Appendix A - Farmer input cost

The input cost for farmers to produce their crops is shown in table A.1. Note that the production of maize less than 4 tons per hectare is not profitable. The decrease in fuel cost could increase their profit.

Table A.1 Farmer input cost

Producing cost for dry land maize production year 2008/2009			
Projected yield (ton/ha)	**3**	**4**	**1.5**
Direct attributable variable cost (R/ha)			
Seed	R 257.52	R 313.20	R 153.61
Fertilizer	R 1 857.42	R 2 388.44	R 1 284.03
Lime	R 134.00	R 134.00	R 134.00
Fuel	R 774.30	R 806.34	R 681.51
Reparation	R 385.82	R 390.82	R 349.01
Weed-killer	R 205.50	R 205.50	R 157.92
Pesticide	R 48.97	R 56.00	R 26.71
Input insurance	R 102.38	R 136.50	R 134.55
Grain price stockade	R 447.55	R 530.32	R 278.93
Extra Labour	R 0.00	R 0.00	R 50.00
Crop insurance	R 197.31	R 263.07	R 262.20
Drying cost	R 0.00	R 0.00	R 0.00
Production credit interest (R/ha)	R 330.81	R 391.81	R 263.44
Total Direct attributable variable cost (R/ha)	**R 4 741.58**	**R 5 616.00**	**R 3 775.91**
Total overheads (R/ha)	R 1 816.48	R 1 816.48	R 1 816.48
Total cost per ha before physical marketing (R/ha)	**R 6 558.06**	**R 7 432.48**	**R 5 592.39**
Total cost per ton before physical marketing (R/ton)	**R 2 186.02**	**R 1 858.12**	**R 3 728.26**
Transport and total marketing cost (R/ton)	R 154.00	R 154.00	R 195.00
Current Safex-price (September 2008)	R 2 100.00	R 2 100.00	R 4 800.00
Production worth (R/ha)	**R 5 838.00**	**R 7 784.00**	**R 6 907.50**
Margin per ha before physical marketing and profit (R/ha)	-R 720.06	R 351.52	R 1 315.11
Profit per ton (R/ton)	**-R 240.02**	**R 87.88**	**R 876.74**
Needed minimum Safex-pice without profit (R/ton)	**R 2 340.02**	**R 2 012.12**	**R 3 923.26**
Without fuel cost			
Margin per ha before physical marketing and profit (R/ha)	R 54.24	R 1 157.86	R 1 996.62
Profit per ton (R/ton)	**R 18.08**	**R 289.47**	**R 1 331.08**

