Software Information

- Please check, whether your inputs, the equations applied and the charactersitics are displayed correctly.
- You are welcome to send your feedback via `https://github.com/oemof/tespy/issues`.
- LaTeXpackages required are:
  - graphicx
  - float
  - hyperref
  - booktabs
  - amsmath
  - units
  - cleveref
- To supress these messages, call the model documentation with the keyword draft=False.

TESPy Version:	0.4.3 - dev
Commit:	788ddfdc@dev
CoolProp version:	6.4.0
Python version:	3.7.6 (default, Jan 8 2020, 20:23:39) [MSC v.1916 64 bit (AMD64)]

1 Connections in offdesign mode

1.1 Specified connection parameters

label	p in bar (1)	T in °C (2)	v in $^{m3}/_{s}$ (3)
consumer back flow:out1_district heating pump:in1	10.000	50.000	-
condenser:out2_consumer:in1	-	90.000	-
ambient air:out1_pump:in1	1.000	8.000	5.577
splitter:out1_superheater:in1	-	-	3.520
evaporator:out1_sink ambient 1:in1	1.000	-	-

Table 1: Specified connection parameters

1.2 Equations applied

$$0 = p - p_{\mathrm{spec}} \tag{1}$$

$$0 = T\left(p, h\right) - T_{\mathrm{spec}} \tag{2}$$

$$0 = \dot{m} \cdot v\left(p, h\right) - \dot{V}_{\mathrm{spec}} \tag{3}$$

1.3 Specified fluids

label	NH3 (4)	air (5)	water (6)
coolant cycle closer:out1_condenser:in1	1.000	0.000	0.000
consumer back flow:out1_district heating pump:in1	0.000	0.000	1.000
ambient air:out1_pump:in1	0.000	0.000	1.000

Table 2: Specified fluids

1.4 Equations applied

$$0 = x_{\mathrm{NH3}} - x_{\mathrm{NH3,spec}} \tag{4}$$

$$0 = x_{\mathrm{air}} - x_{\mathrm{air,spec}} \tag{5}$$

$$0 = x_{\mathrm{water}} - x_{\mathrm{water,spec}} \tag{6}$$

1.5 Referenced values for mass flow

label	reference	factor in -	delta in $^{kg}/_{s}$
evaporator reciculation pump:out1_evaporator:in2	valve:out1_drum:in1	1.250	0

Table 3: Referenced values for mass flow

1.6 Equation applied

$$0 = \text{value} - \text{value}_{\text{ref}} \cdot \text{factor} + \text{delta} \tag{7}$$

1.7 Referenced values for pressure

label	reference	factor in -	delta in bar
consumer:out1_consumer feed flow:in1	consumer back flow:out1_district heating pump:in1	1	0

Table 4: Referenced values for pressure

1.8 Equation applied

$$0 = \text{value} - \text{value}_{\text{ref}} \cdot \text{factor} + \text{delta} \tag{8}$$

1.9 Referenced values for enthalpy

label	reference	factor in -	delta in $^{\text{kJ}}/_{\text{kg}}$
consumer:out1_consumer feed flow:in1	consumer back flow:out1_district heating pump:in1	1	0

Table 5: Referenced values for enthalpy

1.10 Equation applied

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

2 User defined equations in offdesign mode

3 Components in offdesign mode

3.1 Components of type CycleCloser

3.1.1 Mandatory constraints

$$0 = p_{\text{in},i} - p_{\text{out},i} \; \forall i \in [1] \tag{10}$$

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

3.2 Components of type Condenser

3.2.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \; \forall i \in [1, 2] \tag{12}$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1, 2] \tag{13}$$

$$0 = \dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1}) + \dot{m}_{\text{in},2} \cdot (h_{\text{out},2} - h_{\text{in},2}) \tag{14}$$

3.2.2 Inputs specified

label	pr1 (15)	zeta2 (16)	kA_char (17)	subcooling (18)
condenser	0.990	61.371	True	True

