Ejercicio Concentradores

FEST - 2014

(a)

$T_{max} = 110\ ^\circ C$

$V_{max} = 10\ m/s$

$T_a = 15^\circ C$

$\rho_{air}\ (1\ atm) \simeq 1{,}217\ kg/m^3$

$\mu = 179 \cdot 10^{-7}\ N s/m^2$

$k = 25{,}3 \cdot 10^{-3}\ W/m\,K$

} Tablas

$Re = \frac{\rho v D}{\mu}$ → $Nu = 0{,}3\ Re^{0{,}6}$

$Re > 1000$

$h_w = \frac{Nu\ k}{D}$

$\pi D h_w = Nu\ k \pi < 10\ W/m^2 K$

$\pi\ 0{,}3\ Re^{0{,}6} \cdot k < 10\ W/m^2 K$

$0{,}3 \cdot \pi \left(\frac{\rho v}{\mu}\right)^{0{,}6} \cdot k\ D^{0{,}6} < 10\ W/m^2 K$

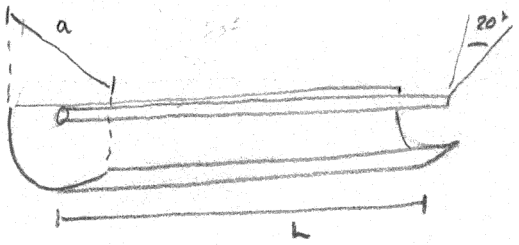
Verifico

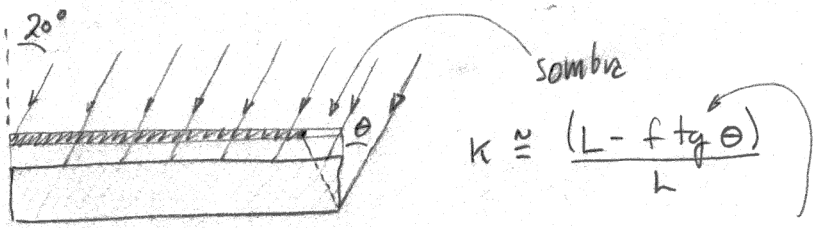
$Re = 2{,}38 \times 10^6 > 1000$ ✓

$D \leq \sqrt[0{,}6]{\frac{10\ W/m^2 K}{0{,}3\ \pi\ k} \left(\frac{\mu}{\rho v}\right)}$

$\boxed{D_{max} = 3{,}5\ cm}$

(b)





$K \cong \frac{(L - f\ tg\ \theta)}{L}$

longitud efectivamente iluminada

$G_T = 500\ W/m^2$

$S = G_T \cdot \rho \cdot \alpha \cdot \gamma\ K$

$100\ kW = S \cdot h_a = G_T\ \rho\ \alpha\ \gamma\ K\ h_a$

$\gamma = 1$

$100\ kW = G_T \rho \alpha \left(1 - \frac{f}{L} tg\ \theta\right) L\ a$

$\frac{100\ kW}{G_T \rho \alpha a} + f\ tg\ \theta = L$

$\boxed{L \cong 74{,}0\ m}$

Por otro lado,

$a = \frac{D \cdot \operatorname{sen} \Psi_r}{\operatorname{sen}(0{,}267 + 0{,}3)}$

$\boxed{a = 3{,}3\ m}$

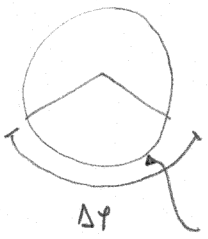
$r_r = \frac{2f}{1 + \cos \Psi_r}$

$\frac{a}{2 \operatorname{sen} \Psi_r} = \frac{2f}{1 + \cos \Psi_r}$

$f = \frac{a(1 + \cos \Psi_r)}{4 \operatorname{sen} \Psi_r}$ → $\boxed{f = 1{,}18\ m}$

$$C = \frac{a\,L}{\frac{D}{2}\cdot 2\pi r\,L} = \frac{a}{D\,\pi r} = \frac{3{,}3\ m}{0{,}035\cdot\left(70°\cdot\frac{\pi}{180}\right)} = 77$$

$$\boxed{C = 77}$$



$\Delta\varphi = 2\pi r$

área iluminada en el receptor $= R\cdot\Delta\varphi\cdot L =$

$= \frac{D}{2}\,2\pi r\,L$

(c) $Q_{útil} = Q_S - Q_L$

$$Q_L = \underbrace{\pi D L\, h_w (T_r - T_a)}_{\sim 70{,}3\ kW!} + \underbrace{\varepsilon \pi D L \sigma (T_r^4 - T_{sky}^4)}_{\sim 943\ W}$$

$$\boxed{Q_{útil} \cong 29\ kW}$$