Appendix B - EES model results for different compression configurations

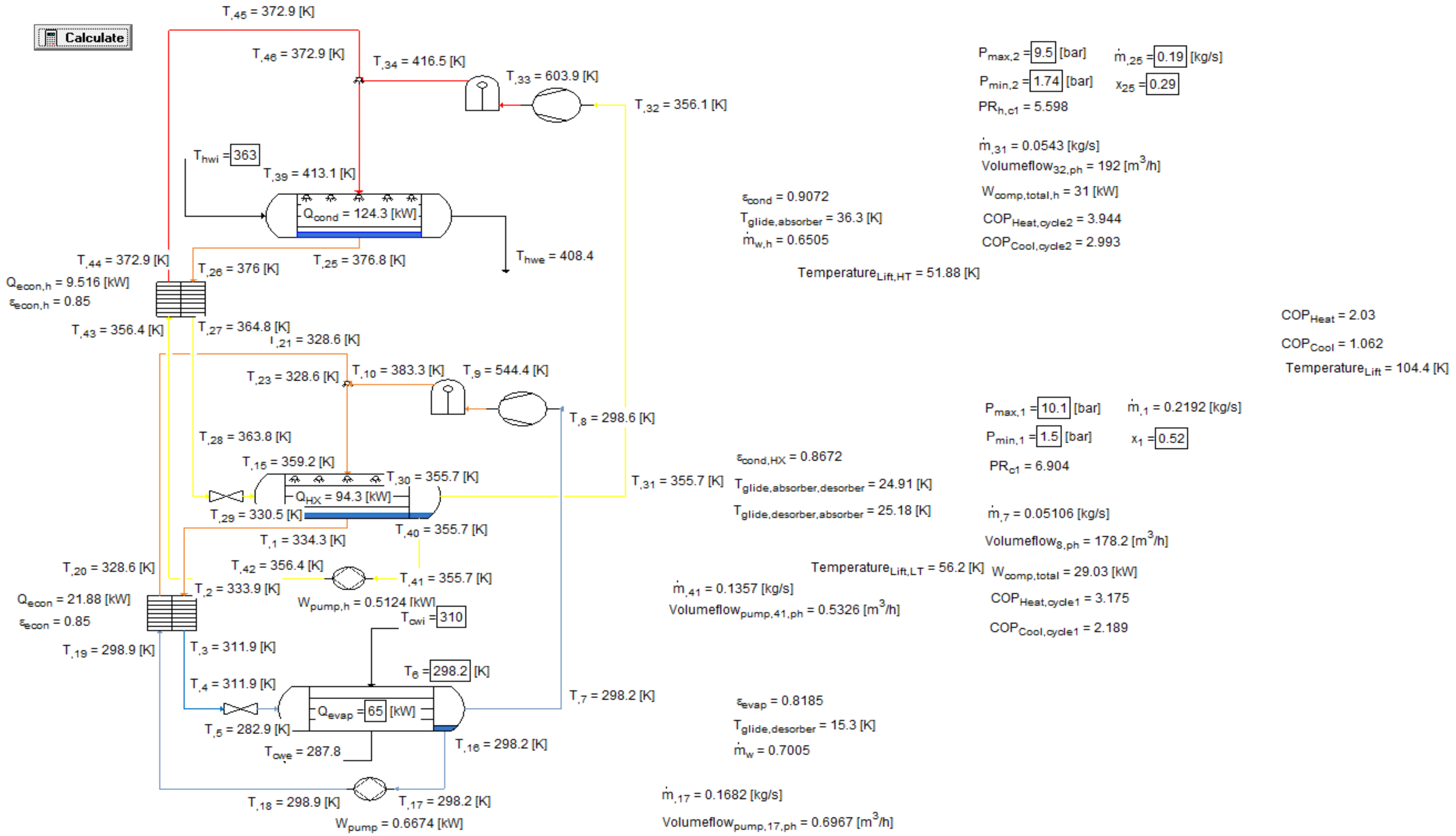

Figure B.1 – Dry compression model results

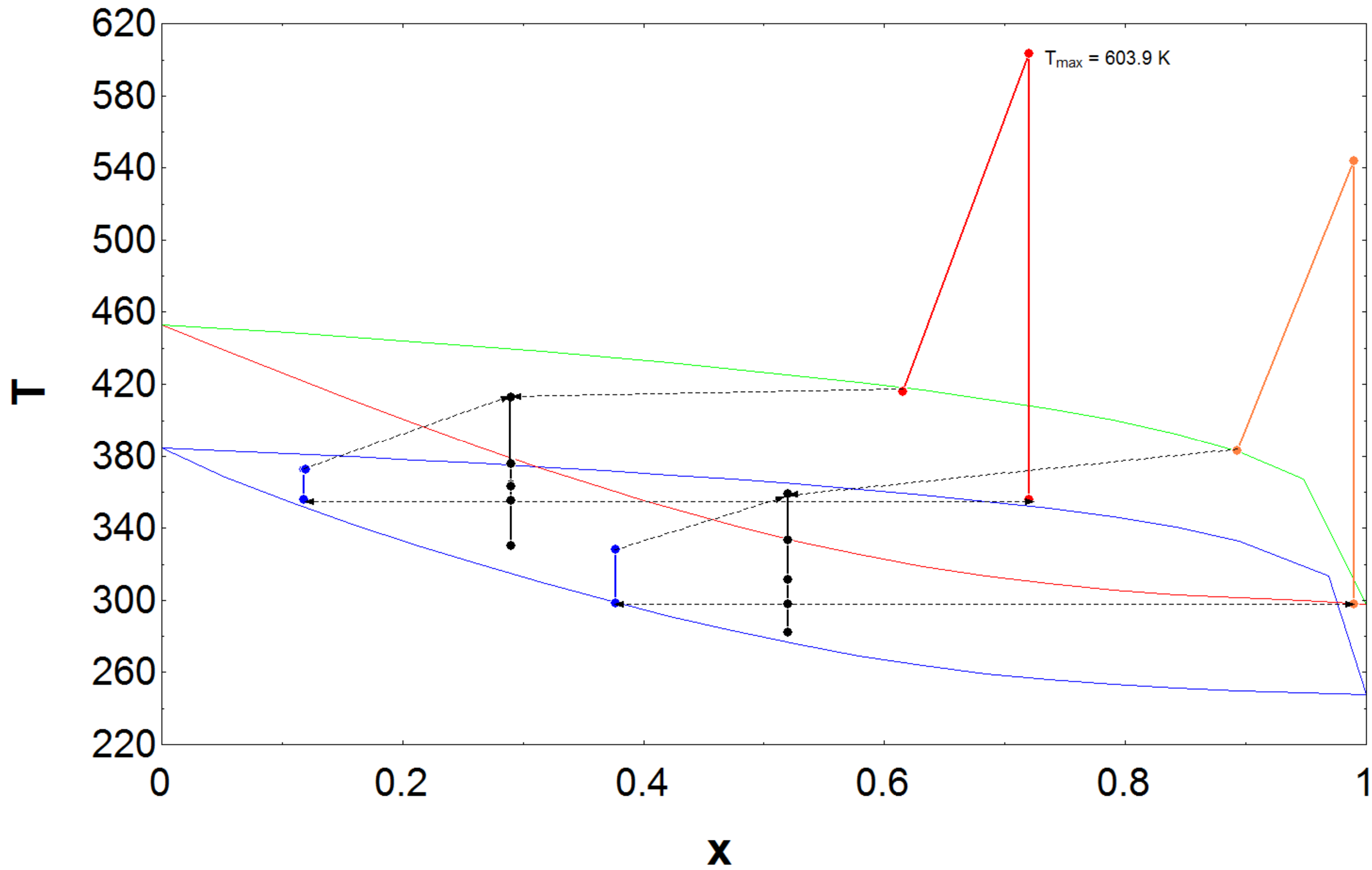

Figure B.2 – Temperature-concentration diagram for dry compression

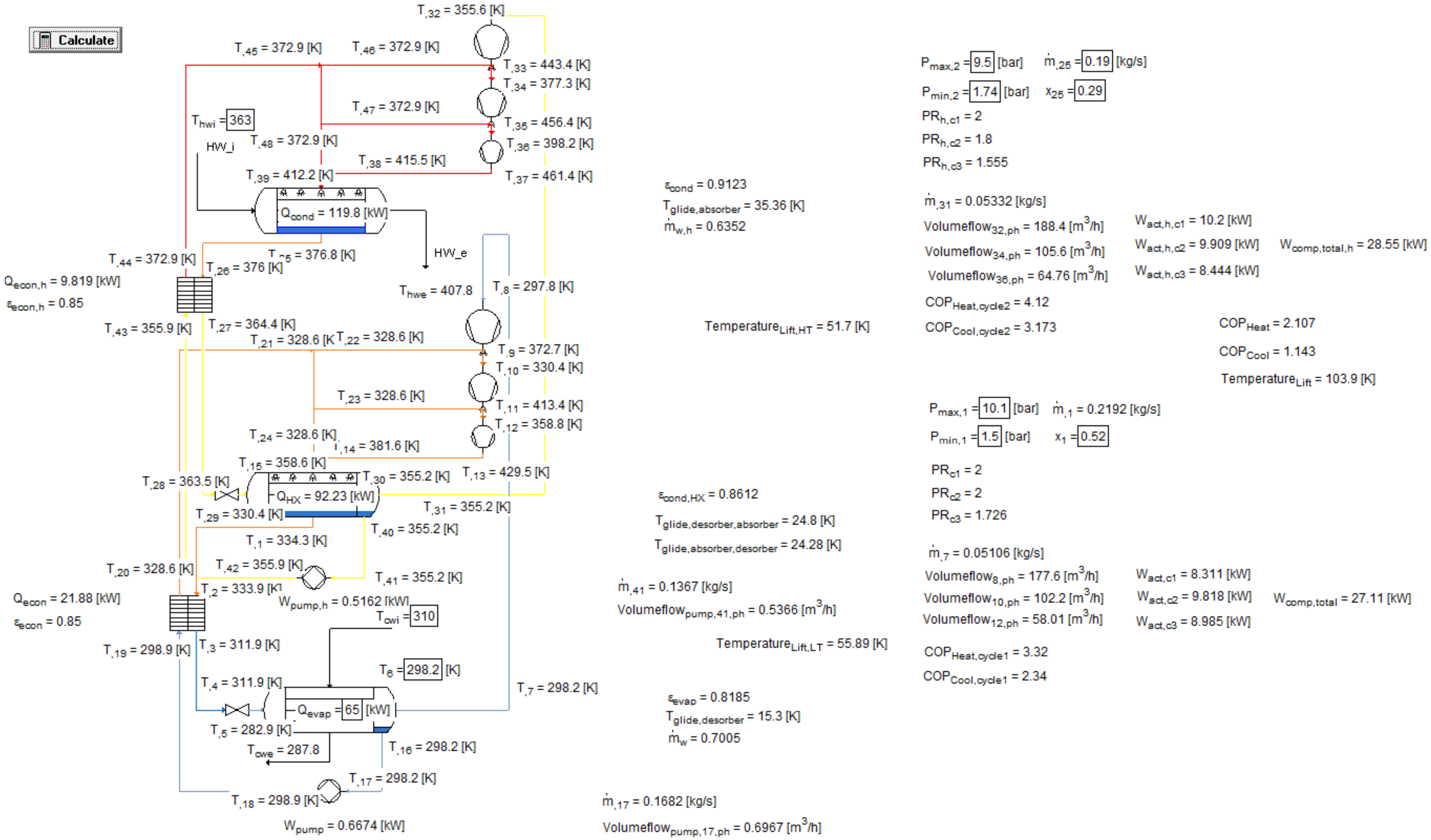

