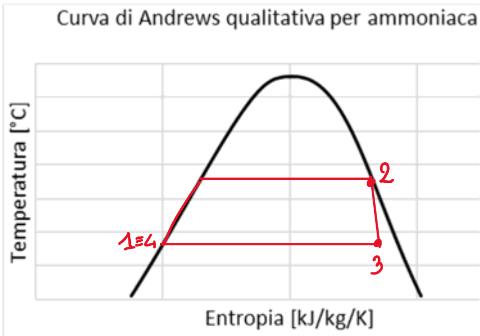
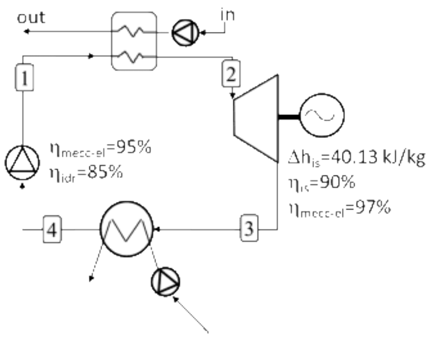
Ese1

mercoledì 17 marzo 2021 14:10

* ESE 1 *

* CICLO RANKINE SATURO (liq. incomprimibile)





* DIFFERENZA PRESSIONE A CAVALLO DELLA POMPA NH_3

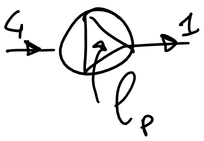
$$P_4 = P_{SAT}(T_4 = 10°C) = 6{,}15 \text{ bar}$$

$$P_2 = P_1 = P_{SAT}(T_2 = 22°C) = 9{,}13 \text{ bar}$$

da tabelle NH_3

$$\Delta P_{\substack{POMPA\\NH_3}} = P_1 - P_4 = 2{,}97 \text{ bar}$$

* h_1 ; $\dot{m}_{NH_3}$?

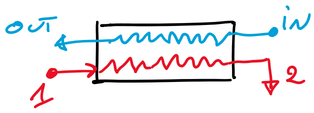


$$h_4 = h_{LS}(T_4 = 10°C) = 389{,}7 \text{ kJ/kg}$$

$$\Delta h_{ID} = \frac{\Delta P_{41}}{\rho} = 0{,}468 \text{ kJ/kg}$$ liq. incomprimibile

$$\Delta h_R = \frac{\Delta h_{ID}}{\eta_{IDR}} = 0{,}551 \text{ kJ/kg}$$

$$h_1 = h_4 + \Delta h_R = 390{,}27 \text{ kJ/kg}$$ (uscita pompa)



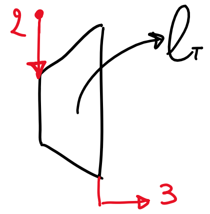
$$\dot{m}_3(h_2 - h_1) = \dot{m}_{IN}\, c_{p_{H_2O}} \overbrace{(T_{IN} - T_{OUT})}^{\text{dato}}$$

$$h_2 = h_{VS}(T = 22°C) = 1624{,}68 \frac{\text{kJ}}{\text{kg}}$$ (ciclo Rankine saturo)

$$\Downarrow$$

$$\Downarrow$$

$$\dot{m}_3 = \frac{\dot{m}_{in}\, c_{p,H_2O}\,(T_{in} - T_{out})}{(h_2 - h_1)} = 122,08\ \mathrm{kg/s}$$



$$h_{3,is} = h_2 - \Delta h_{is} = 1584,55\ \mathrm{kJ/kg}$$

$$\eta_{is} = \frac{\Delta h_r}{\Delta h_{is}} = \frac{h_2 - h_3}{h_2 - h_{3,is}} = 0,9$$

$$\Downarrow$$

$$h_3 = 1588,57\ \mathrm{kJ/kg}$$

$$h_3 = h_{LS}(T = 10°C) + (h_{VS} - h_{LS})\Big|_{T=10°C} X_3$$

$$\Downarrow$$

$$X_3 = 0,9782 \quad \text{(TITOLO SCARICO TURBINA)}$$

* POTENZA POMPE PRELIEVO H_2O MARE *

$$P_{\substack{POMPE\\H_2O}} = \left(\frac{\Delta P_{CALDA}}{\delta\, \eta_{IDR}} \cdot \dot{m}_{CALDA} + \frac{\Delta P_{FREDDA}}{\delta\, \eta_{IDR}} \cdot \dot{m}_{FREDDA} \right) \Big/ \eta_{MECC-EL} = 1555,8\ \mathrm{kW_e}$$

* POTENZA NETTA *

$$P_{NETTA} = \underbrace{\dot{m}_{NH_3}(h_2 - h_3)\,\eta_{\substack{MECC-EL\\TURB}}}_{P_{EL,TV} = 4276,9\ \mathrm{kW_e}} - \underbrace{\frac{\dot{m}_{NH_3}(h_1 - h_4)}{\eta_{\substack{MECC,EL\\POMPA}}}}_{P_{POMPA,NH_3} = 70,8\ \mathrm{kW_e}} - P_{\substack{POMPE\\H_2O}} = 2650,3\ \mathrm{kW}$$