Table 6: Parameters of components of type Condenser

3.2.3 Equations applied

$$0 = p_{\mathrm{in},1} \cdot pr1 - p_{\mathrm{out},1} \tag{15}$$

$$0 = \begin{cases} p_{\mathrm{in},2} - p_{\mathrm{out},2} & |\dot{m}_{\mathrm{in},2}| < 0.0001\,\mathrm{kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\mathrm{in},2} - p_{\mathrm{out},2}) \cdot \pi^2}{8 \cdot \dot{m}_{\mathrm{in},2} \cdot |\dot{m}_{\mathrm{in},2}| \cdot \frac{v_{\mathrm{in},2} + v_{\mathrm{out},2}}{2}} & |\dot{m}_{\mathrm{in},2}| \geq 0.0001\,\mathrm{kg/s} \end{cases} \tag{16}$$

$$\begin{split} 0 =& \dot{m}_{\mathrm{in},1} \cdot \left(h_{\mathrm{out},1} - h_{\mathrm{in},1}\right) \\ & + kA_{\mathrm{design}} \cdot f_{\mathrm{kA}} \cdot \frac{T_{\mathrm{out},1} - T_{\mathrm{in},2} - T_{\mathrm{sat}}\left(p_{\mathrm{in},1}\right) + T_{\mathrm{out},2}}{\ln \frac{T_{\mathrm{out},1} - T_{\mathrm{in},2}}{T_{\mathrm{sat}}\left(p_{\mathrm{in},1}\right) - T_{\mathrm{out},2}}} \\ f_{\mathrm{kA}} =& \frac{2}{\frac{1}{f(X_2)} + \frac{1}{f(X_2)}} \end{split} \tag{17}$$

$$0 = h_{\mathrm{out},1} - h\left(p_{\mathrm{out},1}, x = 0\right) \tag{18}$$

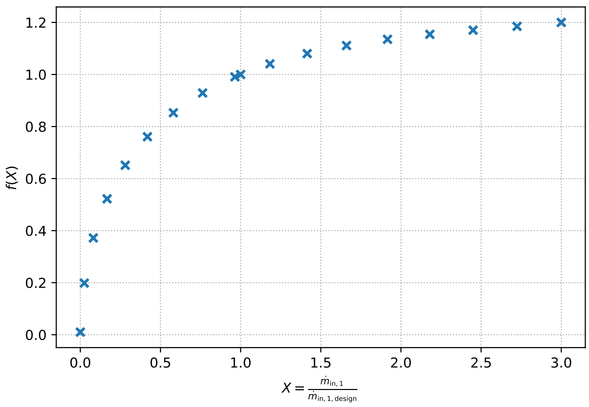

Figure 1: Characteristics of condenser (eq. 17)

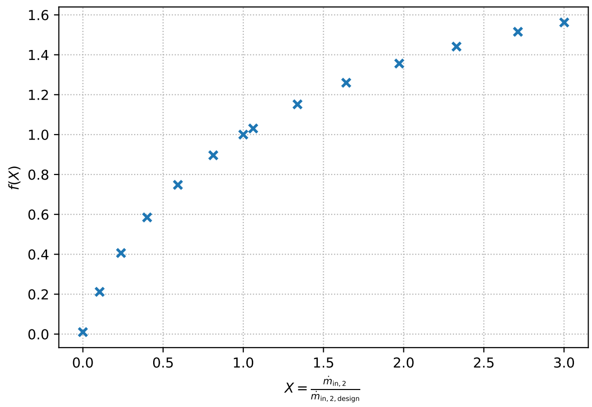

Figure 2: Characteristics of condenser (eq. 17)

3.3 Components of type Pump

3.3.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i} \; \forall i \in [1] \tag{19}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1] \tag{20}$$

3.3.2 Inputs specified

label	eta_s_char (21)
district heating pump	True
evaporator reciculation pump	True
pump	True

Table 7: Parameters of components of type Pump

3.3.3 Equations applied

$$0 = (h_{\text{out}} - h_{\text{in}}) \cdot \eta_{\text{s,design}} \cdot f(X) - (h_{out,s} - h_{in}) \tag{21}$$

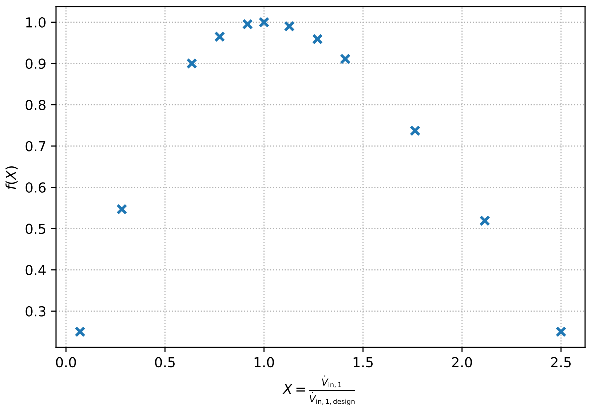

Figure 3: Characteristics of district heating pump (eq. 21)