Figure B.3 – Multistage compression with intercooling model results

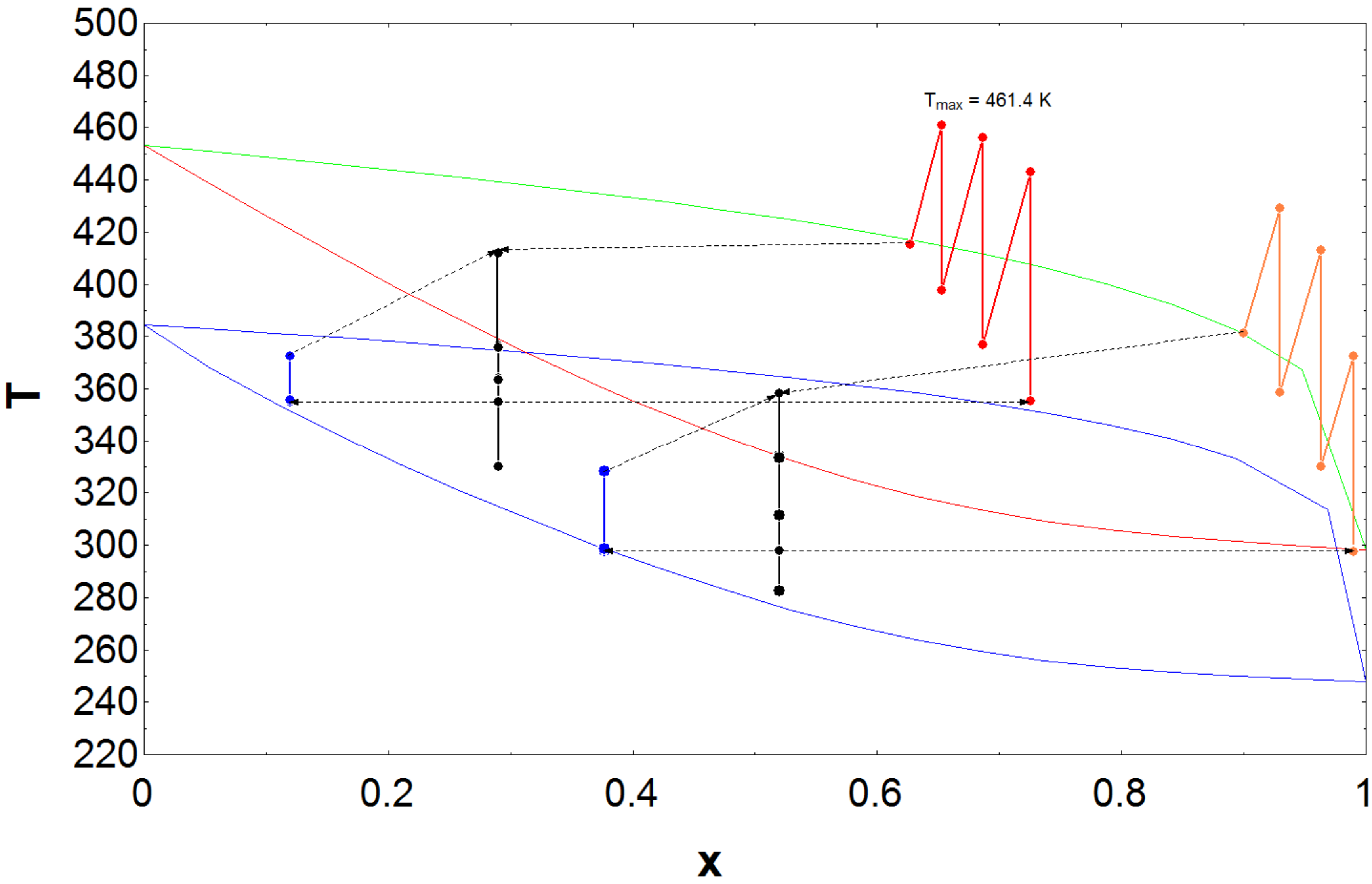

Figure B.4 - Temperature-concentration diagram for multistage compression with intercooling

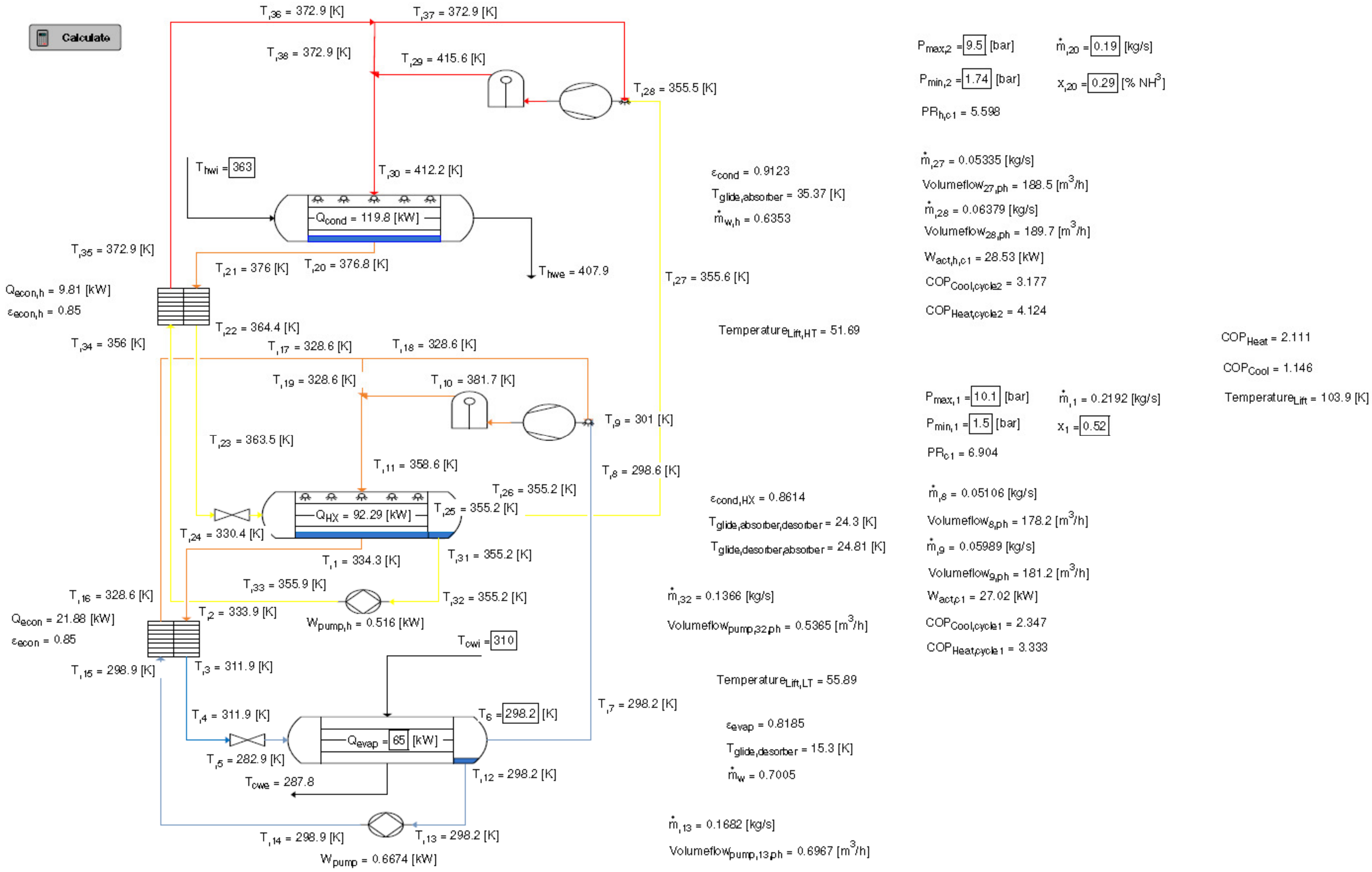

Figure B.5 – Liquid injection model results (Base model)

