

Software Information

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

TESPy Version: 0.4.0 - dev
Commit: d918f10d@feature/self_documenting_models
CoolProp version: 6.4.0
Python version: 3.8.0 (default, Oct 28 2019, 16:14:01) [GCC 8.3.0]

1 Connections in offdesign mode

1.1 Specified connection parameters

label	p in bar (1)	T in °C (2)	v in m ³ /s (3)
consumer cycle closer:out1_district heating pump:in1	10.000	60.000	-
condenser:out2_consumer:in1	-	90.000	-
ambient air:out1_pump:in1	2.000	12.000	0.013
splitter:out1_superheater:in1	-	-	0.013
evaporator:out1_sink ambient 1:in1	2.000	-	-

Table 1: Specified connection parameters

1.2 Equations applied

$$0 = p - p_{\text{spec}} \quad (1)$$

$$0 = T(p, h) - T_{\text{spec}} \quad (2)$$

$$0 = \dot{m} \cdot v(p, h) - \dot{V}_{\text{spec}} \quad (3)$$

1.3 Specified fluids

label	NH3 (4)	air (5)	water (6)
coolant cycle closer:out1_condenser:in1	1.000	0.000	0.000
consumer cycle closer: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

$$0 = x_{\text{NH3}} - x_{\text{NH3,spec}} \quad (4)$$

$$0 = x_{\text{air}} - x_{\text{air,spec}} \quad (5)$$

$$0 = x_{\text{water}} - x_{\text{water,spec}} \quad (6)$$

1.5 Referenced values for mass flow

label	reference	factor in -	delta in kg/s
evaporator recirculation pump:out1_evaporator:in2	valve:out1_drum:in1	1.250	0

Table 3: Referenced values for mass flow

1.6 Equation applied

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

2 Components in offdesign mode

2.1 Components of type CycleCloser

2.1.1 Mandatory constraints

$$0 = p_{\text{in},i} - p_{\text{out},i} \quad \forall i \in [1] \quad (8)$$

$$0 = h_{\text{in},i} - h_{\text{out},i} \quad \forall i \in [1] \quad (9)$$

2.2 Components of type Condenser

2.2.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \quad \forall i \in [1, 2] \quad (10)$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \quad \forall fl \in \text{network fluids}, \forall i \in [1, 2] \quad (11)$$

$$0 = \dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1}) + \dot{m}_{\text{in},2} \cdot (h_{\text{out},2} - h_{\text{in},2}) \quad (12)$$

2.2.2 Inputs specified

label	pr1 (13)	zeta2 (14)	kA_char (15)	subcooling (16)
condenser	0.990	4850715.036	True	True

Table 4: Parameters of components of type Condenser

2.2.3 Equations applied

$$0 = p_{\text{in},1} \cdot pr1 - p_{\text{out},1} \quad (13)$$

$$0 = \begin{cases} p_{\text{in},2} - p_{\text{out},2} & |\dot{m}_{\text{in},2}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\text{in},2} - p_{\text{out},2}) \cdot \pi^2}{8 \cdot \dot{m}_{\text{in},2} \cdot |\dot{m}_{\text{in},2}| \cdot \frac{v_{\text{in},2} + v_{\text{out},2}}{2}} & |\dot{m}_{\text{in},2}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (14)$$

$$0 = \dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1}) + kA_{\text{design}} \cdot f_{\text{kA}} \cdot \frac{T_{\text{out},1} - T_{\text{in},2} - T_{\text{sat}}(p_{\text{in},1}) + T_{\text{out},2}}{\ln \frac{T_{\text{out},1} - T_{\text{in},2}}{T_{\text{sat}}(p_{\text{in},1}) - T_{\text{out},2}}} \quad (15)$$

