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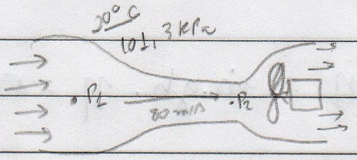
4ª lista de mecânica dos fluidos.

Çengel: 5.87, 5.70, 5.81

5.87. $PV = nRT$



$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2$$

(considera-se zero; $\Delta P_2 \gg P_1$ → pois consideramos o mesmo altura...)

como, $\rho = \frac{n}{V}$

$PV = nRT$

$\rho = \frac{P}{RT}$ $\rho = \frac{101,3 \text{ KPa}}{0,287 \text{ KPa} \cdot m^3 \cdot 293}$

$\frac{n}{V} = \rho$ $\rho = 1,204 \text{ Kg}/m^3$

Dados $P_1 = 101,3$ KPa

$V_2 = 8 m/s$

$t = 20°C \rightarrow 293K$

$R = 0,287 \text{ KPa} \cdot m^3$

aplicando na formula

$$\frac{P_1}{\rho g} + 0 + 0 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + 0 \Rightarrow P_2 =$$

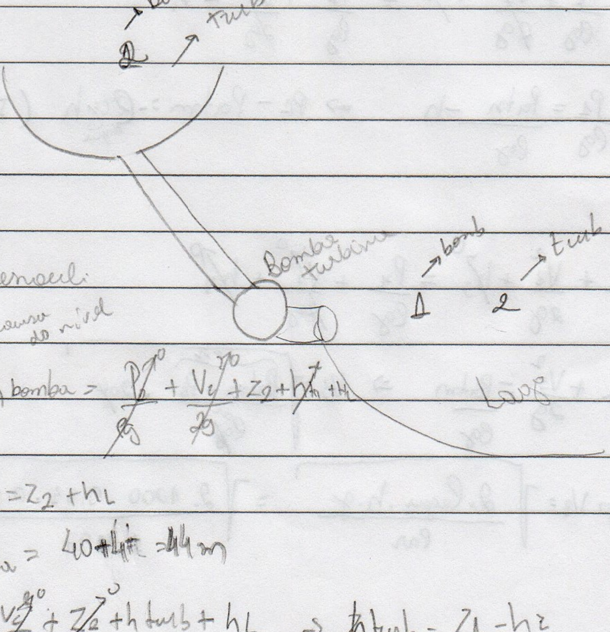
$$\frac{101,3 \times 10^3}{1,204 \cdot 9,81} = \frac{P_2}{1,204 \cdot 9,81} + \frac{80^2}{2 \cdot 9,81}$$

$$8576,57 = \frac{P_2}{11,8112} + 326,1977$$

$P_2 = -317,6212 \cdot 11,8112$

$P_2 = 97,45$ KPa

5,70.



Preço venda: 0,03 R\$/kwh noite

Preço compra: 0,08 R\$/kwh dia

$h = 40m$

$\dot{V} = 2m^3/s$

Perda de carga = 4m

$\eta = 75\%$

$T = 10h$

aplicando em Bernoulli

P/ bomba (por causa do nível)

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 + h_{bomba} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_L$$

$$z_1 + h_{bomba} = z_2 + h_L$$

$h_{bomba} = 40 + 4 = 44m$

P/ turbina temos o (trocamos os pontos)

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 + h_{bomba} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_{turb} + h_L \Rightarrow h_{turb} = z_1 - h_L$$

$h_{turb} = 40 - 4 = 36.$

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~~5,51~~ $\dot{W}_{bomb} = \frac{\rho \cdot \dot{V} \cdot g \cdot h}{\eta} = \frac{1000 \cdot 2 \cdot 9,81 \cdot 44}{0,75} = 1151,040 KW$

$\dot{W}_{turb} = E_{mec\,fluido} \cdot \eta = \dot{m} \cdot g h \cdot \eta = 1000 \cdot 2 \cdot 9,81 \cdot 36 = 530 KW$.

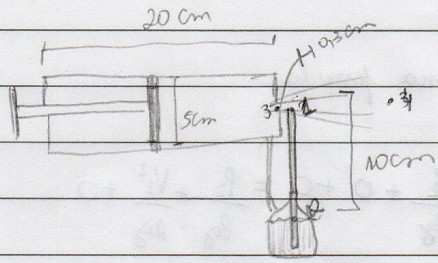
Custo Produção $\dot{W}_{bomb} \cdot \Delta t \cdot$ Preço unitário

$1151,04 \cdot 365 \cdot 10 \cdot 0,03 = 126.035^{R\$}/ano$.

ganho turbina = $\dot{W}_{turb} \cdot \Delta t \cdot$ Preço

$530 \cdot 365 \cdot 10 \cdot 0,08 = 154.760\ R\$/ano$

Receita = $154.760 - 126.035 \cong 28700 \cdot R\$/ano$.



5,51. T = 20°C

P = 95 kPa

$V_2 = ?$ $\quad \frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$

descobrindo ρ do ar — Considerando $P_3 = P_1$

$\rho_{ar} = \frac{P}{Rt} = \frac{95\ kPa}{0,287 \cdot 293} = 1,1297\ Kg/m^3$

P/a água $\quad \frac{P_1}{\rho g} + \frac{V_1^{\nearrow 0}}{2g} + Z_1^{\nearrow 0} = \frac{P_2^{=Patm}}{\rho g} + \frac{V_2^{\nearrow 0}}{2g} - h$

$\frac{P_1}{\rho g} = \frac{Patm}{\rho g} - h \Rightarrow P_1 - Patm = -\rho_{água} g h \quad (I)$

P/ar $\quad \frac{P_3}{\rho g} + \frac{V_3^2}{2g} + h_3^{\nearrow 0} = \frac{P_4}{\rho g} + \frac{V_4^{\nearrow 0}}{2g} + h_4^{\nearrow 0}$

$\frac{P_3}{\rho g} + \frac{V_3^2}{2g} = \frac{Patm}{\rho g} \Rightarrow V_3 = \sqrt{\frac{Patm - P_3}{\rho_{ar}} \cdot 2g}$ ($P_3 = P_1$)

Logo $V_3 = \sqrt{\frac{2 \cdot \rho_{água} \cdot h \cdot g}{\rho_{ar}}} = \sqrt{\frac{2 \cdot 1000 \cdot 9,81 \cdot 0,1}{1,1297}} = 41,6742.$

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$\dot{V}_{pintão} = \dot{V}_{puro}$

$V_{pintão} \cdot A_{pintão} = V_{puro} \cdot A_{puro}$

$V_{pintão} = \frac{V_{puro} \cdot A_{puro}}{A_{pintão}}$ $\quad V_p = V_L \cdot \frac{\frac{\pi \cdot D_f^2}{4}}{\frac{\pi \cdot D_p^2}{4}}$

Logo $V_p = V_L \cdot \frac{D_f^2}{D_f^2} \Rightarrow V_p = 4,6742 \cdot \frac{0,3^2}{5^2} = 0,15 m/s^2$