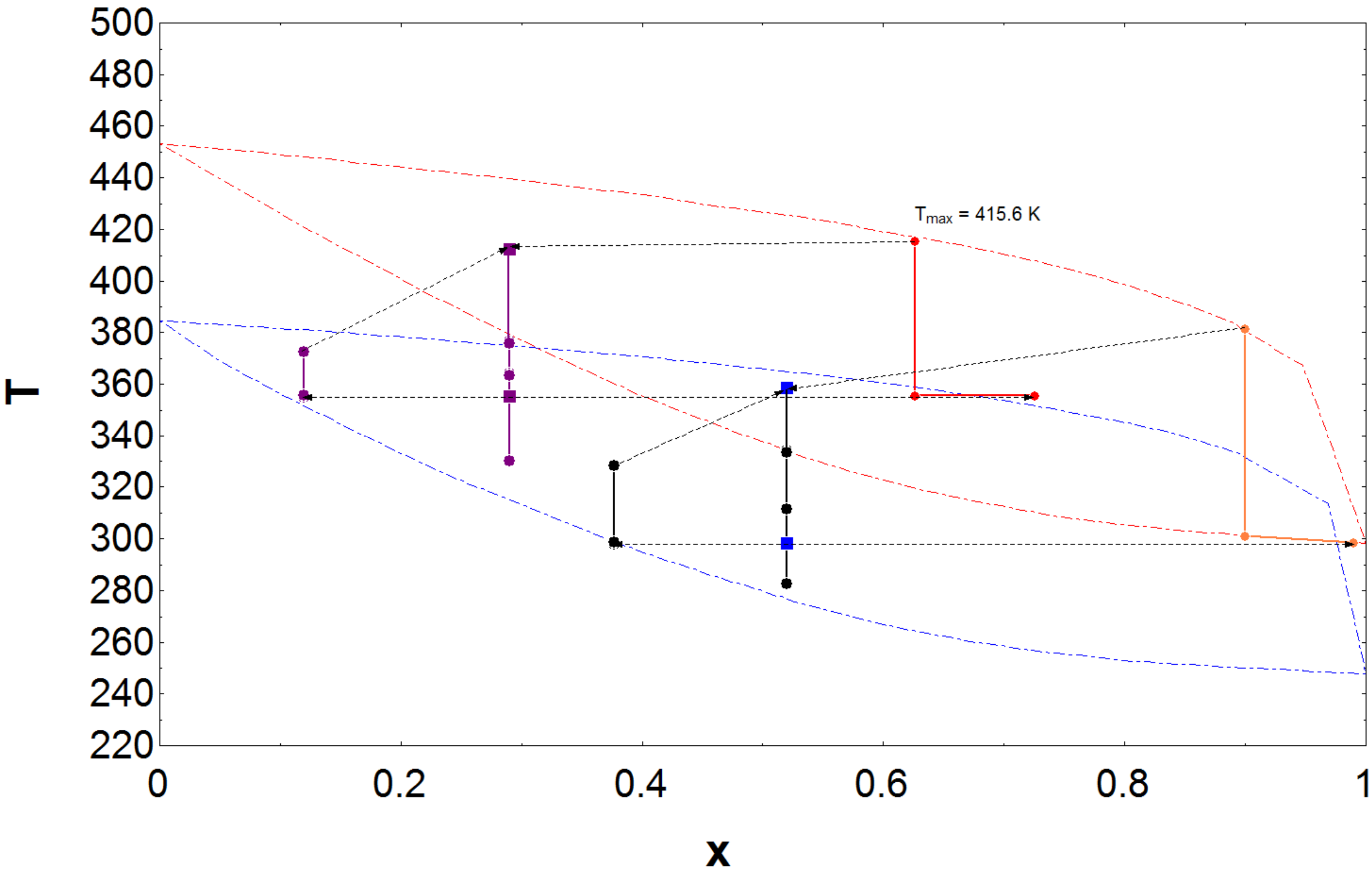

Figure B.6 - Temperature-concentration diagram for liquid injection (Base model)

Appendix C - Characteristics of model due to change in pressure

Table C.1 – Parameter change over LT cycle compressor

Compressor LT	Pressure Ratio	Desorber Pressure	Mass flow to compressor		Volume flow		Ammonia Concentration		Compressor work	Discharge temperature	
Operating Point	PR	P_min	$m_{sat\_vapour\_in}$	m_{mix_in}	$V_{sat\_vapour\_in}$	V_{mix_in}	$x_{sat\_vapour\_in}$	x_{mix_in}	W_{comp}	T_max	
[bar]		[bar]	[kg/s]	[kg/s]	[m^3/h]	[m^3/h]	% NH3	% NH3	[kW]	[K]	[°C]
10	6.93	1.48	0.051	0.060	180.2	183.2	0.990	0.899	27.00	381.5	108.4
11	6.71	1.68	0.052	0.061	161.9	164.6	0.992	0.905	27.08	383.0	109.9
12	6.44	1.91	0.053	0.062	145.0	147.3	0.993	0.911	26.90	384.1	111.0
13	6.23	2.14	0.054	0.063	131.8	133.9	0.995	0.917	26.88	385.1	112.0
14	5.93	2.42	0.055	0.064	118.1	120.2	0.995	0.923	26.51	385.6	112.5
15	5.80	2.65	0.056	0.065	109.5	111.4	0.996	0.926	26.55	386.6	113.5
16	5.56	2.95	0.057	0.065	99.5	101.3	0.997	0.932	26.19	386.8	113.7
17	5.36	3.25	0.058	0.066	91.4	93.1	0.997	0.936	25.89	387.3	114.2
18	5.27	3.50	0.059	0.067	85.9	87.5	0.998	0.939	25.92	388.0	114.9
19	5.00	3.90	0.060	0.068	77.9	79.3	0.998	0.944	25.26	387.5	114.4
20	4.94	4.15	0.060	0.068	73.7	75.1	0.998	0.947	25.26	388.2	115.1

Table C.2 - Parameter change over HT cycle compressor

Compressor HT	Pressure Ratio	Desorber Pressure	Mass flow to compressor		Volume flow		Ammonia Concentration		Compressor work	Discharge temperature	
Operating Point	PR	P_min	$m_{sat\_vapour\_in}$	m_{mix_in}	$V_{sat\_vapour\_in}$	V_{mix_in}	$x_{sat\_vapour\_in}$	x_{mix_in}	W_{comp}	T_max	
[bar]		[bar]	[kg/s]	[kg/s]	[m^3/h]	[m^3/h]	% NH3	% NH3	[kW]	[K]	[°C]
10	5.50	1.87	0.054	0.064	177.6	178.6	0.740	0.641	28.45	416.20	143.05
11	5.37	2.10	0.055	0.065	160.8	161.7	0.767	0.666	28.58	417.30	144.15
12	5.30	2.32	0.055	0.066	147.8	148.6	0.785	0.684	28.84	418.80	145.65
13	5.29	2.52	0.056	0.067	138.3	139.1	0.802	0.700	29.24	420.10	146.95
14	5.20	2.76	0.057	0.068	127.9	128.6	0.819	0.716	29.26	421.00	147.85
15	4.99	3.08	0.058	0.068	116.5	117.1	0.834	0.733	28.88	421.70	148.55
16	4.94	3.32	0.059	0.069	109.4	110.0	0.849	0.748	29.03	422.30	149.15
17	4.84	3.60	0.059	0.070	102.1	102.6	0.862	0.761	28.96	422.80	149.65
18	4.79	3.85	0.060	0.071	96.8	97.3	0.870	0.770	29.20	423.70	150.55
19	4.64	4.20	0.061	0.071	89.5	90.0	0.883	0.785	28.77	423.60	150.45
20	4.61	4.45	0.061	0.072	85.6	86.0	0.890	0.792	28.98	424.50	151.35

Table C.3 – Temperature glide over the heat exchangers

Heat exchanger glide	Desorber	Desorber/Absorber	Absorber/Desorber	Absorber
[bar]	[K]	[K]	[K]	[K]
10	15.33	25.28	24.33	35.90
11	15.39	26.18	24.50	36.96
12	15.65	26.74	24.94	37.66
13	15.47	27.30	24.77	38.37
14	15.51	27.75	24.87	38.83
15	15.52	28.29	25.11	39.23
16	15.53	28.65	25.29	39.60
17	15.57	28.95	25.66	39.83
18	15.50	29.24	25.98	40.13
19	15.16	29.38	25.98	40.06
20	15.45	29.58	27.39	40.26

