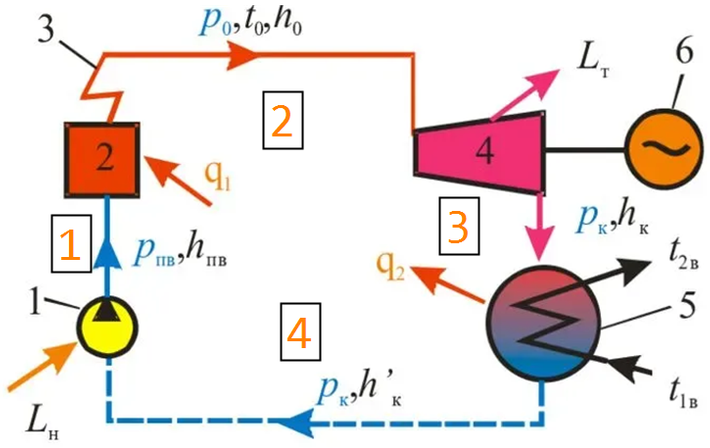


$T_2 := 560\ °C$ $\quad Q_4 := 0$

$P_2 := 13\ MPa$ $\quad \dot{m} := 300\ \frac{kg}{s}$

$P_4 := 5\ kPa$

$Fluid := "IF97::H2O"$

Ideal

State 2: Boiler exit

$h_2 := Prop("H", P_2, T_2)$ $\quad s_2 := Prop("S", P_2, T_2)$

State 4: Condenser exit

$h_4 := Prop("H", P_4, Q_4)$ $\quad s_4 := Prop("S", P_4, Q_4)$

$T_4 := Prop("T", P_4, Q_4)$

State 1: Pump exit

$P_1 := P_2$ $\quad s_1 := s_4$

$h_1 := Prop("H", P_1, s_1)$ $\quad T_1 := Prop("T", P_1, s_1)$

State 3: Turbine exit

$P_3 := P_4$ $\quad s_3 := s_2$

$h_3 := Prop("H", P_3, s_3)$ $\quad T_3 := Prop("T", P_3, s_3)$

$Q_3 := Prop("Q", P_3, h_3)$

States

State	T [°C]	P [kPa]	h [kJ/kg]	s [kJ/kg/K]	Q [%]
1	33.21	13000	150.78	0.48	0
2	560.02	13000	3497.53	6.64	0
3	32.9	5	2024.11	6.64	77.85
4	32.9	5	137.77	0.48	0

Energy balances

Pump $\quad \dot{W}_P := \dot{m} \cdot |h_1 - h_4| = 3.9044\ MW$

Turbine $\quad \dot{W}_T := \dot{m} \cdot |h_3 - h_2| = 442.0239\ MW$

Condenser $\quad \dot{Q}_C := \dot{m} \cdot |h_4 - h_3| = 565.9046\ MW$

Boiler $\quad \dot{Q}_B := \dot{m} \cdot |h_2 - h_1| = 1004.0241\ MW$

Efficiency

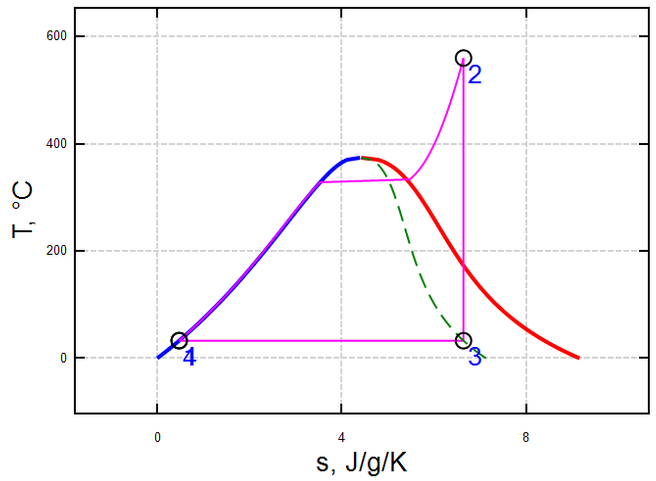
Rankine cycle $\quad \eta := \frac{\dot{W}_T - \dot{W}_P}{\dot{Q}_B} = 43.6364\ \%$

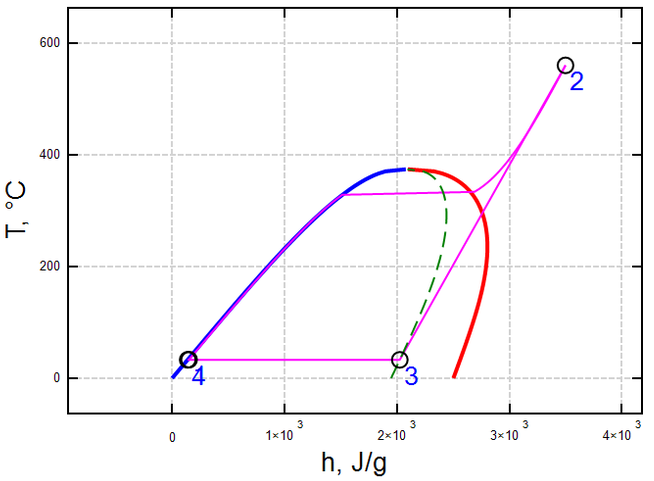
Max theoretical $\quad \eta_{max} := 1 - \frac{T_4}{T_2} = 63.2689\ \%$