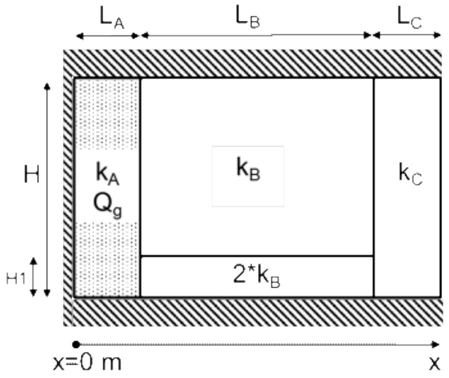
* IL RENDIMENTO IDEALE COINCIDE CON QUELLO DEL CICLO DI CARNOT OPERANTE TRA T_{CALDO} E T_{FREDDA}

$$\eta_{CARNOT} = 1 - \frac{T_{FREDDA}\,[K]}{T_{CALDA}\,[K]} = 0,08$$

Ese2

martedì 8 giugno 2021 14:16

ESE 2



$T_\infty = 25°C$

Aria in Quiete

(conv. Naturale)

* h_{conv}? Conv. Naturale

$$Nu = 0{,}59\, Ra^{0{,}25} = 0{,}59\,(Gr\, Pr)^{0{,}25} \quad \text{(convezione)}$$

$$Pr = \left.\frac{c_p\,\mu}{K}\right|_{aria} = 0{,}722 \qquad Gr = \frac{g\,\beta\,(T_{PARETE} - T_\infty)\,H^3}{\left(\frac{\mu}{\rho}\right)^2} = 3{,}02 \cdot 10^{10}$$

Assumendo Aria come Gas Perfetto $\longrightarrow$ $\beta_{aria} = \dfrac{1}{T_{FILM}} = \dfrac{1}{\frac{(T_{PARETE} + T_\infty)}{2}} = 0{,}00287 \dfrac{1}{K}$

$$\rho_{aria} = \frac{P}{R/MM \cdot T_{FILM}} = 1{,}0116\ kg/m^3$$

$$Nu = 0{,}59\,(Gr \cdot Pr)^{0{,}25} = \frac{h_{conv} \cdot L_C}{K} \Longrightarrow h_{conv} = 3{,}78\ W/m^2K$$

* q_{GEN} $[W/m^3]$? (generazione interna di potenza volumetrica)

$$\dot{Q}_{conv} = h_{conv}\, A_{scambio}\,(T_{PARETE} - T_\infty) = h_{conv}\, H \cdot Spess\,(T_{PARETE} - T_\infty) = 566{,}82\,W$$

$$\dot{Q}_{GEN} = \dot{Q}_{conv} \quad \text{(Stazionarietà)}$$

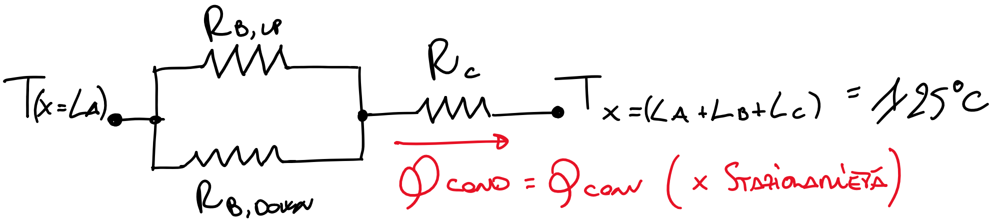
$$q_{GEN} = \frac{\dot{\Phi}_{GEN}}{V} = \frac{\dot{\Phi}_{GEN}}{L_A \cdot H \cdot S_{PESSORE}} = 755{,}8\ W/m^3$$

* Calcolo $T(x = L_A)$?

$$R_{B,UP} = \frac{L_B}{SPESS. \cdot K_B (H - H_1)} = 0{,}3077\ \frac{K}{W} \qquad R_{B,DOWN} = \frac{L_B}{2 K_B H_1 \cdot SPESS} = 1\ \frac{K}{W}$$

$$R_C = \frac{L_C}{K_C H \cdot SPESS} = 0{,}0067\ \frac{K}{W}$$

* Schema Resistenze *



$\dot{\Phi}_{COND} = \dot{\Phi}_{CONV}$ (x Stazionarietà)

$$T(x = L_A + L_B) = 125°C + R_C \cdot \dot{\Phi}_{COND} = 128{,}78\ °C$$

— Resistenze Parallelo $R_{B,UP}$; $R_{B,DOWN}$

$$R_B = \left(\frac{1}{R_{B,UP}} + \frac{1}{R_{B,DOWN}} \right)^{-1} = 0{,}2353\ K/W$$

$$T(x = L_A) = T(x = L_A + L_B) + R_B \cdot \dot{\Phi}_{COND} = 262{,}15\ °C$$