$$f_{\text{kA}} = \frac{2}{\frac{1}{f(X_2)} + \frac{1}{f(X_2)}}$$

$$0 = h_{\text{out},1} - h(p_{\text{out},1}, x = 0) \quad (16)$$

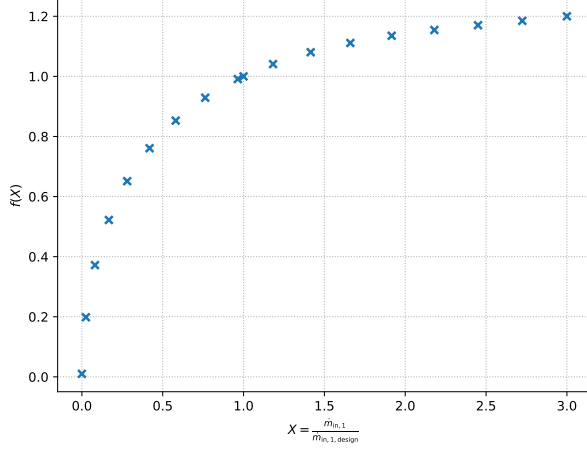


Figure 1: Characteristics of condenser (eq. 15)

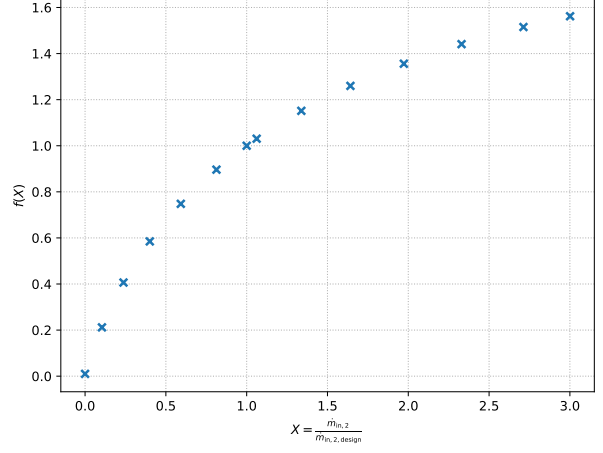


Figure 2: Characteristics of condenser (eq. 15)

2.3 Components of type Pump

2.3.1 Mandatory constraints

$$0 = \dot{m}_{in,i} - \dot{m}_{out,i} \quad \forall i \in [1] \quad (17)$$

$$0 = x_{fl,in,i} - x_{fl,out,i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (18)$$

2.3.2 Inputs specified

label	eta_s_char (19)
district heating pump	True
evaporator recirculation pump	True
pump	True

Table 5: Parameters of components of type Pump

2.3.3 Equations applied

$$0 = (h_{out} - h_{in}) \cdot \eta_{s,design} \cdot f(X) - (h_{out,s} - h_{in}) \quad (19)$$

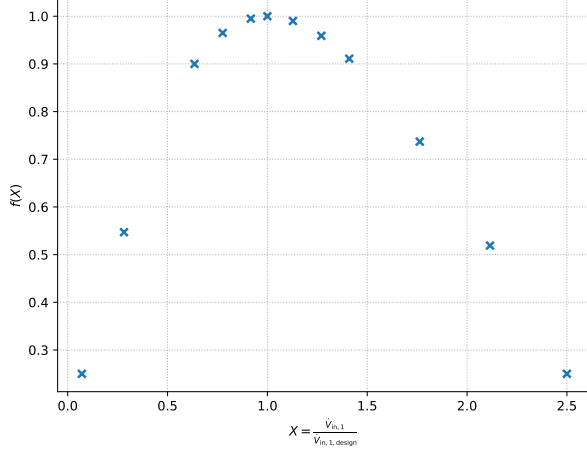


Figure 3: Characteristics of district heating pump (eq. 19)