Table C.4 – LT cycle performance and overall parameter

LT Cycle evaluation	Coefficient of Performance		Templift	Concentration	Pressure Ratio	Economizer	Massflow
Operating Point	COP_c	COP_h	ΔT_lift	x_OP	PR	Q_econ	m_OP
[bar]			[K]	% NH3		[kW]	[kg/s]
10	2.35	3.34	55.86	0.518	6.93	21.87	0.219
11	2.34	3.33	56.21	0.540	6.71	21.15	0.213
12	2.36	3.35	56.25	0.565	6.44	19.68	0.204
13	2.36	3.35	56.44	0.585	6.23	19.25	0.200
14	2.40	3.38	56.18	0.610	5.93	17.81	0.191
15	2.40	3.38	56.62	0.630	5.80	16.96	0.184
16	2.43	3.42	56.47	0.655	5.56	15.47	0.174
17	2.46	3.45	56.53	0.680	5.36	14.03	0.164
18	2.46	3.45	57.07	0.700	5.27	13.14	0.157
19	2.53	3.51	56.58	0.729	5.00	11.59	0.147
20	2.53	3.52	57.52	0.755	4.94	9.96	0.135

Table C.5 – HT cycle performance and overall parameters

HT Cycle evaluation	Coefficient of Performance		Templift	Concentration	Pressure Ratio	Economizer	Massflow
	COP_c	COP_h	ΔT_lift	x_OP	PR	Q_econ	m_OP
			[K]	% NH3		[kW]	[kg/s]
10	3.19	4.13	51.48	0.300	5.50	9.44	0.19
11	3.17	4.12	51.38	0.320	5.37	8.87	0.19
12	3.14	4.08	51.67	0.335	5.30	8.67	0.19
13	3.09	4.04	52.20	0.350	5.29	8.57	0.19
14	3.07	4.02	52.28	0.365	5.20	8.36	0.19
15	3.11	4.06	51.60	0.380	4.99	7.77	0.19
16	3.08	4.03	51.82	0.395	4.94	7.67	0.19
17	3.08	4.03	51.74	0.409	4.84	7.48	0.19
18	3.05	4.00	52.01	0.420	4.79	7.44	0.19
19	3.07	4.02	51.49	0.435	4.64	7.17	0.19
20	3.05	3.99	51.84	0.445	4.61	7.20	0.19

Table C.6 Overall performance of the TSHHP

Overall cycle	Coefficient of Performance		Templift
Operating Point	COP_c	COP_h	ΔT_lift_high
[bar]			[K]
10	1.15	2.11	104.1
11	1.14	2.11	104.2
12	1.14	2.11	105.1
13	1.13	2.10	105.6
14	1.14	2.11	105.9
15	1.15	2.11	106.0
16	1.15	2.12	106.0
17	1.16	2.13	106.0
18	1.16	2.12	106.6
19	1.18	2.14	105.9
20	1.18	2.14	106.6

Table C.7 – LT cycle liquid recirculation

LT Pump	Massflow	Concentration	Pump work	Volumeflow
Operating Point	m_pump	x_pump	W_{pump}	$V_{sat\_liquid\_in}$
[bar]	[kg/s]	[kg NH3/kg total]	[kW]	[m^3/h]
10	0.168	0.375	0.666	0.697
11	0.161	0.394	0.660	0.673
12	0.151	0.415	0.636	0.633
13	0.146	0.433	0.634	0.616
14	0.136	0.453	0.608	0.579
15	0.128	0.469	0.590	0.549
16	0.117	0.489	0.558	0.509
17	0.107	0.508	0.519	0.465
18	0.098	0.522	0.494	0.433
19	0.087	0.545	0.449	0.388
20	0.075	0.559	0.396	0.335

Table C.8 - HT cycle liquid recirculation

HT Pump	Massflow	Concentration	Pump work	Volumeflow
Operating Point	m_pump	x_pump	W_{pump}	$V_{sat\_liquid\_in}$
[bar]	[kg/s]	[kg NH3/kg total]	[kW]	[m^3/h]
10	0.136	0.126	0.523	0.537
11	0.135	0.139	0.535	0.536
12	0.135	0.150	0.549	0.536
13	0.134	0.160	0.562	0.535
14	0.133	0.171	0.576	0.535
15	0.132	0.182	0.587	0.535
16	0.132	0.193	0.600	0.535
17	0.131	0.204	0.612	0.535
18	0.130	0.212	0.625	0.534
19	0.129	0.225	0.636	0.534
20	0.129	0.233	0.649	0.533

Table C.9 – External heat transfer fluid parameter change

Heating heat transfer fluid stream						
Inlet temperature		Exit temperature		Mass flow	Efficiency	Work
T_hwi		T_hwe		m_dot_hw	η	W_cir_hw
[K]	[°C]	[K]	[°C]	[kg/s]		[kW]
290.0	16.9	412.4	139.3	0.238	0.999	0.032
294.7	21.6	412.4	139.3	0.247	0.998	0.033
299.5	26.4	412.3	139.2	0.258	0.998	0.034
304.2	31.1	412.3	139.2	0.269	0.997	0.036
308.9	35.8	412.2	139.1	0.282	0.996	0.038
313.7	40.6	412.1	139.0	0.296	0.995	0.040
318.4	45.3	412.0	138.9	0.311	0.993	0.042
323.2	50.1	411.8	138.7	0.328	0.991	0.044
327.9	54.8	411.6	138.5	0.348	0.989	0.047
332.6	59.5	411.4	138.3	0.369	0.985	0.050
337.4	64.3	411.1	138.0	0.394	0.981	0.054
342.1	69.0	410.8	137.7	0.423	0.975	0.058
346.8	73.7	410.4	137.3	0.457	0.966	0.062
351.6	78.5	409.9	136.8	0.498	0.956	0.068
356.3	83.2	409.3	136.2	0.548	0.941	0.075
361.1	88.0	408.5	135.4	0.610	0.921	0.084
365.8	92.7	407.6	134.5	0.692	0.893	0.096
370.5	97.4	406.4	133.3	0.805	0.853	0.112
375.3	102.2	405.0	131.9	0.972	0.795	0.135
380.0	106.9	403.1	130.0	1.246	0.709	0.174

Table C.10 – External heat transfer fluid parameter change

Cooling heat transfer fluid stream						
Inlet temperature		Exit temperature		Mass flow	Efficiency	Work
T_cwi		T_cwe		m_dot_cw	η	W_cir_cw
[K]	[°C]	[K]	[°C]	[kg/s]		[kW]
380.0	106.9	283.1	10.0	0.159	0.999	0.022
375.7	102.6	283.1	10.0	0.166	0.999	0.023
371.4	98.3	283.1	10.0	0.175	0.999	0.024
367.1	94.0	283.1	10.0	0.184	0.998	0.025
362.7	89.6	283.2	10.1	0.194	0.998	0.027
358.4	85.3	283.2	10.1	0.206	0.997	0.028
354.1	81.0	283.3	10.2	0.219	0.996	0.030
349.8	76.7	283.4	10.3	0.234	0.994	0.032
345.5	72.4	283.5	10.4	0.251	0.992	0.034
341.2	68.1	283.7	10.6	0.270	0.988	0.037
336.8	63.7	283.9	10.8	0.294	0.983	0.040
332.5	59.4	284.2	11.1	0.322	0.976	0.044
328.2	55.1	284.6	11.5	0.356	0.965	0.048
323.9	50.8	285.1	12.0	0.400	0.950	0.054
319.6	46.5	285.7	12.6	0.459	0.926	0.062
315.3	42.2	286.5	13.4	0.541	0.890	0.073
310.9	37.8	287.7	14.6	0.668	0.833	0.090
306.6	33.5	289.2	16.1	0.890	0.739	0.119
302.3	29.2	291.2	18.1	1.403	0.574	0.188
298.0	24.9	292.7	19.6	2.124	0.430	0.284

