ESAME 10/07/2020

"SISTEMI ENERGETICI PER INGEGNERIA FISICA"

- CALCOLO h_1

ACQUA → LIQUIDO $\rho = cost = 994{,}7\ kg/m^3$

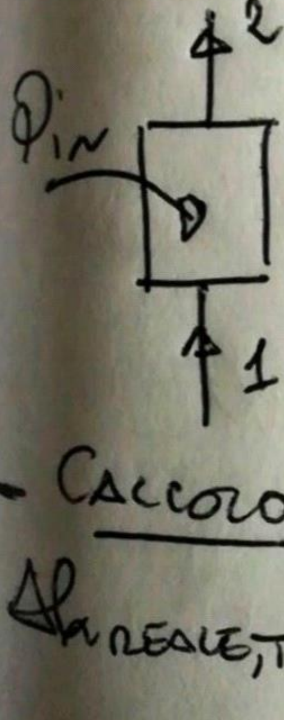
$$\Delta h_{IS,POMPA} = \frac{\Delta P}{\rho} = \frac{P_1 - P_2}{\rho} = 12{,}05\ \frac{kJ}{kg}$$

$$\Delta h_{REALE,POMPA} = \frac{\Delta h_{IS,POMPA}}{\eta_{ISP}} = 15{,}87\ \frac{kJ}{kg}$$

$$h_1 = h_4(LS, P = 0{,}05\ bar) + \Delta h_{REALE,POMPA} = 153{,}63\ \frac{kJ}{kg}$$

- CALCOLO $\dot{m}_1$

(BILANCIO CALDAIA)



$$\dot{Q}_{IN} = \dot{m}_1 (h_2 - h_1)$$

$$\Downarrow$$

$$\dot{m}_1 = 45{,}07\ kg/s$$

- CALCOLO P_{TV}; P_{POMPA}; P_{NETTA}; η_I

$$\Delta h_{REALE,TV} = \Delta h_{IS} \cdot \eta_{IS,TV} = 1264{,}09\ \frac{kJ}{kg}$$

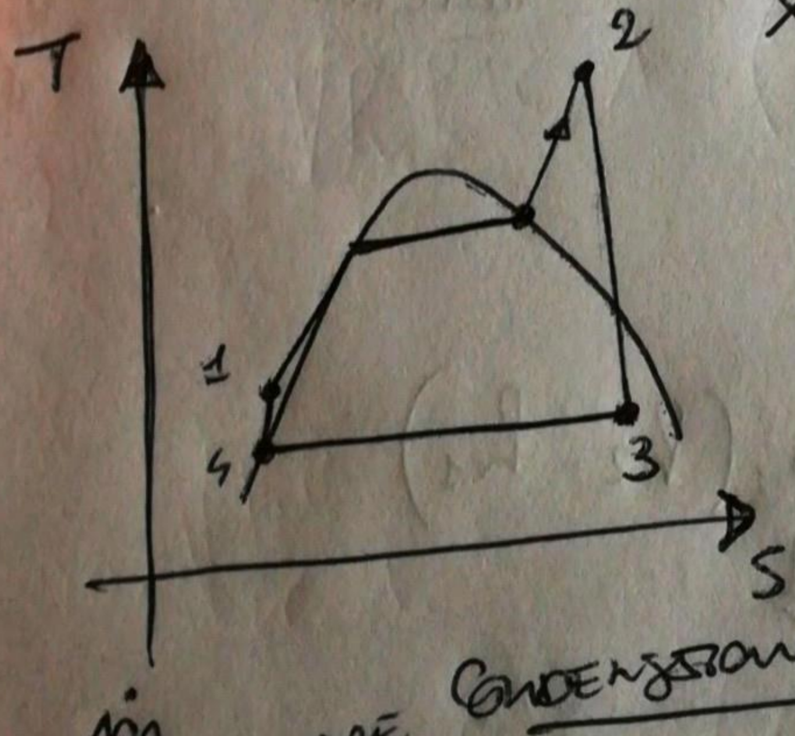
$$P_{TV} = \dot{m}_2 \, \Delta h_{REALE,TV} \cdot \eta_{EL} \, \eta_{ORG} = 55276,3 \, kW$$

$$P_{POMPA} = \dot{m}_1 \frac{\Delta h_{REALE,POMPA}}{\eta_{ORG,EL}} = 760,8 \, kW$$

$$P_{NETTA} = P_{TV} - P_{POMPA} = 54515,6 \, kW$$

$$\eta_I = \frac{P_{NETTA}}{\dot{Q}_{IN}} = 0,36344$$

- DIAGRAMMA T-S



$$X_3 = \frac{h_3 - h_{VLS}(@P_{MIN})}{\Delta h_{COND}(@P_{MIN})} = 0,8584$$ (3 → DENTRO LA CAMPANA)