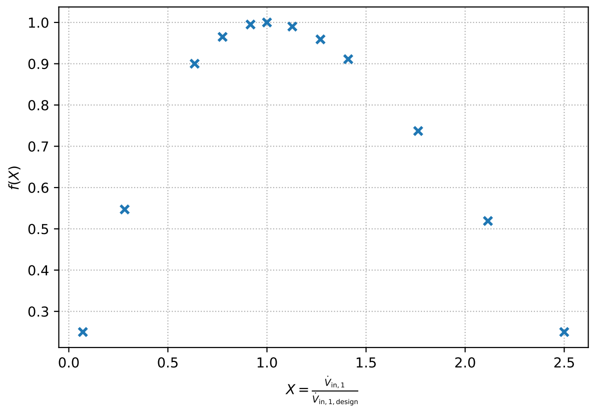

Figure 4: Characteristics of evaporator reciculation pump (eq. 21)

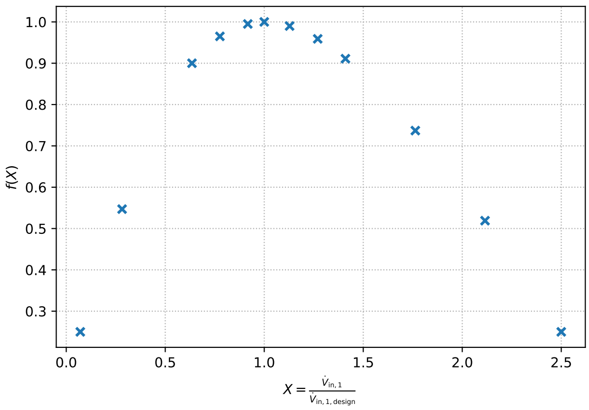

Figure 5: Characteristics of pump (eq. 21)

3.4 Components of type HeatExchangerSimple

3.4.1 Mandatory constraints

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

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

3.4.2 Inputs specified

label	zeta (24)
consumer	60.757

Table 8: Parameters of components of type HeatExchangerSimple

3.4.3 Equations applied

$$0 = \begin{cases} p_{\mathrm{in},1} - p_{\mathrm{out},1} & |\dot{m}_{\mathrm{in},1}| < 0.0001\,\mathrm{kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\mathrm{in},1} - p_{\mathrm{out},1}) \cdot \pi^2}{8 \cdot \dot{m}_{\mathrm{in},1} \cdot |\dot{m}_{\mathrm{in},1}| \cdot \frac{v_{\mathrm{in},1} + v_{\mathrm{out},1}}{2}} & |\dot{m}_{\mathrm{in},1}| \geq 0.0001\,\mathrm{kg/s} \end{cases} \tag{24}$$

3.5 Components of type Valve

3.5.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i}\ \forall i \in [1] \tag{25}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i}\ \forall fl \in \text{network fluids},\ \forall i \in [1] \tag{26}$$

$$0 = h_{\mathrm{in},i} - h_{\mathrm{out},i}\ \forall i \in [1] \tag{27}$$

3.6 Components of type Drum

3.6.1 Mandatory constraints

$$0 = \sum \dot{m}_{\mathrm{in},i} - \sum \dot{m}_{\mathrm{out},j}\ \forall i \in \text{inlets}, \forall j \in \text{outlets} \tag{28}$$

$$0 = x_{fl,\mathrm{in},1} - x_{fl,\mathrm{out},j}\ \forall fl \in \text{network fluids},\ \forall j \in \text{outlets} \tag{29}$$

$$0 = \sum_i \left(\dot{m}_{\mathrm{in},i} \cdot h_{\mathrm{in},i}\right) - \sum_j \left(\dot{m}_{\mathrm{out},j} \cdot h_{\mathrm{out},j}\right)\ \forall i \in \text{inlets}\ \forall j \in \text{outlets} \tag{30}$$

$$\begin{aligned} 0 = p_{\mathrm{in},1} - p_{\mathrm{in},i}\ \forall i \in \text{inlets} \setminus \{1\} \\ 0 = p_{\mathrm{in},1} - p_{\mathrm{out},j}\ \forall j \in \text{outlets} \end{aligned} \tag{31}$$

$$\begin{aligned} 0 =& h_{\mathrm{out},1} - h\left(p_{\mathrm{out},1}, x = 0\right) \\ 0 =& h_{\mathrm{out},2} - h\left(p_{\mathrm{out},2}, x = 1\right) \end{aligned} \tag{32}$$