Appendix D - Optimized model

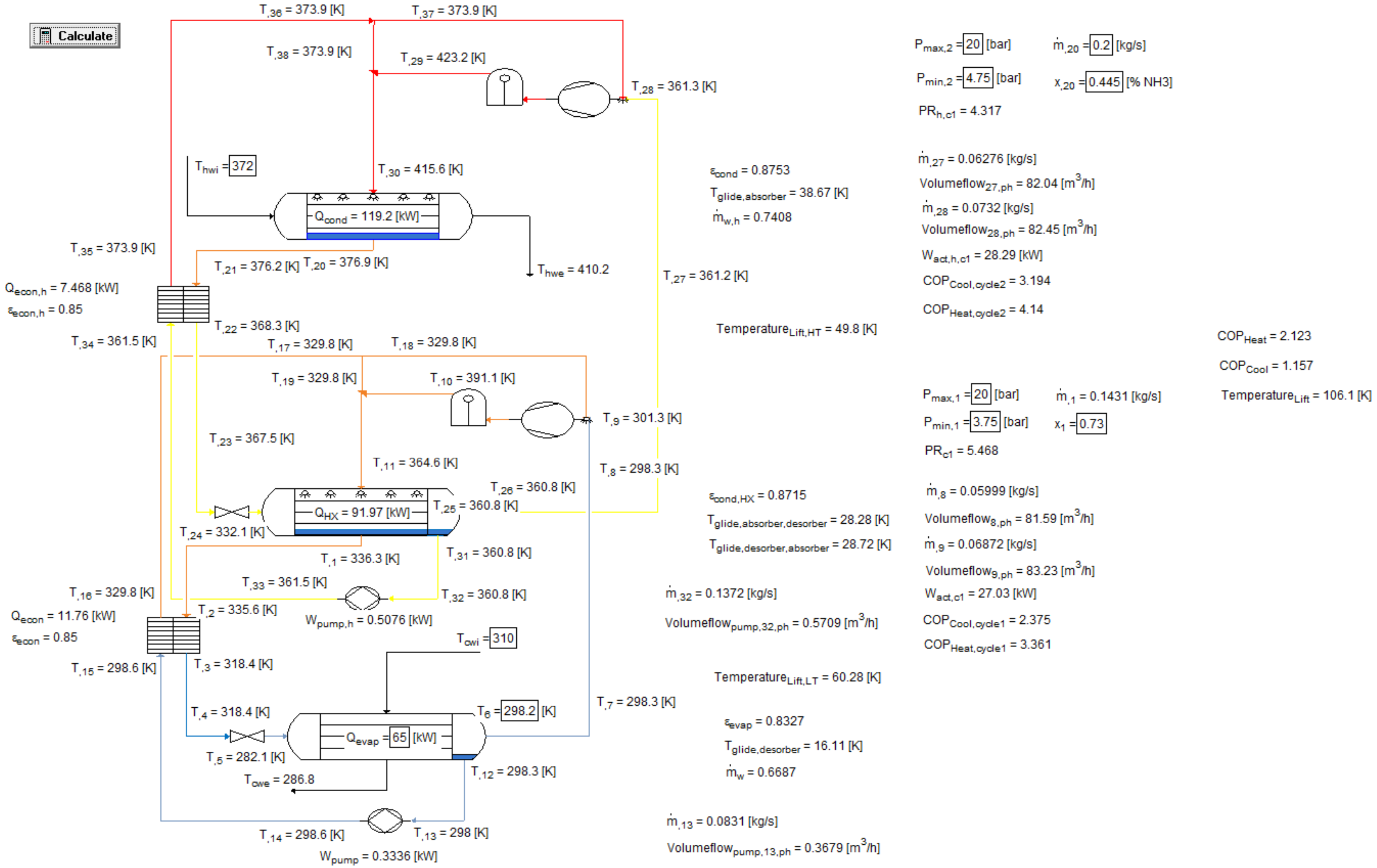

Figure D.1 – Optimized model results

Table D.1 – Different properties for each point in optimized cycle

Sort	1 $\dot{m}_i$ [kg/s]	2 $\bar{P}_i$ [bar]	3 $\bar{T}_i$ [K]	4 $\bar{h}_i$	5 $\bar{s}_i$	6 $\bar{u}_i$	7 $\bar{v}_i$	8 $\bar{q}_i$	9 $\bar{x}_i$ [% NH3]
[1]	0.1431	20	336.3	117.4	0.8444	114.5	0.001467	0	0.73
[2]	0.1431	19.9	335.6	114	0.8338	111	0.001465	-0.001	0.73
[3]	0.1431	19.7	318.4	31.79	0.5825	29	0.001415	-0.001	0.73
[4]	0.1431	19.6	318.4	31.79	0.5826	29.02	0.001415	-0.001	0.73
[5]	0.1431	3.75	282.1	31.79	0.6259	14.33	0.04656	0.1305	0.73
[6]	0.1431	3.694	298.2	486.1	2.194	427.4	0.1588	0.4183	0.73
[7]	0.05999	3.694	298.3	1333	4.931	1194	0.3758	1	0.9979
[8]	0.05999	3.694	298.3	1336	4.942	1197	0.3778	0.9997	0.9979
[9]	0.06872	3.694	301.3	1169	4.403	1045	0.3364	0.8795	0.9393
[10]	0.06872	20.2	391.1	1562	4.812	1389	0.08568	1	0.9393
[11]	0.1431	20.2	364.6	760.2	2.684	685.9	0.03678	0.4599	0.73
[12]	0.0831	3.694	298.3	-125.3	0.2181	-125.8	0.00123	0	0.5366
[13]	0.0831	3.694	298	-126.5	0.214	-127	0.00123	-0.001	0.5366
[14]	0.0831	20.2	298.6	-122.5	0.2207	-125	0.001229	-0.001	0.5366
[15]	0.0831	20.18	298.6	-122.5	0.2207	-125	0.001229	-0.001	0.5366
[16]	0.0831	19.98	329.8	18.94	0.6713	16.39	0.001277	-0.001	0.5366
[17]	0.0831	19.96	329.8	18.94	0.6713	16.39	0.001277	-0.001	0.5366
[18]	0.008733	19.96	329.8	18.94	0.6713	16.39	0.001277	-0.001	0.5366
[19]	0.07437	19.96	329.8	18.94	0.6713	16.39	0.001277	-0.001	0.5366
[20]	0.2	20	376.9	235.2	1.292	232.6	0.001312	0	0.445
[21]	0.2	19.9	376.2	231.2	1.281	228.6	0.00131	-0.001	0.445
[22]	0.2	19.7	368.3	193.9	1.181	191.3	0.001291	-0.001	0.445
[23]	0.2	19.6	367.5	189.9	1.17	187.3	0.001289	-0.001	0.445
[24]	0.2	4.75	332.1	189.9	1.206	172.3	0.0369	0.1091	0.445
[25]	0.2	4.679	360.8	649.7	2.529	596	0.1146	0.3138	0.445
[26]	0.06276	4.679	360.8	1595	5.541	1425	0.3627	1	0.8942
[27]	0.06276	4.679	361.2	1596	5.543	1426	0.3631	1.001	0.8942
[28]	0.0732	4.679	361.3	1407	4.94	1261	0.3129	0.8611	0.8008
[29]	0.0732	20.2	423.2	1794	5.307	1607	0.09269	1	0.8008
[30]	0.2	20.2	415.6	831.3	2.79	774.7	0.02802	0.2972	0.445
[31]	0.1372	4.679	360.8	217.4	1.152	216.8	0.001156	0	0.2396
[32]	0.1372	4.679	360.8	217.4	1.152	216.8	0.001156	-0.001	0.2396
[33]	0.1372	20.2	361.5	221.1	1.157	218.8	0.001156	-0.001	0.2396
[34]	0.1372	20.18	361.5	221.1	1.158	218.8	0.001156	-0.001	0.2396
[35]	0.1372	19.98	373.9	275.5	1.306	273.2	0.001174	-0.001	0.2396
[36]	0.1372	19.96	373.9	275.6	1.306	273.2	0.001174	-0.001	0.2396
[37]	0.01044	19.96	373.9	275.6	1.306	273.2	0.001174	-0.001	0.2396
[38]	0.1268	19.96	373.9	275.6	1.306	273.2	0.001174	-0.001	0.2396

