Software Information

General information

TESPy Version:	0.4.3-005 - Grassmann's Graph
CoolProp version:	6.4.1
Python version:	3.8.12
Documentation generated:	January 28, 2022

Parameter highlighting

Variable component parameters:	*italic*
Specified input parameter:	normalfont
Paremeter "input value":	Varying values depending on the parameter influence or optimization approach

1 Connections in design mode

1.1 Specified connection parameters

Table 1: Specified connection parameters

label	m in kg/s (1)	p in bar (2)	T in °C (3)	x in − (4)	Td_bp in °C (5)
1	-	-	input value	-	-
7	-	-	-	-	-2.0
12	-	-	-	0.50	-
10	-	-	-	0.50	-
20	-	0.6000	5.0	-	-
22	-	0.6000	-	-	-
30	20.000	-	140.0	1.00	-
32	180.000	-	140.0	0.00	-

1.2 Equations applied

$$0 = \dot{m} - \dot{m}_{\text{spec}} \tag{1}$$

$$0 = p - p_{\text{spec}} \tag{2}$$

$$0 = T\left(p, h\right) - T_{\text{spec}} \tag{3}$$

$$0 = h - h\left(p, x_{\text{spec}}\right) \tag{4}$$

$$0 = \Delta T_{\text{spec}} - T_{\text{sat}}\left(p\right) \tag{5}$$

1.3 Specified fluids

Table 2: Specified fluids

label	R245ca (6)	air (7)	water (8)
6	1.000	0.000	0.000
20	0.000	1.000	0.000
30	0.000	0.000	1.000
32	0.000	0.000	1.000

1.4 Equations applied

$$0 = x_{\text{R245ca}} - x_{\text{R245ca,spec}} \tag{6}$$

$$0 = x_{\text{air}} - x_{\text{air,spec}} \tag{7}$$

$$0 = x_{\text{water}} - x_{\text{water,spec}} \tag{8}$$

1.5 Referenced temperature

Table 3: Specified reference values for temperature

label	reference	factor in -	delta in °C
0	21	1	input value

1.6 Equation applied

$$0 = \text{value} - \text{value}_{\text{ref}} \cdot \text{factor} + \text{delta} \tag{9}$$

2 User defined equations in design mode

2.1 Equation for "ihe deshuperheat ratio"(10)

$$0 = h_3 - h_2 - x_{\text{IHE}} \cdot (h_3 - h\left(p_2, T_5 + \Delta T_{\text{t,u,min}}\right)) \tag{10}$$

3 Components in design mode

3.1 Components of type CycleCloser

3.1.1 Mandatory constraints

$$0 = p_{\text{in},i} - p_{\text{out},i} \; \forall i \in [1] \tag{11}$$

$$0 = h_{\text{in},i} - h_{\text{out},i} \; \forall i \in [1] \tag{12}$$

3.2 Components of type Turbine

3.2.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \; \forall i \in [1] \tag{13}$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1] \tag{14}$$

3.2.2 Inputs specified

Table 4: Parameters of components of type Turbine

label	eta_s (15)
turbine	0.90

3.2.3 Equations applied

$$0 = -\left(h_{\text{out}} - h_{\text{in}}\right) + \left(h_{\text{out,s}} - h_{\text{in}}\right) \cdot \eta_{\text{s}} \tag{15}$$

3.3 Components of type HeatExchanger

3.3.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i} \; \forall i \in [1, 2] \tag{16}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1, 2] \tag{17}$$

$$0 = \dot{m}_{\mathrm{in},1} \cdot (h_{\mathrm{out},1} - h_{\mathrm{in},1}) + \dot{m}_{\mathrm{in},2} \cdot (h_{\mathrm{out},2} - h_{\mathrm{in},2}) \tag{18}$$

3.3.2 Inputs specified

Table 5: Parameters of components of type HeatExchanger

label	ttd_l (19)	pr1 (20)	pr2 (21)
internal heat exchanger	-	0.98	0.98
preheater	-	0.98	0.98
geobrine evaporator	8.00	0.98	-