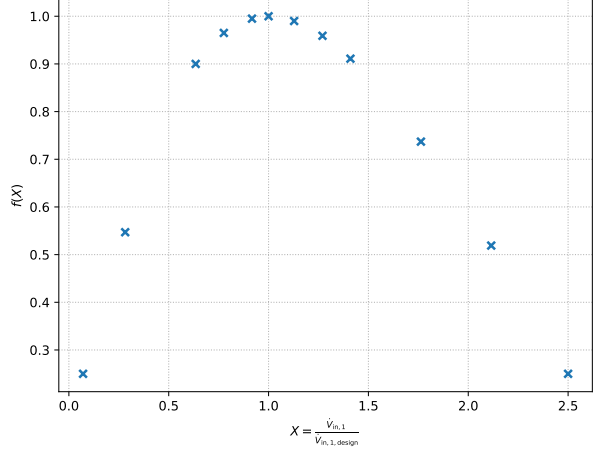


Figure 4: Characteristics of evaporator recirculation pump (eq. 19)

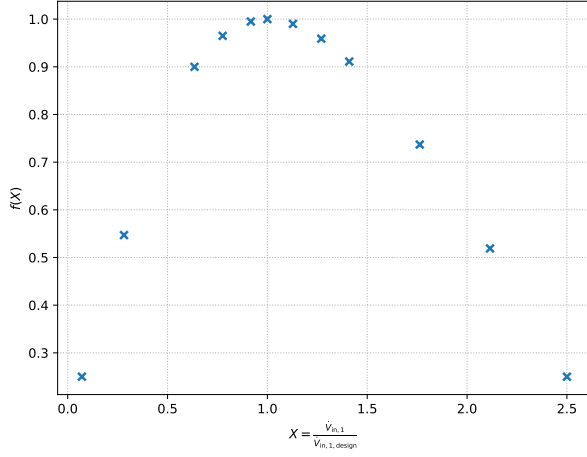


Figure 5: Characteristics of pump (eq. 19)

2.4 Components of type HeatExchangerSimple

2.4.1 Mandatory constraints

$$0 = \dot{m}_{in,i} - \dot{m}_{out,i} \quad \forall i \in [1] \quad (20)$$

$$0 = x_{fl,in,i} - x_{fl,out,i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (21)$$

2.4.2 Inputs specified

label	Q (22)	zeta (23)
consumer	-200000.000	4802189.049

Table 6: Parameters of components of type HeatExchangerSimple

2.4.3 Equations applied

$$0 = \dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}}) - \dot{Q} \quad (22)$$

$$0 = \begin{cases} p_{\text{in},1} - p_{\text{out},1} & |\dot{m}_{\text{in},1}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{\text{in},1} - p_{\text{out},1}) \cdot \pi^2}{8 \cdot \dot{m}_{\text{in},1} \cdot |\dot{m}_{\text{in},1}| \cdot \frac{v_{\text{in},1} + v_{\text{out},1}}{2}} & |\dot{m}_{\text{in},1}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (23)$$

2.5 Components of type Valve

2.5.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \quad \forall i \in [1] \quad (24)$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (25)$$

$$0 = h_{\text{in},i} - h_{\text{out},i} \quad \forall i \in [1] \quad (26)$$

2.6 Components of type Drum

2.6.1 Mandatory constraints

$$0 = \sum \dot{m}_{\text{in},i} - \sum \dot{m}_{\text{out},j} \quad \forall i \in \text{inlets}, \forall j \in \text{outlets} \quad (27)$$

$$0 = x_{fl,\text{in},1} - x_{fl,\text{out},j} \quad \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \quad (28)$$

$$0 = \sum_i (\dot{m}_{\text{in},i} \cdot h_{\text{in},i}) - \sum_j (\dot{m}_{\text{out},j} \cdot h_{\text{out},j}) \quad \forall i \in \text{inlets} \quad \forall j \in \text{outlets} \quad (29)$$

$$\begin{aligned} 0 &= p_{\text{in},1} - p_{\text{in},i} \quad \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{\text{in},1} - p_{\text{out},j} \quad \forall j \in \text{outlets} \end{aligned} \quad (30)$$

$$\begin{aligned} 0 &= h_{\text{out},1} - h(p_{\text{out},1}, x = 0) \\ 0 &= h_{\text{out},2} - h(p_{\text{out},2}, x = 1) \end{aligned} \quad (31)$$

