P1] La industria requiere un total de agua definido por

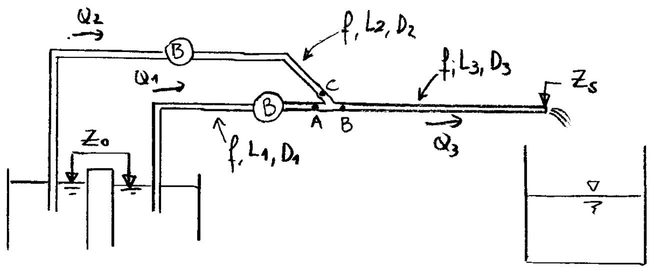
$$\forall_{diario} = Q \cdot T = 120\ [lt/s] \cdot 8\ [hr] \cdot 3600 \left[\frac{s}{hr}\right] \cdot 0{,}001 \left[\frac{m^3}{lt}\right]$$

(Q: caudal usado; T: Tiempo durante el cual se ocupa)

$$\forall_{diario} = 3456\ [m^3]$$

a) Suministro de caudal continuo

$$Q = \frac{\forall_{diario}}{24\ horas} = 0{,}04\ [m^3/s]$$



Entre (B) y la descarga:

$$B_B = B_S + f\frac{L_3}{D_3}\frac{Q_3^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2} \qquad B_S = Z_S + \frac{Q_3^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2}$$

$$B_B = Z_s + f\frac{L_3}{D_3}\frac{Q_3^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2} + \frac{Q_3^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2} \qquad (1)$$

Entre el pozo (0) y (A):

$$B_0 = B_A + f\frac{L_1}{D_1}\frac{Q_1^2}{2g\left(\frac{\pi D_1^2}{4}\right)^2} - \frac{P_{B1}}{\gamma Q_1} \qquad B_0 = Z_0$$

$$Z_0 = B_A + f\frac{L_1}{D_1}\frac{Q_1^2}{2g\left(\frac{\pi D_1^2}{4}\right)^2} - \frac{P_{B1}}{\gamma Q_1} \qquad (2)$$

Análogamente, entre el pozo (0) y (C):

$$z_0 = B_C + \frac{f \cdot L_2}{D_2} \frac{Q_2^2}{2g\left(\frac{\pi D_2^2}{4}\right)^2} - \frac{P_{B2}}{\gamma Q_2} \qquad (3)$$

Adicionalmente, $B_A = B_B = B_C$ (no hay perdidas singulares),
y $Q_3 = Q_1 + Q_2$ (continuidad en el nudo)

De (1), usando $Q_3 = 0{,}04$ [m³/s]

$$B_B = 10 + \frac{0{,}02 \cdot 200}{0{,}25} \frac{0{,}04^2}{2 \cdot 9{,}8 \cdot \left(\frac{\pi \cdot 0{,}25^2}{4}\right)^2} + \frac{0{,}04^2}{2 \cdot 9{,}8 \cdot \left(\frac{\pi \cdot 0{,}25^2}{4}\right)^2}$$

$$B_B = 17{,}23 \text{ [m]}$$

$B_A = B_B = 17{,}23$ [m], usando esto en (2):

$$(B_A - z_0) + \frac{f \cdot L_1}{D_1} \frac{Q_1^2}{2g\left(\frac{\pi D_1^2}{4}\right)^2} - \frac{P_{B1}}{\gamma Q_1} = 0$$

$$\left(\frac{16 f \cdot L_1}{2g \pi^2 D_1^5}\right) Q_1^3 + (B_A - z_0) Q_1 - \frac{P_{B1}}{\gamma} = 0$$

$$16542{,}23\, Q_1^3 + 17{,}23\, Q_1 - 1{,}0204 = 0$$

$$\Rightarrow Q_1 = 0{,}031 \text{ [m}^3\text{/s]}$$

Por continuidad $Q_3 = Q_1 + Q_2 \Rightarrow Q_2 = Q_3 - Q_1 = 0{,}009$ [m³/s]

Con Q_2 conocido, en (3):

$$P_{B2} = \gamma Q_2 \left[B_C - z_0 + \frac{f \cdot L_2}{D_2} \frac{16 Q_2^2}{2g \pi^2 D_2^4} \right] = 1720 \text{ [W]}$$

b) Durante 12 horas funciona sólo una bomba

Entre el pozo y la descarga:

$$B_0 = B_S + \frac{f \cdot L_1}{D_1} \frac{Q^2}{2g\left(\frac{\pi D_1^2}{4}\right)^2} + \frac{f \cdot L_3}{D_3} \frac{Q^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2} - \frac{P_{B1}}{\gamma Q}$$

$$\Rightarrow Z_0 = Z_S + \frac{Q^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2} + \frac{f \cdot L_1}{D_1} \frac{Q^2}{2g\left(\frac{\pi D_1^2}{4}\right)^2} + \frac{f L_3}{D_3} \frac{Q^2}{2g\left(\frac{\pi D_3^2}{4}\right)^2} - \frac{P_{B1}}{\gamma Q}$$

$$Q^3 \cdot \frac{16}{2g\pi^2}\left[\frac{1}{D_3^4} + \frac{f \cdot L_1}{D_1^5} + \frac{f \cdot L_3}{D_3^5}\right] + (Z_S - Z_0)Q - \frac{P_{B1}}{\gamma} = 0$$

$Q = 0{,}032$ [m³/s]

$$\text{Volumen total} = Q \cdot \underset{\uparrow 12 \text{ horas}}{T} + Q' \cdot \underset{\uparrow}{T'}$$

$\Rightarrow Q' = 0{,}048$ [m³/s]

Análogamente al caso a), se debe encontrar la distribución de caudales y potencia de bomba 2, conocido el caudal que llega al estanque.

(1), con $Q_3' = 0{,}048$ [m³/s]

$B_b = 20{,}36$ [m]

$B_A = B_B = 20{,}36$ [m], en (2):

$$(B_A - Z_0) + \frac{f_1 L_1}{D_1} \frac{Q_1'}{2g\left(\frac{\pi D_1^2}{4}\right)^2} - \frac{P_{B1}}{\gamma Q_1'} = 0$$

$$\left(\frac{16 f L_1}{2g \pi^2 D_1^5}\right) Q_1'^3 + (B_A - Z_0) Q_1 - \frac{P_{B1}}{\gamma} = 0$$

$Q_1' = 0{,}029$ [m³/s]

Por continuidad $Q_3' = Q_1' + Q_2' \Rightarrow Q_2' = 0{,}018$ [m³/s]

Con Q_2' conocido en (3):

$$P_{B2} = \gamma Q_2'\left[B_c - Z_0 + \frac{f \cdot L_2}{D_2} \frac{16 Q_2'^2}{2g\pi^2 D_2^4}\right] = 5202 \text{ [W]}$$