David Frisk

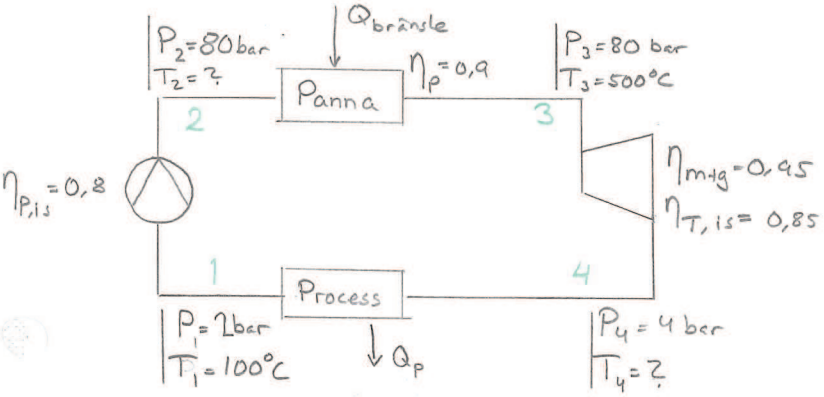
Demo 1

BE-2

En ångpanna producerar ånga som expanderar i en turbin.

Data: $P_{\ddot{a}} = 80$ bar $T_{\ddot{a}} = 500°C$ $P_{mot} = 4$ bar $P_{kond} = 2$bar, $T_{kond} = 100°C$

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



Har tryck och temperatur i 3.

DoD $\Rightarrow$ h_3 (80 bar, 500°C) = 3398 kJ/kg

s_3 = (80 bar, 500°C) = 6,723 kJ/kg·K $\quad h_{4,is} = 2666$ kJ/kg (Mollier)

$$P_T = \eta_{m+g}\,\dot{m}\,(h_3 - h_4) =$$

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

Hävstångsregeln: $x = \frac{s' - s}{s'' - s} \Rightarrow s = x s'' + (1-x)s'$

$s' = 1,7765$ kJ/kg·K, $s'' = 6,8965$ kJ/kg $\Rightarrow x = 0,966$

$h_{4,is} = 2666$ kJ/kg

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

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 bar) = 0,0010605 m³/kg

v' (80 bar) = 0,0013838 m³/kg

$\Rightarrow \bar{v}' = 0,001222$ m³/kg

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

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

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

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

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

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