

Problema 1:

$$D_{cond} = 42 \text{ plp}$$

$$L = 3 \text{ m}$$

$$N_t = 1200$$

$$D_o = 0,75 \text{ plp} = 0,019 \text{ m}$$

$$BWG 14$$

$$D_i = 0,0147 \text{ m}$$

$$\square$$

$$P_t = 1 \text{ plp}$$

$$B = 0,15 \text{ m}$$

$$R_{cond} = 0$$

$$h_o = 1250 \text{ W/(m}^2\text{K)}$$

meland (o) : CO_2

agua (i) : tubos

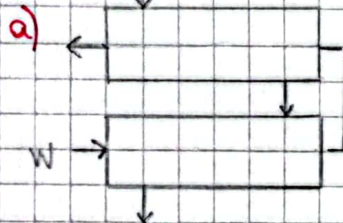
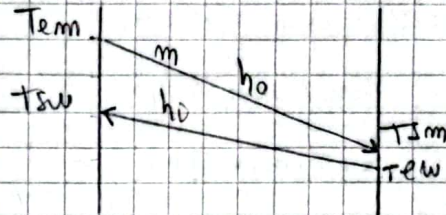
$$\dot{M}_m = 33 \text{ kg/s}$$

$$T_{em} = 65^\circ\text{C}$$

$$T_{sm} = 30^\circ\text{C}$$

$$T_{ew} = 25^\circ\text{C}$$

$$T_{sw} = 40^\circ\text{C}$$

 $\frac{\rho}{\mu} \frac{C_p}{k}$ tabla


es equivalente a tener 1 intercambiador más largo con 1 paso por los tubos

$$N = 1, L_t = 2L, N_t = 1200$$

$$(\text{con } F = 1 \text{ (1-1 contracorriente)})$$

$$A_{req} = \frac{\dot{Q}}{U_o \Delta T_{mL}} \rightarrow A_{req} = 708,51 \text{ m}^2$$

$$\dot{Q} = \dot{M}_m C_{p,m} (T_{em} - T_{sm}) = 2896,740 \text{ J/s}$$

$$\Delta T_{mL} = \frac{(T_{em} - T_{sw}) - (T_{sm} - T_{ew})}{\ln \left(\frac{T_{em} - T_{sw}}{T_{sm} - T_{ew}} \right)} = 12,43^\circ\text{C}$$

$$U_o (U_{puis}) = \left(\left(\frac{1}{h_i} + \frac{r_{fi}}{D_i} \right) \frac{D_o}{D_i} + \frac{1}{h_o} + r_{fo} \right)^{-1} = 329,01 \text{ W/(m}^2\text{K)}$$

$$r_{fi} (180 \text{ dias}) = 0,0001 \text{ m}^2\text{K/W}$$

$$r_{fo} (180 \text{ dias}) = 0,0003 \text{ m}^2\text{K/W}$$

$$h_i: A_t = \frac{\pi D_i^2 N_t}{4} = 0,204 \text{ m}^2$$

$$m_i = \dot{M}_w / A_t = 226,8 \text{ kg/(s m}^2\text{)}$$

$$Re_i = m_i D_i / \mu_w = 3333,9 \text{ (TRANSICIÓN)}$$

$$\dot{Q} = \dot{M}_w C_{p,w} (T_{sw} - T_{ew}) \rightarrow \dot{M}_w = 46,19 \text{ kg/s}$$

$$h_i = 0,116 C_{p,w} m_i \left[\frac{Re_i^{0,26} - 125}{Re_i} \right] \left[1 + \left(\frac{D_i}{L_t} \right)^{2/3} \right] Pr_i^{-2/3}$$

NOTA

$$Pr_i = \mu_w C_{p,w} / k_w = 8,198$$

$$h_i = 714,3 \text{ W/(m}^2\text{K)}$$

- $A_{dissp} = \pi D_o N_e L_e = 429,77 \text{ m}^2$

↳ NO SE CUMPLE EL REQUISITO.

