Examen Hydraulique et pneumatique
2ème ST électromécanique.

Le 11/06/22

~~Exercice 1~~ Questions de cours (5 pts)

$$\frac{1}{2}(v_2^2 - v_1^2) + g(z_2 - z_1) + \frac{p_2 - p_1}{\rho} = 0 \quad (0,5)$$

Venturi horiz $\Rightarrow z_2 = z_1$

$$\frac{1}{2}(v_2^2 - v_1^2) + \frac{p_2 - p_1}{\rho} = 0 \quad (0,5)$$

* Théorème de Pascal

$$\left.\begin{aligned} p_1 &= p + \rho g z_1 \\ p_2 &= p + \rho g z_2 \end{aligned}\right\} \quad (0,5) \Rightarrow p_2 - p_1 = \rho g (z_2 - z_1) = -\rho g h \quad (0,5)$$

on a $v_2 = \frac{q_v}{S_2}$ et $v_1 = \frac{q_v}{S_1}$ $(0,25 + 0,25)$ $\Rightarrow v_2 S_2 = v_1 S_1$

$$\Rightarrow v_2^2 - v_1^2 = \frac{q_v^2}{S_2^2} - \frac{q_v^2}{S_1^2} = q_v^2 \left[\frac{1}{S_2^2} - \frac{1}{S_1^2}\right] \quad (0,5)$$

$$\frac{1}{2}\left[v_2^2 - v_1^2\right] + \frac{p_2 - p_1}{\rho} = 0$$

~~$\frac{q_v^2}{2}\left[\frac{1}{S_2^2} - \frac{1}{S_1^2}\right] - gh = 0$~~ $\frac{q_v^2}{2}\left[\frac{1}{S_2^2} - \frac{1}{S_1^2}\right] - gh = 0$ (0,5)

$$\Rightarrow q_v^2 = \frac{2gh}{\frac{1}{S_2^2} - \frac{1}{S_1^2}} \quad (0,5)$$

$$\Rightarrow q_v = \sqrt{\frac{2gh}{\frac{1}{S_2^2} - \frac{1}{S_1^2}}} = \sqrt{\frac{2gh}{\frac{1}{S_1^2}\left(\frac{S_1^2}{S_2^2} - 1\right)}} = S_1 \sqrt{\frac{2gh}{\left(\frac{S_1}{S_2}\right)^2 - 1}}$$

(0,5) (0,5)

## Exercice 2 (6 Pts)

1- Vitesse d'écoulement (0,5)

(0,5) $V = \frac{4 Q_v}{\pi D^2} = \frac{4 \times 2,772 \times 10^{-3}}{3600 \times 3,14 \times 3,1 \times 10^{-3}} = 1,02 \text{ m/s}$ (0,5)

2- La puissance hydraulique

$\frac{1}{2}(V_2^2 - V_1^2) + g(z_2 - z_1) + \frac{P_2 - P_1}{\rho} = W_{1\nu}$ (1,0)

On a (0,5) $V_1 = V_2 \Rightarrow g(z_2 - z_1) + \frac{P_2 - P_1}{\rho} = \frac{P_{hyd}}{\rho Q_v}$ (0,5)

$P_{hyd} = \rho Q_v \left[ g(z_2 - z_1) + \frac{P_2 - P_1}{\rho} \right]$ (0,5)

(0,5) $= 1000 \times \frac{2,772 \times 10^{-3}}{3600} \left[ 9,8 \times 1 (30 - (-26)) + \frac{(1-2) \times 10^5}{10^3} \right]$

$= 346 \text{ Watt}$ (0,5)

3) Puissance électrique

$P_e = \frac{P_{hyd}}{\eta_e} = \frac{346}{0,8} = 432 \text{ Watt}$ (0,5) (0,5)

## Exercice 1* (3 Pts)

1) EF H entre 1 et 2 (0,5)

$P_2 = P_1 + \rho_c g h \Rightarrow P_2 = 1 \times 10^5 + 700 \times 9,81 \times 0,728$ (0,5)

$= 1,05 \times 10^5 \text{ Pa}$ (0,5)

2) Pour le mercure

$P_2 = P_3 + \rho_m g h' \Rightarrow P_3 = P_2 - \rho_m g h'$ (0,5)

$P_3 = 1,05 \times 10^5 - 13600 \times 9,8 \times 0,15 = 1,03 \times 10^5 \text{ Pa}$ (0,5) (0,5)

3) $P_3 = P_{3'} = P_1 + \rho_c g h'' \Rightarrow \rho_c g h'' = P_3 - P_1 \Rightarrow h'' = \frac{P_3 - P_1}{\rho_c g}$

$h'' = \frac{(1,03 - 1) \times 10^5}{700 \times 9,81} = 0,436 \text{ m}$

## Exercice 3 (6 pts)

1) Vitesse d'écoulement

$$v = \frac{Q_V}{S} = \frac{4 Q_V}{\pi D^2} = \frac{4 \times 2,8 \times 10^{-3}}{3,14 \times (0,135)^2} = 0,2 \text{ m/s}$$ (0,5) (0,5)

2) $$Re = \frac{\rho v D}{\mu} = \frac{10^3 \times 0,2 \times 0,135}{1 \times 10^{-3}} = 27000$$ (0,5)

$2000 < Re < 10^5 \Rightarrow$ Régime turb lisse. (0,5)

3) Coef de perte de charge linéaire.

$$\lambda = 0,316 (Re)^{-0,25} = 0,025$$ (0,5)

4) Perte de charge

$$J_L = -\lambda \frac{v^2}{2} \frac{L}{D} = -0,025 \left(\frac{0,2^2}{2}\right) \left(\frac{65}{0,135}\right)$$ (0,5)

$$= -0,24 \text{ J/Kg}.$$

5) Puissance de la pompe

$$\frac{1}{2}(v_2^2 - v_1^2) + g(z_2 - z_1) + \frac{P_2 - P_1}{\rho} = \frac{P_{hyd}}{\rho Q_V} + J_{1,2}$$ (0,5)

(0,25) on a $v_2 = v_1$ et $P_2 = P_1 = P_{Atm}$ (0,25)

$$g(z_2 - z_1) = \frac{P_{hyd}}{\rho Q_V} + J_{1,2}$$ (0,5)

$$\frac{P_{hyd}}{\rho Q_V} = g(z_2 - z_1) - J_{1,2}$$

$$P_{hyd} = \left[g(z_2 - z_1) - J_{1,2}\right] \times \rho Q_V$$ (0,5)

(0,5) $= 10^3 \times 2,8 \times 10^{-3} \left[9,81(35 - 0) + 0,24\right] = 962 \text{ Watt}$ (0,5)