Software Information

General information

TESPy Version:	0.6.0 - Colored Chemicals
Commit:	1054198a@features/chemical_exergy
CoolProp version:	6.4.1
Python version:	3.8.12 — packaged by conda-forge — (default, Oct 12 2021, 21:19:05) [MSC v.1916 64
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Parameter highlighting

Variable component parameters:	*italic*
Specified input parameter:	**bold**
Results of simulation:	normalfont

Equations are displayed for input parameters only.

1 Connections in design mode

1.1 Connection specifications and results

Table 1: Connection specifications and results

label	m in $^{kg}/_{s}$ (1)	p in bar (2)	h in $^{J}/_{kg}$	T in °C (3)	s in $^{J}/_{kgK}$	x in − (4)	Td_bp in °C (5)
1	90.939	**1.0130**	327,381.60	**25.0**	6,911.1124	0.00	0.0
2	90.939	10.1300	653,922.98	338.4	6,988.6093	0.00	0.0
3	90.939	9.6235	916,984.02	**576.8**	7,366.2478	0.00	0.0
10	1.647	**12.0000**	899,139.96	**25.0**	5,366.9804	-1.00	-
4	92.586	9.1423	1,879,591.92	**1,246.8**	8,036.5346	0.00	0.0
5	92.586	1.0993	1,234,835.22	738.2	8,145.0316	0.00	0.0
6	92.586	1.0663	976,452.66	521.7	7,866.7572	0.00	0.0
6p	92.586	1.0393	680,441.41	259.7	7,423.4159	0.00	0.0
7	92.586	**1.0130**	569,451.75	157.3	7,199.7497	0.00	0.0
8	**14.000**	**20.0000**	106,676.98	**25.0**	366.7079	-1.00	-
8p	14.000	20.0000	840,683.94	197.4	2,304.8871	-1.00	**-15.0**
11	29.005	20.0000	908,498.08	212.4	2,446.7542	0.00	-
11p	29.005	20.0000	1,853,395.34	212.4	4,392.8804	**0.50**	-
9	14.000	20.0000	2,798,292.60	212.4	6,339.0066	1.00	-

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	CH4 (6)	CO2 (7)	H2O (8)	N2 (9)	O2 (10)
1	**0.000**	**0.000**	**0.012**	**0.758**	**0.230**
10	**1.000**	**0.000**	**0.000**	**0.000**	**0.000**
8	**0.000**	**0.000**	**1.000**	**0.000**	**0.000**

1.4 Equations applied

$$0 = x_{\text{CH4}} - x_{\text{CH4,spec}} \tag{6}$$

$$0 = x_{\text{CO2}} - x_{\text{CO2,spec}} \tag{7}$$

$$0 = x_{\text{H2O}} - x_{\text{H2O,spec}} \tag{8}$$

$$0 = x_{\mathrm{N2}} - x_{\mathrm{N2,spec}} \tag{9}$$

$$0 = x_{\mathrm{O2}} - x_{\mathrm{O2,spec}} \tag{10}$$

2 Components in design mode

2.1 Components of type Compressor

2.1.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i} \; \forall i \in [1] \tag{11}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1] \tag{12}$$

2.1.2 Specifications and results

Table 3: Parameters of components of type Compressor

label	P	eta_s (13)	pr (14)
compressor	29,695,495.55	**0.86**	**10.00**

2.1.3 Equations applied

$$0 = -\left(h_{\mathrm{out}} - h_{\mathrm{in}}\right) \cdot \eta_{\mathrm{s}} + \left(h_{\mathrm{out,s}} - h_{\mathrm{in}}\right) \tag{13}$$

$$0 = p_{\mathrm{in},1} \cdot pr - p_{\mathrm{out},1} \tag{14}$$

2.2 Components of type HeatExchanger

2.2.1 Mandatory constraints

$$0 = \dot{m}_{\mathrm{in},i} - \dot{m}_{\mathrm{out},i} \; \forall i \in [1, 2] \tag{15}$$

$$0 = x_{fl,\mathrm{in},i} - x_{fl,\mathrm{out},i} \; \forall fl \in \text{network fluids}, \forall i \in [1, 2] \tag{16}$$

$$0 = \dot{m}_{\mathrm{in},1} \cdot \left(h_{\mathrm{out},1} - h_{\mathrm{in},1}\right) + \dot{m}_{\mathrm{in},2} \cdot \left(h_{\mathrm{out},2} - h_{\mathrm{in},2}\right) \tag{17}$$