b) • $C_w = \dot{M}_w C_{pw} = 193116$
 $C_m = \dot{M}_m C_{pm} = 82768$

$C^* = C_m / C_w = 0,429$

• $\Delta T_{max} = T_{em} - T_{ew}$

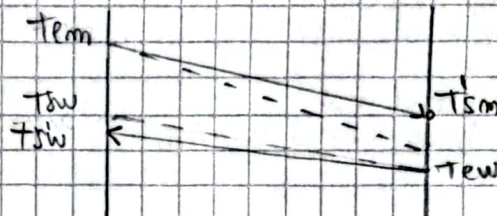
• $Q_{max} = C_m \Delta T_{max}$

• $NTU = \frac{UA}{C_m} = \frac{U_o A_{dissp}}{C_m} = 1,709$

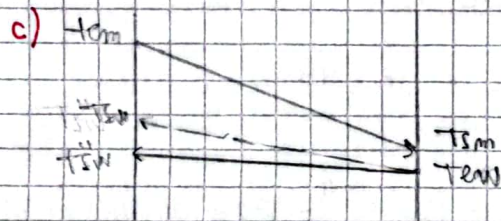
• $NTU \left\{ \begin{array}{l} \text{práctica} \end{array} \right. \Rightarrow \epsilon = 0,75$

• $Q = \epsilon Q_{max} = \dot{M}_m C_{pm} (T_{em} - T_{sm})$

$T_{sm} = 35^\circ \text{C}$



• \dot{M}_w no cambia
pero si T_{sw}



$Q = \dot{M}_m C_{pm} (T_{em} - T_{sm})$

$Q = \dot{M}_w C_{pw} (T_{sw}'' - T_{ew})$ ①

• $\Delta T_{lm} = \frac{(T_{em} - T_{sw}'') - (T_{sm} - T_{ew})}{\ln \left(\frac{T_{em} - T_{sw}''}{T_{sm} - T_{ew}} \right)}$ ②

• $\dot{m}_i'' = \dot{M}_w / a_i$

$Re_i = \dot{m}_i'' D_i / \mu_w =$

$h_i'' = 0,116 C_{pw} \dot{m}_i'' \left[\frac{Re_i^{0,66} - 125}{Re_i} \right] \left[\frac{1 + (D_i/L_e)^{2/3}}{L_e} \right] Re_i^{-2/3}$ ③ (TRANSICIÓN)

• $U_o'' = \left(\frac{1}{h_o} + r_{fo} + \left(\frac{1}{h_i''} + r_{fi} \right) \frac{D_o}{D_i} \right)^{-1}$ ④

• $Q = A_{dissp} U_o'' \Delta T_{lm}$

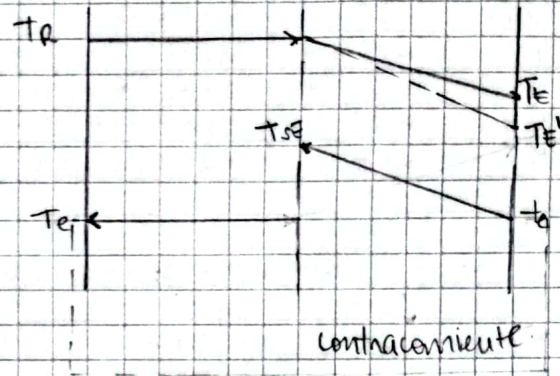
NOTA

✳ Continúa en la hoja 2

Problema 2:

$$\begin{aligned}
 T_R &= 700^\circ\text{C} \\
 T_E &= 500^\circ\text{C} \\
 T_E &= 212^\circ\text{C} \\
 T_{SE} &= 400^\circ\text{C} \\
 \%E &= 20\% \\
 SDE &= 20\%
 \end{aligned}
 \rightarrow \text{con } M_v = 10000 \text{ kg/h}$$

$$\begin{aligned}
 D_i &= 0,05 \text{ m} \\
 D_o &= 0,06 \text{ m} \\
 L &= 20 \text{ m} \\
 \lambda &= 50 \text{ Kcal/(h m } ^\circ\text{C)} \\
 h_o &= 40 \text{ Kcal/(h m}^2\text{ } ^\circ\text{C)} \\
 h_i &= 1000 \text{ Kcal/(h m}^2\text{ } ^\circ\text{C)} \\
 C_{pv} &= 0,57 \text{ Kcal/(kg } ^\circ\text{C)}
 \end{aligned}$$



$$SDE = \frac{A_{disp} - A_{req}}{A_{disp}}$$

Aug: con el caudal $M_v = 10000 \text{ kg/h}$
 A_{disp} : con el caudal M_{vmax}

$$A_{req} = \frac{Q_E}{U_o \Delta T_{mL}} \rightarrow A_{req} = 95,91 \text{ m}^2$$