2.7 Components of type HeatExchanger

2.7.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i} \quad \forall i \in [1, 2] \quad (32)$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i} \quad \forall fl \in \text{network fluids}, \forall i \in [1, 2] \quad (33)$$

$$0 = \dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1}) + \dot{m}_{\text{in},2} \cdot (h_{\text{out},2} - h_{\text{in},2}) \quad (34)$$

2.7.2 Inputs specified

label	pr2 (35)	zeta1 (36)	zeta2 (37)	kA_char (38)
evaporator	0.990	31802.919	-	True
superheater	-	32447.412	603927.870	True
intercooler	-	7186396.333	16272842.690	True

Table 7: Parameters of components of type HeatExchanger

2.7.3 Equations applied

$$0 = p_{in,2} \cdot pr2 - p_{out,2} \quad (35)$$

$$0 = \begin{cases} p_{in,1} - p_{out,1} & |\dot{m}_{in,1}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{in,1} - p_{out,1}) \cdot \pi^2}{8 \cdot \dot{m}_{in,1} \cdot |\dot{m}_{in,1}| \cdot \frac{v_{in,1} + v_{out,1}}{2}} & |\dot{m}_{in,1}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (36)$$

$$0 = \begin{cases} p_{in,2} - p_{out,2} & |\dot{m}_{in,2}| < 0.0001 \text{ kg/s} \\ \frac{\zeta}{D^4} - \frac{(p_{in,2} - p_{out,2}) \cdot \pi^2}{8 \cdot \dot{m}_{in,2} \cdot |\dot{m}_{in,2}| \cdot \frac{v_{in,2} + v_{out,2}}{2}} & |\dot{m}_{in,2}| \geq 0.0001 \text{ kg/s} \end{cases} \quad (37)$$

$$0 = \dot{m}_{in,1} \cdot (h_{out,1} - h_{in,1}) + kA_{design} \cdot f_{kA} \cdot \frac{T_{out,1} - T_{in,2} - T_{in,1} + T_{out,2}}{\ln \frac{T_{out,1} - T_{in,2}}{T_{in,1} - T_{out,2}}} \quad (38)$$

$$f_{kA} = \frac{2}{\frac{1}{f(X_1)} + \frac{1}{f(X_2)}}$$

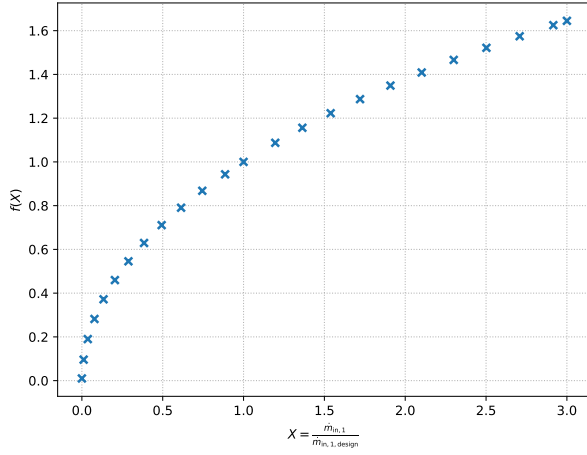


Figure 6: Characteristics of evaporator (eq. 38)

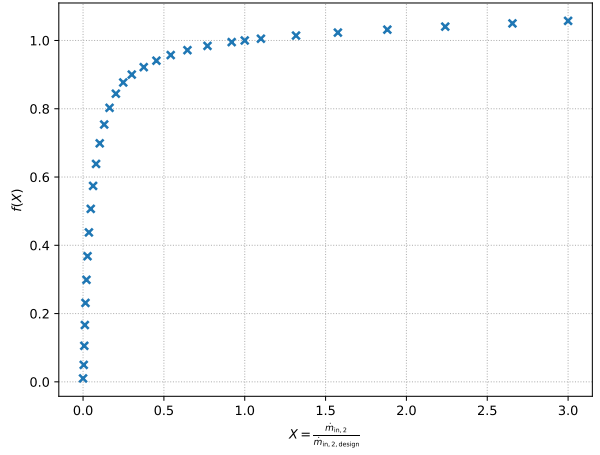


Figure 7: Characteristics of evaporator (eq. 38)