3.7 Components of type HeatExchanger

3.7.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i}\ \forall i \in [1,2] \tag{33}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i}\ \forall fl \in \text{network fluids},\ \forall i \in [1,2] \tag{34}$$

$$0 = \dot{m}_{\mathrm{in},1} \cdot \left(h_{\mathrm{out},1} - h_{\mathrm{in},1}\right) + \dot{m}_{\mathrm{in},2} \cdot \left(h_{\mathrm{out},2} - h_{\mathrm{in},2}\right) \tag{35}$$

3.7.2 Inputs specified

label	kA (36)	pr2 (37)	zeta1 (38)	zeta2 (39)	kA_char (40)
evaporator	-	0.990	0.203	-	True
superheater	303554.478	-	0.207	2.988	-
intercooler	-	-	50.415	0.607	True

Table 9: Parameters of components of type HeatExchanger

3.7.3 Equations applied

$$0 = \dot{m}_{\mathrm{in},1} \cdot \left(h_{\mathrm{out},1} - h_{\mathrm{in},1}\right) + kA \cdot \frac{T_{\mathrm{out},1} - T_{\mathrm{in},2} - T_{\mathrm{in},1} + T_{\mathrm{out},2}}{\ln \frac{T_{\mathrm{out},1} - T_{\mathrm{in},2}}{T_{\mathrm{in},1} - T_{\mathrm{out},2}}} \tag{36}$$

$$0 = p_{\mathrm{in},2} \cdot pr2 - p_{\mathrm{out},2} \tag{37}$$

$$0 = \begin{cases} p_{\mathrm{in},1} - p_{\mathrm{out},1} & |\dot{m}_{\mathrm{in},1}| < 0.0001\,\mathrm{kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\mathrm{in},1} - p_{\mathrm{out},1}) \cdot \pi^2}{8 \cdot \dot{m}_{\mathrm{in},1} \cdot |\dot{m}_{\mathrm{in},1}| \cdot \frac{v_{\mathrm{in},1} + v_{\mathrm{out},1}}{2}} & |\dot{m}_{\mathrm{in},1}| \geq 0.0001\,\mathrm{kg/s} \end{cases} \tag{38}$$

$$0 = \begin{cases} p_{\mathrm{in},2} - p_{\mathrm{out},2} & |\dot{m}_{\mathrm{in},2}| < 0.0001\,\mathrm{kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\mathrm{in},2} - p_{\mathrm{out},2}) \cdot \pi^2}{8 \cdot \dot{m}_{\mathrm{in},2} \cdot |\dot{m}_{\mathrm{in},2}| \cdot \frac{v_{\mathrm{in},2} + v_{\mathrm{out},2}}{2}} & |\dot{m}_{\mathrm{in},2}| \geq 0.0001\,\mathrm{kg/s} \end{cases} \tag{39}$$

$$\begin{aligned} 0 =& \dot{m}_{\mathrm{in},1} \cdot \left(h_{\mathrm{out},1} - h_{\mathrm{in},1}\right) \\ &+ kA_{\mathrm{design}} \cdot f_{\mathrm{kA}} \cdot \frac{T_{\mathrm{out},1} - T_{\mathrm{in},2} - T_{\mathrm{in},1} + T_{\mathrm{out},2}}{\ln \frac{T_{\mathrm{out},1} - T_{\mathrm{in},2}}{T_{\mathrm{in},1} - T_{\mathrm{out},2}}} \\ f_{\mathrm{kA}} =& \frac{2}{\frac{1}{f(X_1)} + \frac{1}{f(X_2)}} \end{aligned} \tag{40}$$