- $\dot{m}_{H_2O,MARE}$ CONDENSAZIONE

$$\dot{Q}_{COND} = \dot{m}_3 (h_3 - h_4) = 93740 \, kW$$

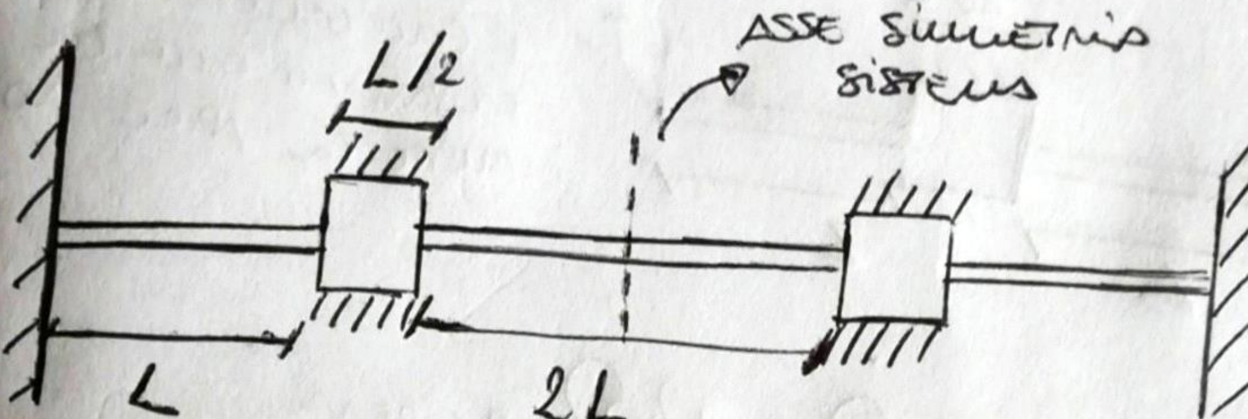
$$\dot{m}_{H_2O,MARE} = \frac{\dot{Q}_{COND}}{\Delta T_{H_2O} \cdot c_p} = 2231,9 \, kg/s$$

- MASSIMA POTENZA PRODUCIBILE A PARI $\dot{Q}_{IN}$ E T_{MAX}, T_{MIN}

$$\eta_{CARNOT} = 1 - \frac{T_{MIN}}{T_{MAX}} = 0,63$$

$$P_{MAX} = \dot{Q}_{IN} \cdot \eta_{CARNOT} = 94230\ kW$$

(2)



- CALCOLO POTENZA TOTALE SISTEMA

$$V_{CUBO} = \frac{L^3}{8} = 1,25 \cdot 10^{-7}\ m^3$$

$$\dot{Q}_{GEN,CUBO} = \dot{V}_{CUBO} \cdot q_{GEN} = 0,375\ W$$

$$\dot{Q}_{TOT,SYS} = 2 \cdot \dot{Q}_{GEN,CUBO} = 0,75\ W$$

- COEFF. SCAMBIO TERMICO CONVETTIVO CILINDRO

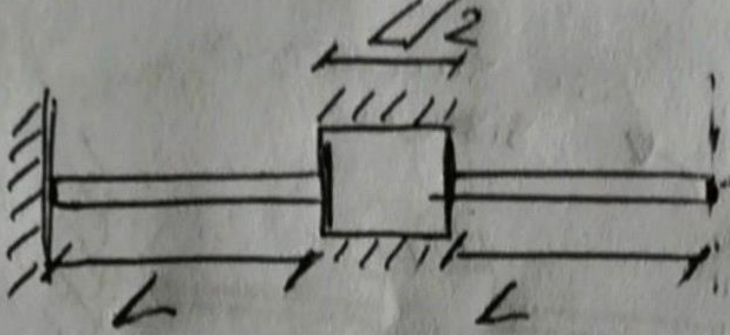
$$Pr = \frac{c_p \mu}{k} = 0,72 \quad Re = \frac{\rho v_\infty d}{\mu} = 632$$

$$Nu = a\, Re^b\, Pr^c = \frac{h_c d}{k} = 12,35$$

$$h_c = \frac{Nu\,K_{aria}}{d_c} = 159{,}8\ \frac{W}{m^2K}$$

— T SUP ESTERNA $T(\cancel{x=0}\ x=L) \neq T_b$

- IL PROBLEMA È SIMMETRICO



I COLLEGAMENTI SI COMPORTANO COME ALETTE CON APICE ADIAB.

$$\dot{Q}_{CUBO} = 2\dot{Q}_{COLL} + 2\dot{Q}_{SUP,LIBERA}$$

$$\dot{Q}_{COLL} = \sqrt{h_c P_c K_c A_c}\,(T_L - T_\infty)\tanh mL$$

SINGOLA ALETTA

$$A_c = \frac{\pi d_c^2}{4};\ P_c = \pi d_c$$

$$m = \sqrt{\frac{h_c P_c}{K_c A_c}} = 76{,}21\ \frac{1}{m}$$

$$\dot{Q}_{SUP,LIBERA} = h_{LIBERA}\left(\frac{L^2}{4} - A_c\right)(T_L - T_\infty)$$

$$\Downarrow$$

$$T_L = \frac{\dot{Q}_{CUBO}}{2} \Big/ \left[\sqrt{h_c P_c A_c K_c}\tanh mL + h_{LIB}\left(\frac{L^2}{4} - A_c\right)\right] + T_\infty = 45{,}6\,°C$$

- SE $K_{COLL} \to \infty$ (ALETTA ISOTERMA)

$$T_{(x=0)} = \left(\frac{\dot{Q}_{CAVO}}{2}\right) \Big/ \left(h_{COLL} \cdot \pi d_c L + h_{LIBERA} A_{LIBERA}\right) +$$

$$T_\infty = 42,53 °C$$