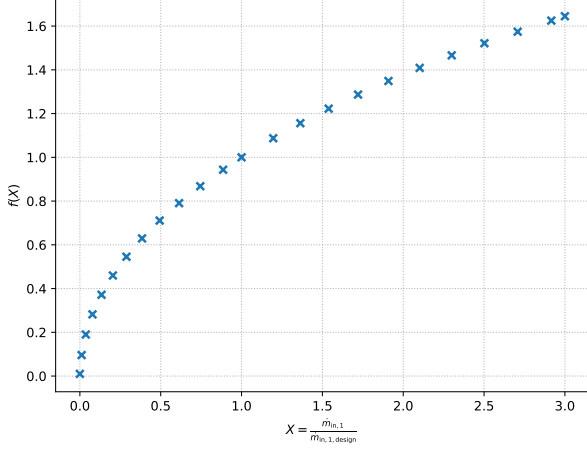


Figure 8: Characteristics of superheater (eq. 38)

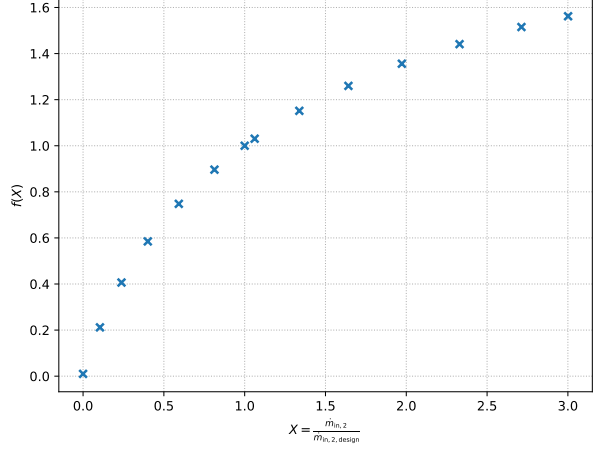


Figure 9: Characteristics of superheater (eq. 38)

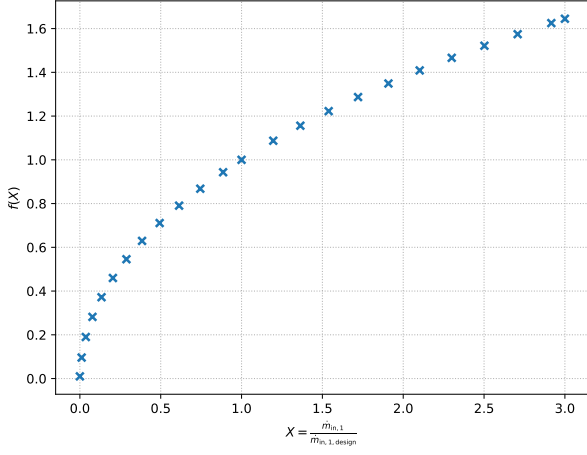


Figure 10: Characteristics of intercooler (eq. 38)

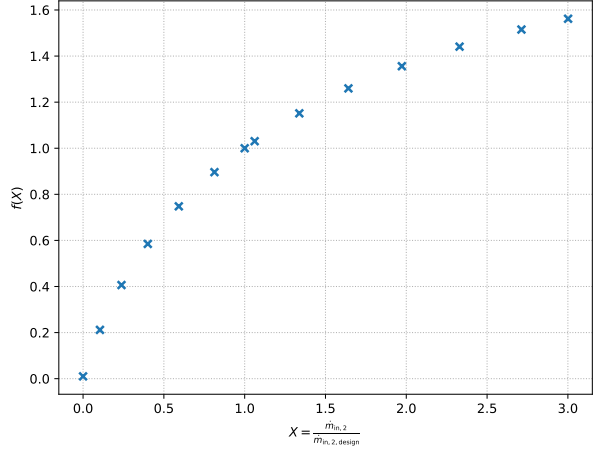


Figure 11: Characteristics of intercooler (eq. 38)