Appendix E - Aspen validation results

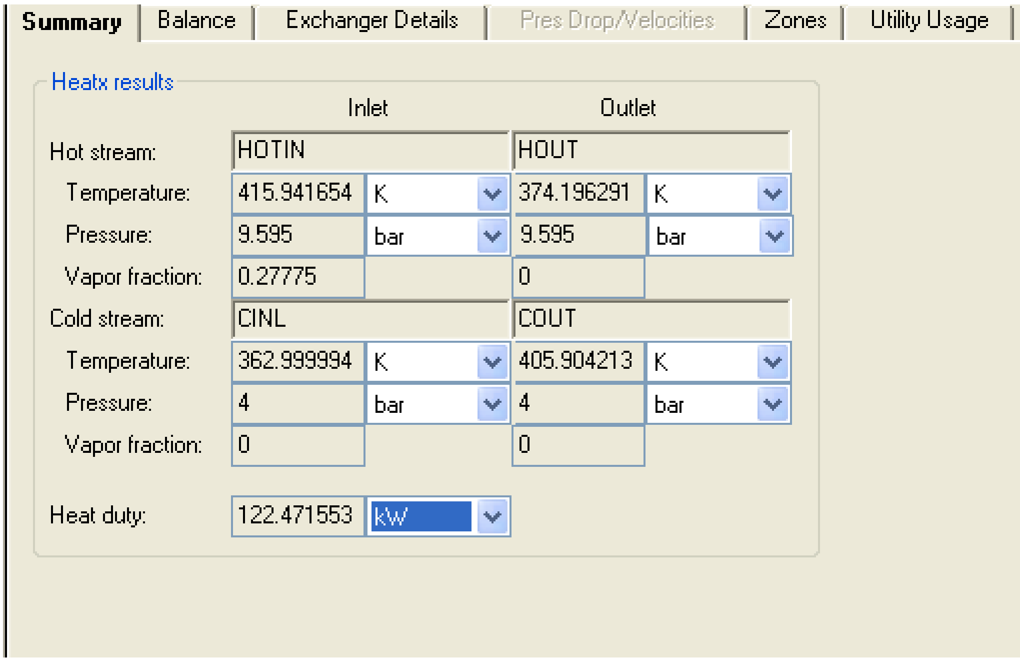

Figure E.1 – Absorber heat transfer validation

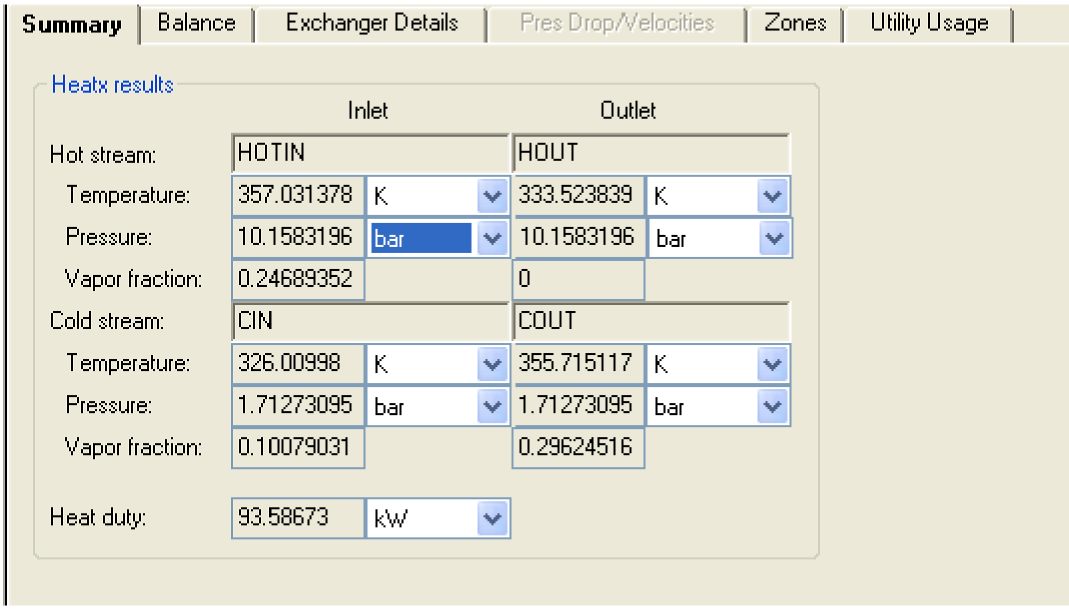

Figure E.2 – Absorber/Desorber heat transfer validation

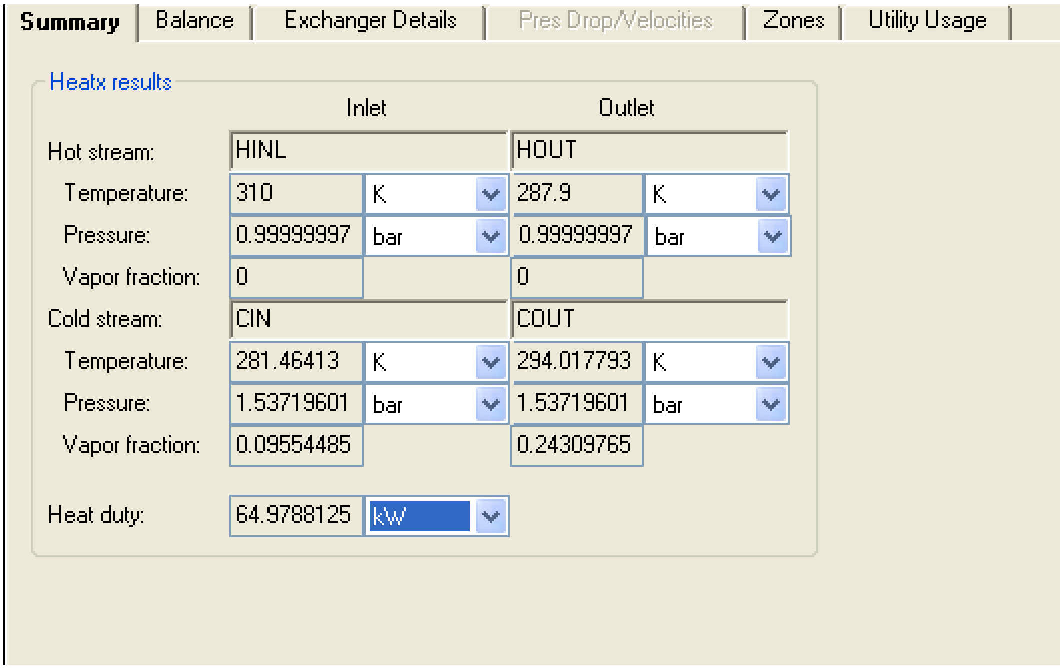

Figure E.3 – Desorber heat transfer validation

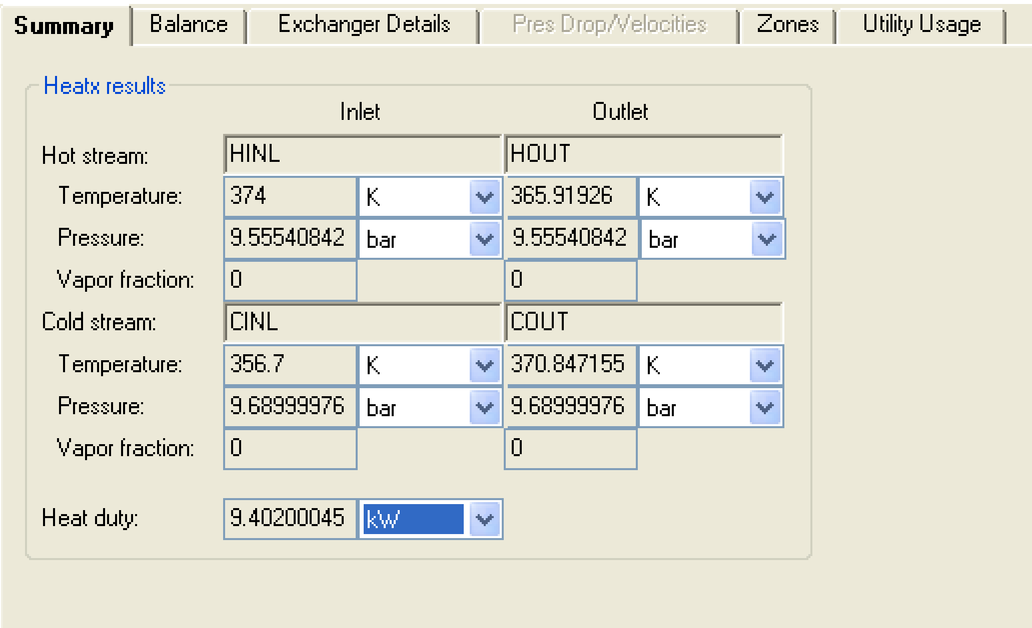

Figure E.4 – HT economizer heat transfer validation

LT Economizer

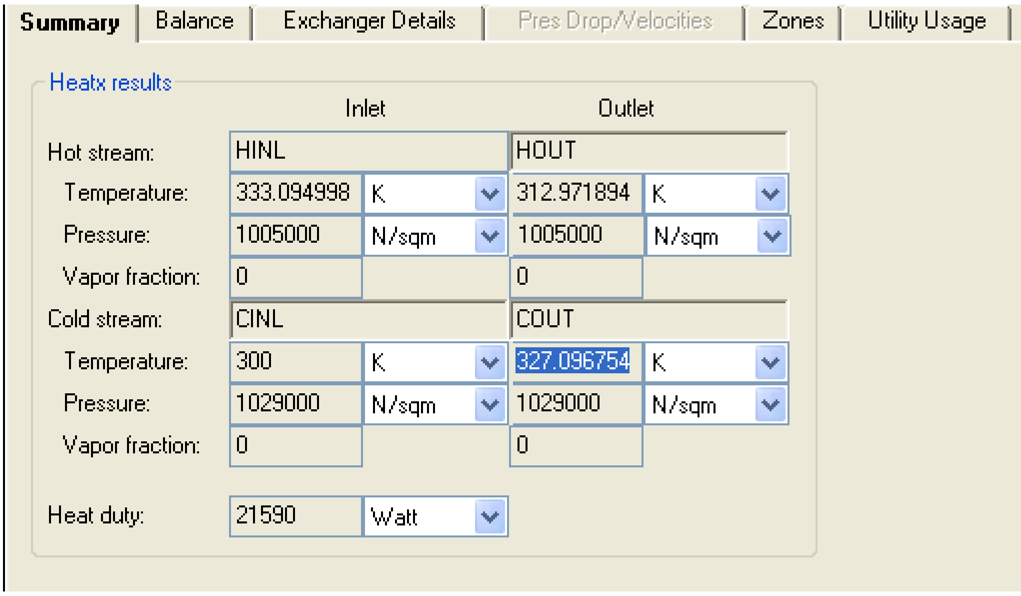

Figure E.5 – LT economizer heat transfer validation