2.2.2 Specifications and results

Table 4: Parameters of components of type HeatExchanger

label	Q	ttd_u	ttd_l	pr1 (18)	pr2 (19)
air preheater	-23,922,627.92	161.33	183.30	**0.97**	**0.95**
evaporator	-27,406,521.33	309.28	47.35	**0.97**	1.00
economizer	-10,276,097.34	62.35	132.32	**0.97**	**1.00**

2.2.3 Equations applied

$$0 = p_{\mathrm{in},1} \cdot pr1 - p_{\mathrm{out},1} \tag{18}$$

$$0 = p_{\mathrm{in},2} \cdot pr2 - p_{\mathrm{out},2} \tag{19}$$

2.3 Components of type DiabaticCombustionChamber

2.3.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},1} + \dot{m}_{\text{in},2} - \dot{m}_{\text{out},1} \tag{20}$$

$$\begin{aligned}
\Delta\dot{m}_{\text{fluid}} &= \dot{m}_{\text{in},1} \cdot x_{\text{fluid,in},1} + \dot{m}_{\text{in},2} \cdot x_{\text{fluid,in},2} - \dot{m}_{\text{out},1} \cdot x_{\text{fluid,out},1} \\
\dot{m}_{\text{fluid,m}} &= \frac{\dot{m}_{\text{in},1} \cdot x_{\text{fluid,in},1} + \dot{m}_{\text{in},2} \cdot x_{\text{fluid,in},2}}{M_{\text{fluid}}} \\
\dot{m}_{\text{H,m}} &= \dot{m}_{\text{CH4,m}} \cdot 4 \\
\dot{m}_{\text{C,m}} &= \dot{m}_{\text{CH4,m}} \cdot 1 \\
\dot{m}_{\text{O2,m,stoich}} &= \frac{\dot{m}_{\text{H,m}}}{4} + \dot{m}_{\text{C,m}}
\end{aligned} \tag{21}$$

$$0 = \Delta\dot{m}_{\text{CH4}} - \dot{m}_{\text{CH4,m}} \cdot M_{\text{CH4}} \tag{22}$$

$$0 = \Delta\dot{m}_{\text{CO2}} + \dot{m}_{\text{C,m}} \cdot M_{\text{CO2}} \tag{23}$$

$$0 = \Delta\dot{m}_{\text{H2O}} + \frac{\dot{m}_{\text{H,m}}}{2} \cdot M_{\text{H2O}} \tag{24}$$

$$0 = \Delta\dot{m}_{\text{N2}} \tag{25}$$

$$0 = \Delta\dot{m}_{\text{O2}} - \dot{m}_{\text{O2,m,stoich}} \cdot M_{\text{O2}} \tag{26}$$

2.3.2 Specifications and results

Table 5: Parameters of components of type DiabaticCombustionChamber

label	lamb	ti	pr (27)	eta (28)
combustion chamber	3.18	82,374,461.62	**0.95**	**0.98**

2.3.3 Equations applied

$$0 = p_{\text{in},1} \cdot pr - p_{\text{out},1} \tag{27}$$

$$\begin{aligned}
0 = &\sum_i \dot{m}_{\text{in},i} \cdot (h_{\text{in},i} - h_{\text{in},i,\text{ref}}) - \dot{m}_{\text{out},1} \cdot (h_{\text{out},1} - h_{\text{out},1,\text{ref}}) \\
&+ LHV_{fuel} \cdot \left(\sum_i \dot{m}_{\text{in},i} \cdot x_{fuel,\text{in},i} - \dot{m}_{\text{out},1} \cdot x_{fuel,\text{out},1} \right) \cdot \eta \\
&\forall i \in \text{inlets} \\
&T_{\text{ref}} = 298.15\,\text{K}\ p_{\text{ref}} = 10^5\,\text{Pa}
\end{aligned} \tag{28}$$

2.4 Components of type Turbine

2.4.1 Mandatory constraints

$$0 = \dot{m}_{\text{in},i} - \dot{m}_{\text{out},i}\ \forall i \in [1] \tag{29}$$

$$0 = x_{fl,\text{in},i} - x_{fl,\text{out},i}\ \forall fl \in \text{network fluids},\ \forall i \in [1] \tag{30}$$

2.4.2 Specifications and results

Table 6: Parameters of components of type Turbine

label	P	eta_s (31)	pr
gas turbine	-59,695,495.55	**0.86**	0.12

2.4.3 Equations applied

$$0 = -\left(h_{\text{out}} - h_{\text{in}}\right) + \left(h_{\text{out,s}} - h_{\text{in}}\right) \cdot \eta_{\text{s}} \tag{31}$$