3.3.3 Equations applied

$$0 = ttd_{\mathrm{l}} - T_{\mathrm{out},1} + T_{\mathrm{in},2} \tag{19}$$

$$0 = p_{\mathrm{in},1} \cdot pr1 - p_{\mathrm{out},1} \tag{20}$$

$$0 = p_{\mathrm{in},2} \cdot pr2 - p_{\mathrm{out},2} \tag{21}$$

3.4 Components of type Condenser

3.4.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i} \; \forall i \in [1, 2] \tag{22}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1, 2] \tag{23}$$

$$0 = \dot{m}_{\mathrm{in},1} \cdot (h_{\mathrm{out},1} - h_{\mathrm{in},1}) + \dot{m}_{\mathrm{in},2} \cdot (h_{\mathrm{out},2} - h_{\mathrm{in},2}) \tag{24}$$

3.4.2 Inputs specified

Table 6: Parameters of components of type Condenser

label	ttd_u (25)	pr1 (26)	pr2 (27)
condenser	10.00	1.00	0.99
geosteam evaporator	-	-	-

3.4.3 Equations applied

$$0 = ttd_{\mathrm{u}} - T_{\mathrm{sat}}\left(p_{\mathrm{in},1}\right) + T_{\mathrm{out},2} \tag{25}$$

$$0 = p_{\mathrm{in},1} \cdot pr1 - p_{\mathrm{out},1} \tag{26}$$

$$0 = p_{\mathrm{in},2} \cdot pr2 - p_{\mathrm{out},2} \tag{27}$$

3.5 Components of type Pump

3.5.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \; \forall i \in [1] \tag{28}$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1] \tag{29}$$

3.5.2 Inputs specified

Table 7: Parameters of components of type Pump

	eta_s (30)
label	
feed pump	0.75

3.5.3 Equations applied

$$0 = -\left(h_{\text{out}} - h_{\text{in}}\right) \cdot \eta_{\text{s}} + \left(h_{\text{out,s}} - h_{\text{in}}\right) \tag{30}$$

3.6 Components of type Drum

3.6.1 Mandatory constraints

$$0 = \sum \dot{m}_{\text{in},i} - \sum \dot{m}_{\text{out},j} \; \forall i \in \text{inlets}, \forall j \in \text{outlets} \tag{31}$$

$$0 = x_{fl,\text{in},1} - x_{fl,\text{out},j} \; \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \tag{32}$$

$$0 = \sum_i \left(\dot{m}_{\text{in},i} \cdot h_{\text{in},i}\right) - \sum_j \left(\dot{m}_{\text{out},j} \cdot h_{\text{out},j}\right) \; \forall i \in \text{inlets} \; \forall j \in \text{outlets} \tag{33}$$

$$\begin{aligned} 0 &= p_{\text{in},1} - p_{\text{in},i} \; \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{\text{in},1} - p_{\text{out},j} \; \forall j \in \text{outlets} \end{aligned} \tag{34}$$

$$\begin{aligned} 0 &= h_{\text{out},1} - h\left(p_{\text{out},1}, x = 0\right) \\ 0 &= h_{\text{out},2} - h\left(p_{\text{out},2}, x = 1\right) \end{aligned} \tag{35}$$

3.7 Components of type Splitter

3.7.1 Mandatory constraints

$$0 = \sum \dot{m}_{\text{in},i} - \sum \dot{m}_{\text{out},j} \; \forall i \in \text{inlets}, \forall j \in \text{outlets} \tag{36}$$

$$0 = x_{fl,\text{in}} - x_{fl,\text{out},j} \; \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \tag{37}$$

$$0 = h_{in} - h_{\text{out},j} \; \forall j \in \text{outlets} \tag{38}$$

$$\begin{aligned} 0 &= p_{\text{in},1} - p_{\text{in},i} \; \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{\text{in},1} - p_{\text{out},j} \; \forall j \in \text{outlets} \end{aligned} \tag{39}$$