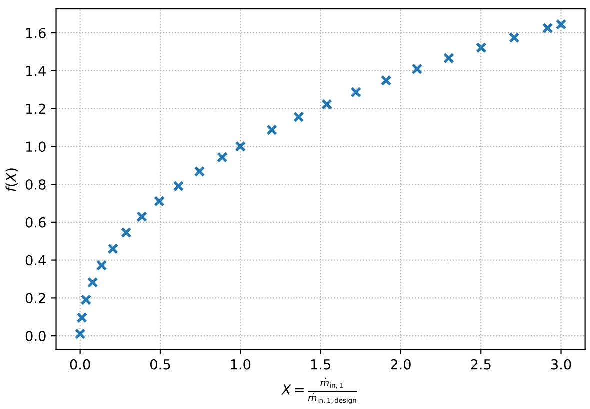

Figure 6: Characteristics of evaporator (eq. 40)

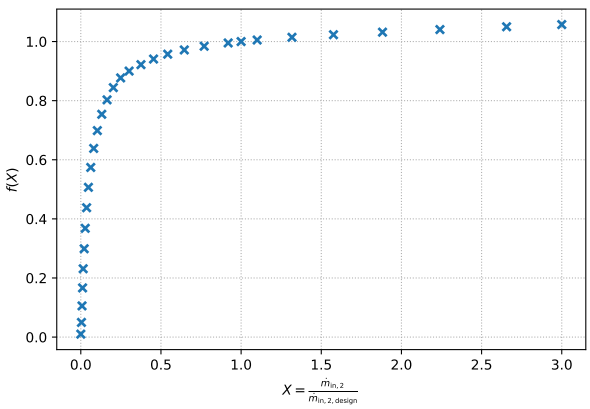

Figure 7: Characteristics of evaporator (eq. 40)

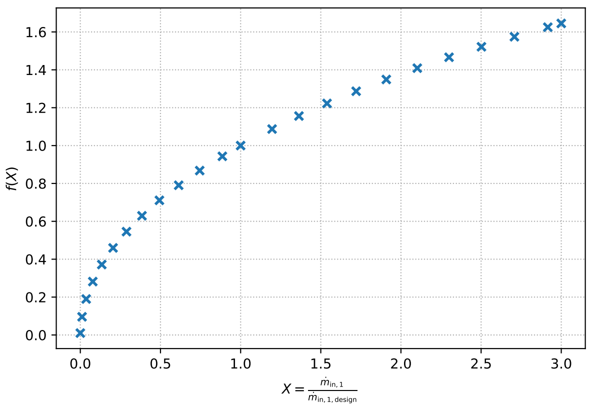

Figure 8: Characteristics of intercooler (eq. 40)

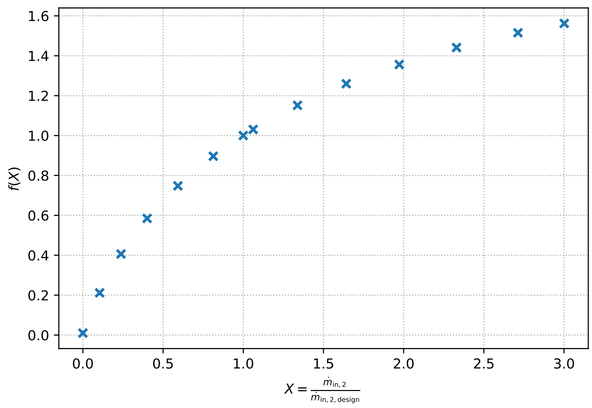

Figure 9: Characteristics of intercooler (eq. 40)

3.8 Components of type Splitter

3.8.1 Mandatory constraints

$$0 = \sum \dot{m}_{\mathrm{in},i} - \sum \dot{m}_{\mathrm{out},j} \ \forall i \in \text{inlets}, \forall j \in \text{outlets} \tag{41}$$

$$0 = x_{fl,\mathrm{in}} - x_{fl,\mathrm{out},j} \ \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \tag{42}$$

$$0 = h_{in} - h_{\mathrm{out},j} \ \forall j \in \text{outlets} \tag{43}$$

$$\begin{split} 0 = p_{\mathrm{in},1} - p_{\mathrm{in},i} \ \forall i \in \text{inlets} \setminus \{1\} \\ 0 = p_{\mathrm{in},1} - p_{\mathrm{out},j} \ \forall j \in \text{outlets} \end{split} \tag{44}$$

3.9 Components of type Compressor

3.9.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i} \ \forall i \in [1] \tag{45}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i} \ \forall fl \in \text{network fluids}, \forall i \in [1] \tag{46}$$