2.5 Components of type Drum

2.5.1 Mandatory constraints

$$0 = \sum \dot{m}_{\text{in},i} - \sum \dot{m}_{\text{out},j} \ \forall i \in \text{inlets}, \forall j \in \text{outlets} \tag{32}$$

$$0 = x_{fl,\text{in},1} - x_{fl,\text{out},j} \ \forall fl \in \text{network fluids}, \forall j \in \text{outlets} \tag{33}$$

$$0 = \sum_i \left(\dot{m}_{\text{in},i} \cdot h_{\text{in},i}\right) - \sum_j \left(\dot{m}_{\text{out},j} \cdot h_{\text{out},j}\right) \ \forall i \in \text{inlets} \ \forall j \in \text{outlets} \tag{34}$$

$$\begin{aligned} 0 &= p_{\text{in},1} - p_{\text{in},i} \ \forall i \in \text{inlets} \setminus \{1\} \\ 0 &= p_{\text{in},1} - p_{\text{out},j} \ \forall j \in \text{outlets} \end{aligned} \tag{35}$$

$$\begin{aligned} 0 &= h_{\text{out},1} - h\left(p_{\text{out},1}, x = 0\right) \\ 0 &= h_{\text{out},2} - h\left(p_{\text{out},2}, x = 1\right) \end{aligned} \tag{36}$$

3 Busses in design mode

3.1 Bus “total power”

Specified total value of energy flow: $\dot{E}_{\text{bus}} = -30,000,000.00\,\text{W}$

$$0 = \dot{E}_{\text{bus}} - \sum_i \dot{E}_{\text{bus},i} \tag{37}$$

Table 7: Results overview for bus total power

label	$\dot{E}_{\text{comp}}$	$\dot{E}_{\text{comp,result}}$	$\dot{E}_{\text{bus}}$	$\dot{E}_{\text{bus,result}}$	η_{result}
compressor	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	29,695,495.55	$\frac{\dot{E}_{\text{comp}}}{\eta}$	29,695,495.55	1.00
gas turbine	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	-59,695,495.55	$\dot{E}_{\text{comp}} \cdot \eta$	-59,695,495.55	1.00
total	-	-30,000,000.00	-	**-30,000,000.00**	-

3.2 Bus “heat output”

This bus is used for postprocessing only.

Table 8: Results overview for bus heat output

label		$\dot{E}_{\text{comp}}$	$\dot{E}_{\text{comp,result}}$	$\dot{E}_{\text{bus}}$	$\dot{E}_{\text{bus,result}}$	η_{result}
economizer	$\dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1})$	-10,276,097.34	$\dot{E}_{\text{comp}} \cdot \eta$	10,276,097.34	-1.00
evaporator	$\dot{m}_{\text{in},1} \cdot (h_{\text{out},1} - h_{\text{in},1})$	-27,406,521.33	$\dot{E}_{\text{comp}} \cdot \eta$	27,406,521.33	-1.00
total		-	-37,682,618.67	-	37,682,618.67	-

3.3 Bus “power output”

This bus is used for postprocessing only.

Table 9: Results overview for bus power output

label		$\dot{E}_{\text{comp}}$	$\dot{E}_{\text{comp,result}}$	$\dot{E}_{\text{bus}}$	$\dot{E}_{\text{bus,result}}$	η_{result}
compressor	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	29,695,495.55	$\frac{\dot{E}_{\text{comp}}}{\eta}$	29,695,495.55	1.00
gas turbine	$\dot{m}_{\text{in}} \cdot (h_{\text{out}} - h_{\text{in}})$	-59,695,495.55	$\dot{E}_{\text{comp}} \cdot \eta$	-59,695,495.55	1.00
total		-	-30,000,000.00	-	-30,000,000.00	-

3.4 Bus “fuel input”

This bus is used for postprocessing only.

Table 10: Results overview for bus fuel input

label		$\dot{E}_{\text{comp}}$	$\dot{E}_{\text{comp,result}}$	$\dot{E}_{\text{bus}}$	$\dot{E}_{\text{bus,result}}$	η_{result}
combustion chamber	$LHV_{\text{fuel}} \cdot [\sum_i (\dot{m}_{\text{in},i} \cdot x_{\text{fuel,in},i}) - \dot{m}_{\text{out},1} \cdot x_{\text{fuel,out},1}]$	82,374,461.62	$\frac{\dot{E}_{\text{comp}}}{\eta}$	82,374,461.62	1.00
total		-	82,374,461.62	-	82,374,461.62	-