2.8 Components of type Splitter

2.8.1 Mandatory constraints

$$0 = \sum \dot{m}_{in,i} - \sum \dot{m}_{out,j} \quad \forall i \in \text{inlets}, \forall j \in \text{outlets} \quad (39)$$

$$0 = x_{fl,in} - x_{fl,out,j} \quad \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \quad (40)$$

$$0 = h_{in} - h_{out,j} \quad \forall j \in \text{outlets} \quad (41)$$

$$\begin{aligned} 0 &= p_{in,1} - p_{in,i} \quad \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{in,1} - p_{out,j} \quad \forall j \in \text{outlets} \end{aligned} \quad (42)$$

2.9 Components of type Compressor

2.9.1 Mandatory constraints

$$0 = \dot{m}_{in,i} - \dot{m}_{out,i} \quad \forall i \in [1] \quad (43)$$

$$0 = x_{fl,in,i} - x_{fl,out,i} \quad \forall fl \in \text{network fluids}, \forall i \in [1] \quad (44)$$

2.9.2 Inputs specified

label	eta_s.char (45)	pr (46)
compressor 1	True	-
compressor 2	True	3.000

Table 8: Parameters of components of type Compressor

2.9.3 Equations applied

$$0 = (h_{out} - h_{in}) \cdot \eta_{s,design} \cdot f(X) - (h_{out,s} - h_{in}) \quad (45)$$

$$0 = p_{in,1} \cdot pr - p_{out,1} \quad (46)$$

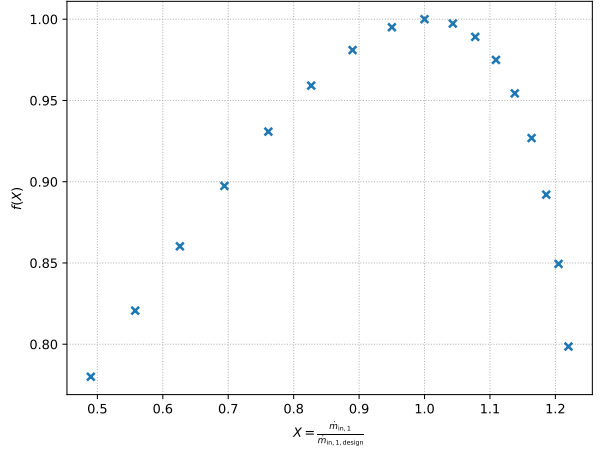
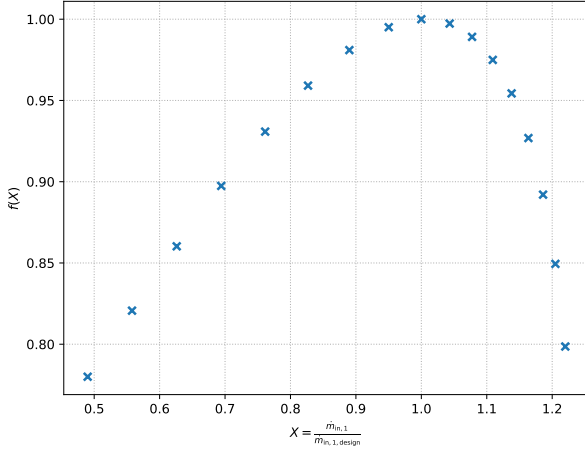


Figure 12: Characteristics of compressor 1 (eq. 45) Figure 13: Characteristics of compressor 2 (eq. 45)