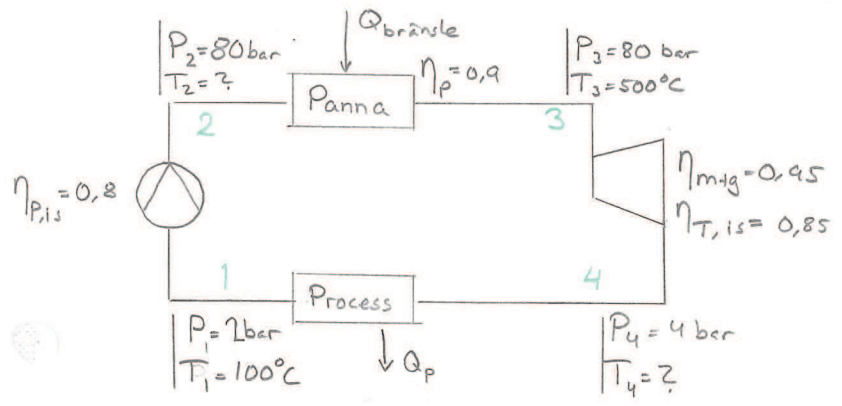


BE-2

En ångpanna producerar ånga som expanderar i en turbin.

Data: $P_a = 80 \text{ bar}$ $T_a = 500^\circ\text{C}$ $P_{mot} = 4 \text{ bar}$ $P_{kond} = 2 \text{ bar}$, $T_{kond} = 100^\circ\text{C}$

$\eta_{panna} = 0,9$, $\eta_{T, is} = 0,85$, $\eta_g = 0,95$, $\eta_{P, is} = 0,8$



Har tryck och temperatur i 3.

DoD $\Rightarrow h_3(80 \text{ bar}, 500^\circ\text{C}) = 3398 \text{ kJ/kg}$
 $s_3(80 \text{ bar}, 500^\circ\text{C}) = 6,723 \text{ kJ/kg}\cdot\text{K}$ $h_{4, is} = 2666 \text{ kJ/kg}$ (Molier)

$P_T = \eta_{m+g} \dot{m} (h_3 - h_4) =$
 $\left\{ \eta_{is} = \frac{h_3 - h_4}{h_3 - h_{4, is}} \Rightarrow h_4 = 2776 \text{ kJ/kg} \right\} = 0,95 \cdot \dot{m} (3398 - 2776) \text{ kW}$

Hävstångsregeln: $x = \frac{s' - s}{s'' - s} \Rightarrow s = x s'' + (1-x) s'$
 $s' = 1,7765 \text{ kJ/kg}\cdot\text{K}$, $s'' = 6,8965 \text{ kJ/kg}\cdot\text{K} \Rightarrow x = 0,966$
 $h_{4, is} = 2666 \text{ kJ/kg}$

$Q_p = \dot{m} (h_4 - h_1) = \left\{ \begin{aligned} h_1 &= h'_{100^\circ\text{C}} + v'_{100^\circ\text{C}} (P - P_{100^\circ\text{C}}) = 419 + 0,00104(2 - 1,013) = 419,21 \text{ kJ/kg} \\ &= \underline{2356,8 \text{ m kW}} \end{aligned} \right\}$

Pumparbete: $P_p = \dot{m} (h_2 - h_1)$ $\eta_{P, is} = \frac{h_{2, is} - h_1}{h_2 - h_1}$
 $h_{2, is} = h_1 + v'(P_2 - P_1)$ $v'(2 \text{ bar}) = 0,0010605 \text{ m}^3/\text{kg}$
 $v'(80 \text{ bar}) = 0,0013838 \text{ m}^3/\text{kg}$ $\left. \begin{aligned} & \\ & \end{aligned} \right\} \bar{v} = 0,001222 \text{ m}^3/\text{kg}$

$\Rightarrow h_{2, is} = 419,21 \text{ kJ/kg} + 0,001222 \text{ m}^3/\text{kg} (80 - 2) \cdot 10^5 \cdot 10^{-3} = 428,74 \text{ kJ/kg}$

$\Rightarrow h_2 = 431,13 \text{ kJ/kg} \Rightarrow P_p = 11,92 \text{ kJ/kg}$

$P_{el} = P_T - P_p = 579 \text{ m}$ $\eta_{el} = \frac{P_{el}}{Q_{bränst}}$ $Q_{bränst} = \frac{\dot{m} (h_3 - h_2)}{\eta_p} = 3296,5 \text{ m}$

$\Rightarrow \eta_{el} = \frac{579,08 \text{ m}}{3296,5 \text{ m}} = 0,176$

$\eta_{tot} = \frac{P_{el} + Q_p}{Q_{bränst}} = \frac{579 \text{ m} + 2356,8 \text{ m}}{3296,5 \text{ m}} = \boxed{0,891}$

$\alpha = \frac{P_{el}}{Q_p} = \frac{579 \text{ m}}{2356,8 \text{ m}} = \boxed{0,246}$