Plots

Ranges $n := 100$ $T_{1\text{-}2} := pR\left(T_1, T_2, n\right)$

$T_{Tr\text{-}Cr} := pR\left(Prop\left("TTriple"\right), Prop\left("TCrit"\right) - 0.00001\ K, n\right)$



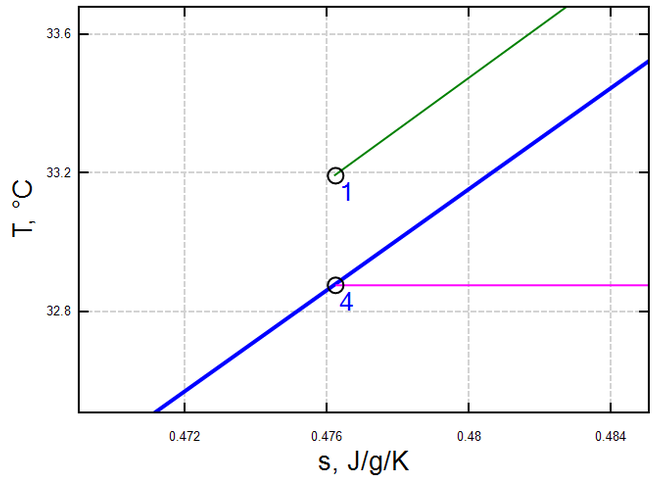


$sT := \left| \begin{array}{l} f(s, T) := augment\left(\frac{s}{\frac{kJ}{kg\ K}}, \frac{T}{K} - 273.15\right) \\ \left\{ \begin{array}{l} f\left(\overrightarrow{Prop\left("S", T_{Tr\text{-}Cr}, 0\right)}, T_{Tr\text{-}Cr}\right) \\ f\left(\overrightarrow{Prop\left("S", T_{Tr\text{-}Cr}, 1\right)}, T_{Tr\text{-}Cr}\right) \\ f\left(\overrightarrow{Prop\left("S", dummy := P_2, T_{1\text{-}2}\right)}, T_{1\text{-}2}\right) \\ f\left(s_{[2..4]}, T_{[2..4]}\right) \\ f\left(\overrightarrow{Prop\left("S", dummy := Q_3, T_{Tr\text{-}Cr}\right)}, T_{Tr\text{-}Cr}\right) \\ augment\left(f(s, T), "o"\right) \\ augment\left(f(s, T), \overrightarrow{num2str\left([1..4]\right)}\right) \end{array} \right. \end{array} \right.$

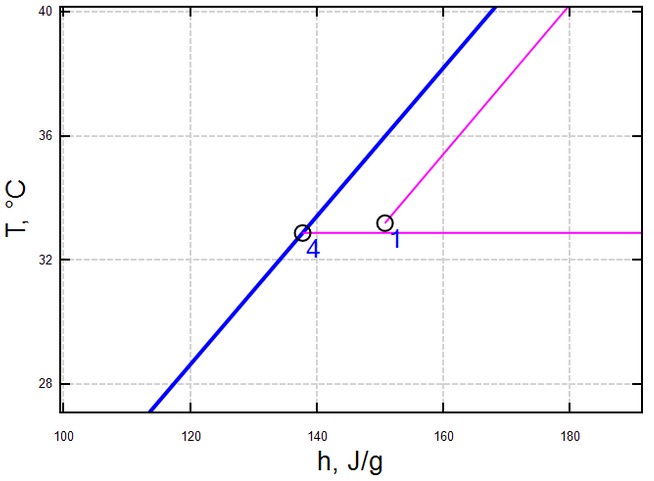
$hT := \left| \begin{array}{l} f(h, T) := augment\left(\frac{h}{\frac{kJ}{kg}}, \frac{T}{K} - 273.15\right) \\ \left\{ \begin{array}{l} f\left(\overrightarrow{Prop\left("H", T_{Tr\text{-}Cr}, 0\right)}, T_{Tr\text{-}Cr}\right) \\ f\left(\overrightarrow{Prop\left("H", T_{Tr\text{-}Cr}, 1\right)}, T_{Tr\text{-}Cr}\right) \\ f\left(\overrightarrow{Prop\left("H", dummy := P_2, T_{1\text{-}2}\right)}, T_{1\text{-}2}\right) \\ f\left(h_{[2..4]}, T_{[2..4]}\right) \\ f\left(\overrightarrow{Prop\left("H", dummy := Q_3, T_{Tr\text{-}Cr}\right)}, T_{Tr\text{-}Cr}\right) \\ augment\left(f(h, T), "o"\right) \\ augment\left(f(h, T), \overrightarrow{num2str\left([1..4]\right)}\right) \end{array} \right. \end{array} \right.$

Details

$Prop\left("Q", T_1, P_1, "WATER"\right) = -1$



sT



hT

Alvaro appVersion(4) = "1.0.8348.30405"