3.9.2 Inputs specified

label	eta_s_char (47)	pr (48)
compressor 1	True	-
compressor 2	True	3.000

Table 10: Parameters of components of type Compressor

3.9.3 Equations applied

$$0 = (h_{\mathrm{out}} - h_{\mathrm{in}}) \cdot \eta_{\mathrm{s,design}} \cdot f(X) - (h_{out,s} - h_{in}) \tag{47}$$

$$0 = p_{\mathrm{in},1} \cdot pr - p_{\mathrm{out},1} \tag{48}$$

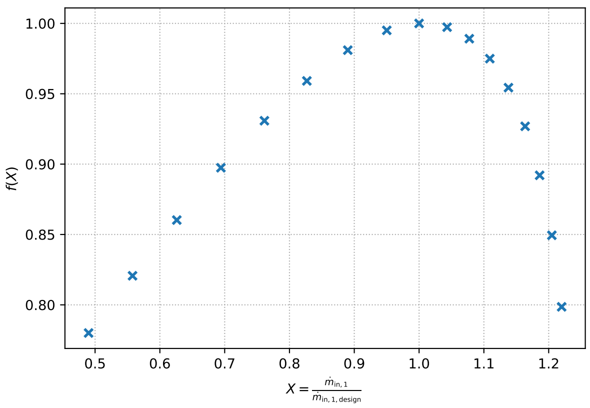

Figure 10: Characteristics of compressor 1 (eq. 47)

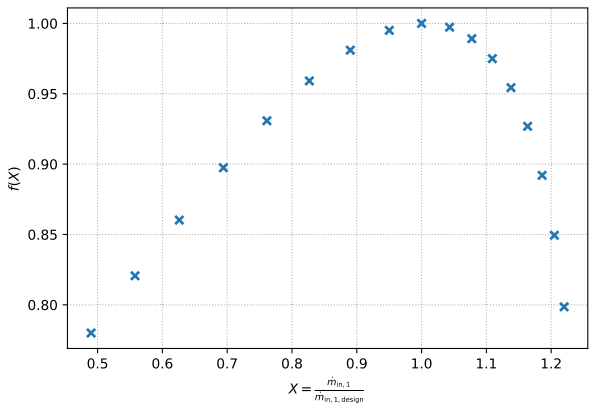

Figure 11: Characteristics of compressor 2 (eq. 47)

4 Busses in offdesign mode

4.1 Bus "total compressor power"

This bus is used for postprocessing only.

label	$\dot{E}_\text{comp}$	$\dot{E}_\text{bus}$	η
compressor 1	$\dot{m}_\text{in} \cdot (h_\text{out} - h_\text{in})$	$\dot{E}_\text{comp} \cdot \eta$	$f(X)$ (12)
compressor 2	$\dot{m}_\text{in} \cdot (h_\text{out} - h_\text{in})$	$\dot{E}_\text{comp} \cdot \eta$	$f(X)$ (13)
pump	$\dot{m}_\text{in} \cdot (h_\text{out} - h_\text{in})$	$\dot{E}_\text{comp} \cdot \eta$	$f(X)$ (14)
district heating pump	$\dot{m}_\text{in} \cdot (h_\text{out} - h_\text{in})$	$\dot{E}_\text{comp} \cdot \eta$	$f(X)$ (15)
evaporator reciculation pump	$\dot{m}_\text{in} \cdot (h_\text{out} - h_\text{in})$	$\dot{E}_\text{comp} \cdot \eta$	$f(X)$ (16)