$$Q_E = M_v C_{pv} (T_{SE} - t_e) = 1071600 \text{ Kcal/h}$$

$$U_o = \left(\frac{1}{h_i} + \frac{r_{fi}}{D_i} + \frac{D_o}{2\lambda} \ln \left(\frac{D_o}{D_i} \right) + \frac{1}{h_o} \right)^{-1} = 38 \text{ Kcal/(h m}^2\text{ } ^\circ\text{C)}$$

$$\Delta T_{mL} = \frac{(T_R - T_E) - (T_E' - t_e)}{\ln \left(\frac{T_R - T_E}{T_E' - t_e} \right)} = 29,4^\circ\text{C}$$

$$A_{disp} = A_{req} 10,8 = 119,89 \text{ m}^2$$

$$Q_{Emax} = A_{disp} U_o \Delta T_{mL} = M_{vmax} C_{pv} (T_{SE} - t_e)$$

$$\Delta T_{mL} = \frac{(T_R - T_{SE}) - (T_E' - t_e)}{\ln \left(\frac{T_R - T_{SE}}{T_E' - t_e} \right)}$$

Para calcular T_E' usará el gráfico

$$\eta = \epsilon_R + \epsilon_E + \frac{\%E}{100} + \epsilon_{ch} + \epsilon_p \rightarrow \epsilon_p + \epsilon_E = 0,575 \text{ (cte)}$$

$$T_R = 700^\circ\text{C} + \%E \rightarrow \epsilon_{ch} + \epsilon_E' = 0,425 = \epsilon_{ch} + \epsilon_E$$

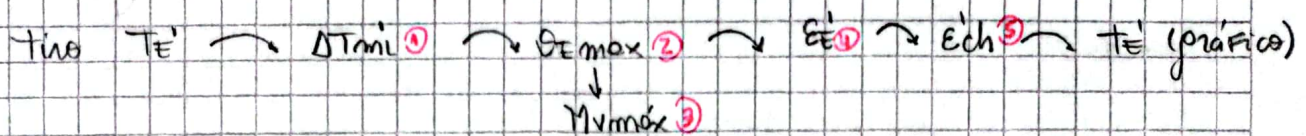
$$T_E = 500^\circ\text{C} + \%E \rightarrow \epsilon_{ch} + \frac{\%E}{100} = 0,23$$

NOTA

$$\epsilon_E = 0,195$$

✓ $Q_{generado} = Q_E / \epsilon_E = 5.495384,6 \text{ Kcal/h}$

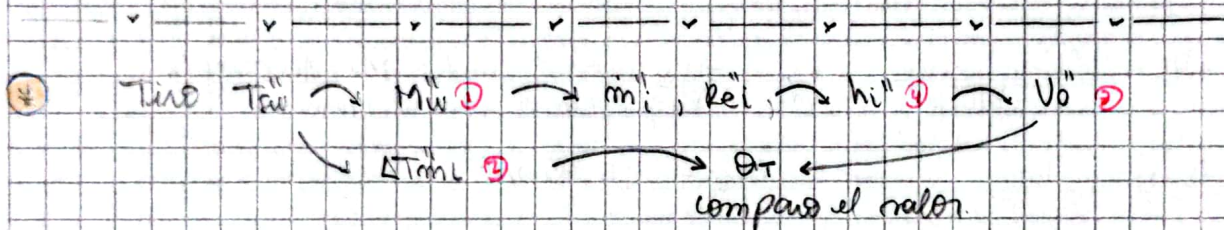
✓ $\epsilon_E = Q_{Emax} / Q_{generado}$ ①



T_E	ΔT_{mL}	Q_{Emax}	ϵ_E'	ϵ_{ch}	T_E'
500	294	1339500	0,214	0,181	400
400	239,7	1092044,4	0,199	0,226	480
480	283,7	1292748,13	0,235	0,190	440
440	262,4	1195489,5	0,218	0,207	450
450	267,8	1220321,46	0,222	0,203	450

$Q_{Emax} = M_{vmax} C_{pw} (T_{E'} - T_E)$

$M_{vmax} = 11387,8 \text{ kg/h}$



$\Rightarrow T_{sw}'' = 33,82^\circ\text{C}$

$\downarrow T_{sw}'' \quad \uparrow M_{w'}$

$M_{w'} = 78,55 \text{ kg/s}$

$Re_i'' = 5669,9$ ① ✓

NOTA