/3} \Rightarrow H_1 = \left[\frac{(1170)(30)^{1/2}}{2000}\right]^{4/3}$$

$$\Rightarrow H_1 = 4,72 \text{ pie}$$

$$\Rightarrow H_2 = H_1 \left(\frac{\omega_2}{\omega_1}\right)^2 \left(\frac{D_2}{D_1}\right)^2 = 4,72 \left(\frac{1750}{1170}\right)^2 (1)^2 \Rightarrow H_2 = 10,56 \text{ pie}$$

$$P_i = \rho g Q H_1 = 1,94 \frac{\text{slug}}{\text{pie}^3} \times 32,2 \frac{\text{pie}}{\text{s}^2} \times 30 \frac{\text{gal}}{\text{min}} \times \frac{0,134 \text{ pie}^3}{\text{gal}} \times \frac{1 \text{ min}}{60 \text{ s}} \times 4,72 \text{ pie}$$

$$P_i = 147,42 \frac{\text{lb-ft-pie}}{\text{s}} \times \frac{1 \text{ hp}}{550 \frac{\text{lb-ft-pie}}{\text{s}}} = 0,27 \text{ hp}$$

Como

$$\frac{P_1}{\rho \omega_1^3 D_1^5} = \frac{P_2}{\rho \omega_2^3 D_2^5} \Rightarrow P_2 = P_1 \left( \frac{\rho_2}{\rho_1} \right) \left( \frac{\omega_2}{\omega_1} \right)^3 \left( \frac{D_2}{D_1} \right)^5 = 0,27 (1) \left( \frac{1750}{1170} \right)^3 (1)^5$$

$$P_2 = 0,9 \text{ hp}$$

Considerando la eficiencia:

$$\eta = \frac{P_{\text{req}}}{P_{\text{sum}}} = \frac{P_2}{P_{\text{in}}} \Rightarrow P_{\text{in}} = \frac{P_2}{\eta} = \frac{0,9}{0,8} = 1,13 \text{ hp}$$

Comprobando  $N_s$ :

$$N_{s_2} = \frac{\omega_2 Q_2^{1/2}}{H_2^{3/4}} = \frac{(1750)(44,87)^{1/2}}{(10,56)^{3/4}} = 2001,09 \approx \underline{\underline{2000}}$$