Table 11: total compressor power

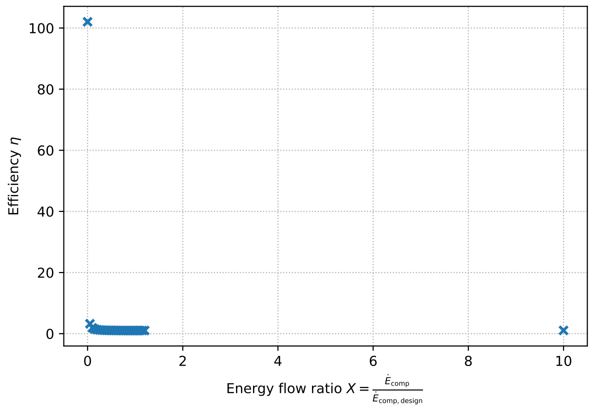

Figure 12: Bus efficiency characteristic

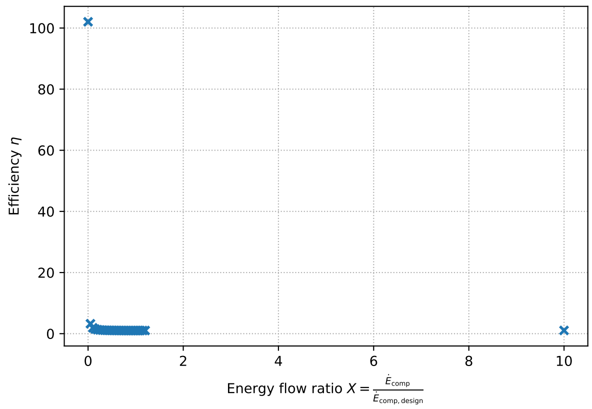

Figure 13: Bus efficiency characteristic

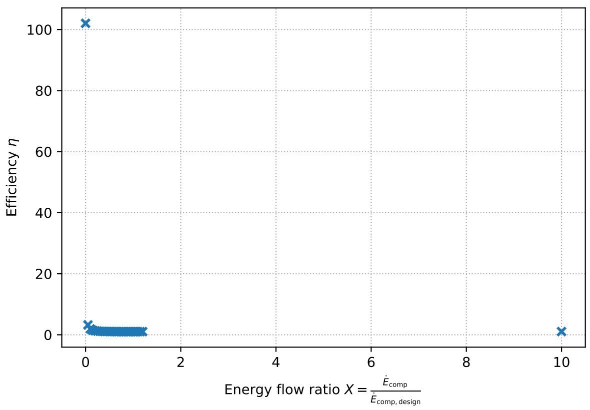

Figure 14: Bus efficiency characteristic

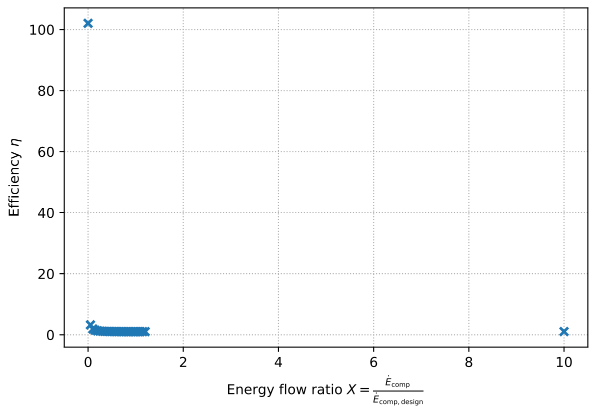

Figure 15: Bus efficiency characteristic

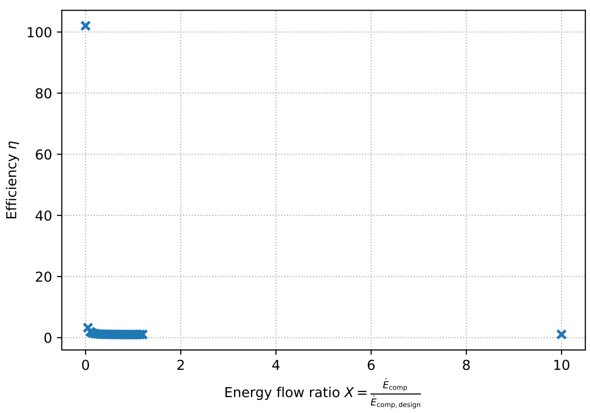

Figure 16: Bus efficiency characteristic

4.2 Bus “total delivered heat”

Specified total value of energy flow: $\dot{E}_\mathrm{bus} = -75000000.000\,\mathrm{W}$

$$0 = \dot{E}_\mathrm{bus} - \sum_i \dot{E}_{\mathrm{bus},i} \tag{49}$$

label	$\dot{E}_\mathrm{comp}$	$\dot{E}_\mathrm{bus}$	η
condenser	$\dot{m}_{\mathrm{in},1} \cdot (h_{\mathrm{out},1} - h_{\mathrm{in},1})$	$\dot{E}_\mathrm{comp} \cdot \eta$	1.000

Table 12: total delivered heat