3.8 Components of type Merge

3.8.1 Mandatory constraints

$$0 = \sum \dot{m}_{\text{in},i} - \sum \dot{m}_{\text{out},j} \; \forall i \in \text{inlets}, \forall j \in \text{outlets} \tag{40}$$

$$0 = \sum_i \dot{m}_{\text{in},i} \cdot x_{fl,\text{in},i} - \dot{m}_{\text{out}} \cdot x_{fl,\text{out}} \; \forall fl \in \text{network fluids}, \forall i \in \text{inlets} \tag{41}$$

$$0 = \sum_i \left(\dot{m}_{\text{in},i} \cdot h_{\text{in},i}\right) - \dot{m}_{\text{out}} \cdot h_{\text{out}} \; \forall i \in \text{inlets} \tag{42}$$

$$\begin{aligned} 0 &= p_{\text{in},1} - p_{\text{in},i} \; \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{\text{in},1} - p_{\text{out},j} \; \forall j \in \text{outlets} \end{aligned} \tag{43}$$

3.9 Components of type Compressor

3.9.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \; \forall i \in [1] \tag{44}$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1] \tag{45}$$

3.9.2 Inputs specified

Table 8: Parameters of components of type Compressor

label	eta_s (46)
air fan	0.60

3.9.3 Equations applied

$$0 = -\left(h_{\text{out}} - h_{\text{in}}\right) \cdot \eta_{\text{s}} + \left(h_{\text{out,s}} - h_{\text{in}}\right) \tag{46}$$

4 Busses in design mode

4.1 Bus “net power output”

This bus is used for postprocessing only.

Table 9: Results overview for bus net power output

label	$\dot{E}_{\text{comp}}$	$\dot{E}_{\text{bus}}$	η
turbine	$\dot{m}_{\text{in}} \cdot \left(h_{\text{out}} - h_{\text{in}}\right)$	$\dot{E}_{\text{comp}} \cdot \eta$	0.97
feed pump	$\dot{m}_{\text{in}} \cdot \left(h_{\text{out}} - h_{\text{in}}\right)$	$\frac{\dot{E}_{\text{comp}}}{\eta}$	0.97
air fan	$\dot{m}_{\text{in}} \cdot \left(h_{\text{out}} - h_{\text{in}}\right)$	$\frac{\dot{E}_{\text{comp}}}{\eta}$	0.97

4.2 Bus “cycle gross power output”

This bus is used for postprocessing only.

Table 10: Results overview for bus cycle gross power output

label	$\dot{E}_{\mathrm{comp}}$	$\dot{E}_{\mathrm{bus}}$	η
turbine	$\dot{m}_{\mathrm{in}} \cdot (h_{\mathrm{out}} - h_{\mathrm{in}})$	$\dot{E}_{\mathrm{comp}} \cdot \eta$	1.00
feed pump	$\dot{m}_{\mathrm{in}} \cdot (h_{\mathrm{out}} - h_{\mathrm{in}})$	$\dot{E}_{\mathrm{comp}} \cdot \eta$	1.00

4.3 Bus “thermal input”

This bus is used for postprocessing only.

Table 11: Results overview for bus thermal input

label	$\dot{E}_{\mathrm{comp}}$	$\dot{E}_{\mathrm{bus}}$	η
preheater	$\dot{m}_{\mathrm{in},1} \cdot (h_{\mathrm{out},1} - h_{\mathrm{in},1})$	$\dot{E}_{\mathrm{comp}} \cdot \eta$	-1.00
geobrine evaporator	$\dot{m}_{\mathrm{in},1} \cdot (h_{\mathrm{out},1} - h_{\mathrm{in},1})$	$\dot{E}_{\mathrm{comp}} \cdot \eta$	-1.00
geosteam evaporator	$\dot{m}_{\mathrm{in},1} \cdot (h_{\mathrm{out},1} - h_{\mathrm{in},1})$	$\dot{E}_{\mathrm{comp}} \cdot \eta$	-1.00