Appendix F - Heat loss calculation

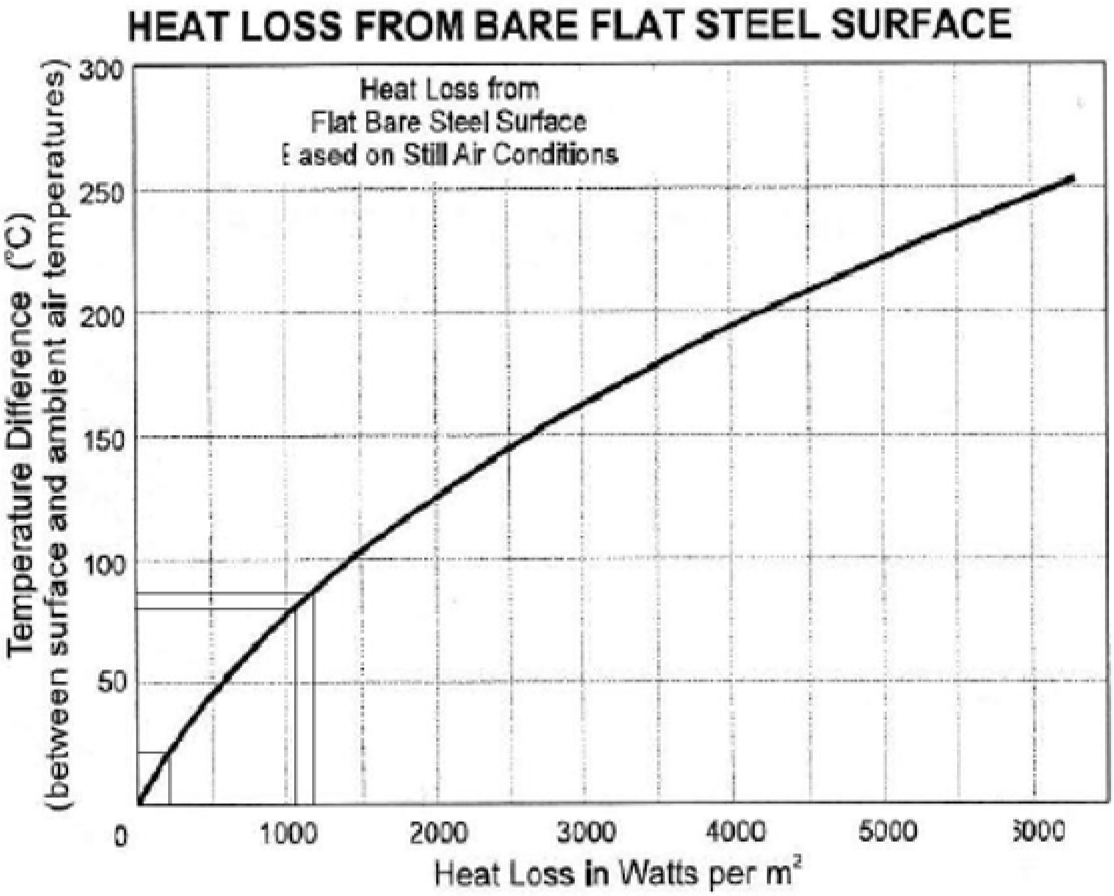

Figure F.1 – Bare surface heat loss

Table F.1 – Calculation of Bare surface heat loss ethanol production process

Bare surface	Tank Volume		Length	Area_HT	T_max	T_amb	Delta_T	Heat loss	Q
Heat transfer	[l]	[m^3]	[m]	[m^2]	[°C]	[°C]	[°C]	[W/m^2]	[kW]
Cook Tank	4047	4.05	1.59	12.70	105	20	85.00	1100	13.97
Fermentation tank	4047	4.05	1.59	12.70	37	20	17.00	200	2.54
Distillation	4047	4.05	1.59	12.70	101.5	20	81.50	1050	13.33

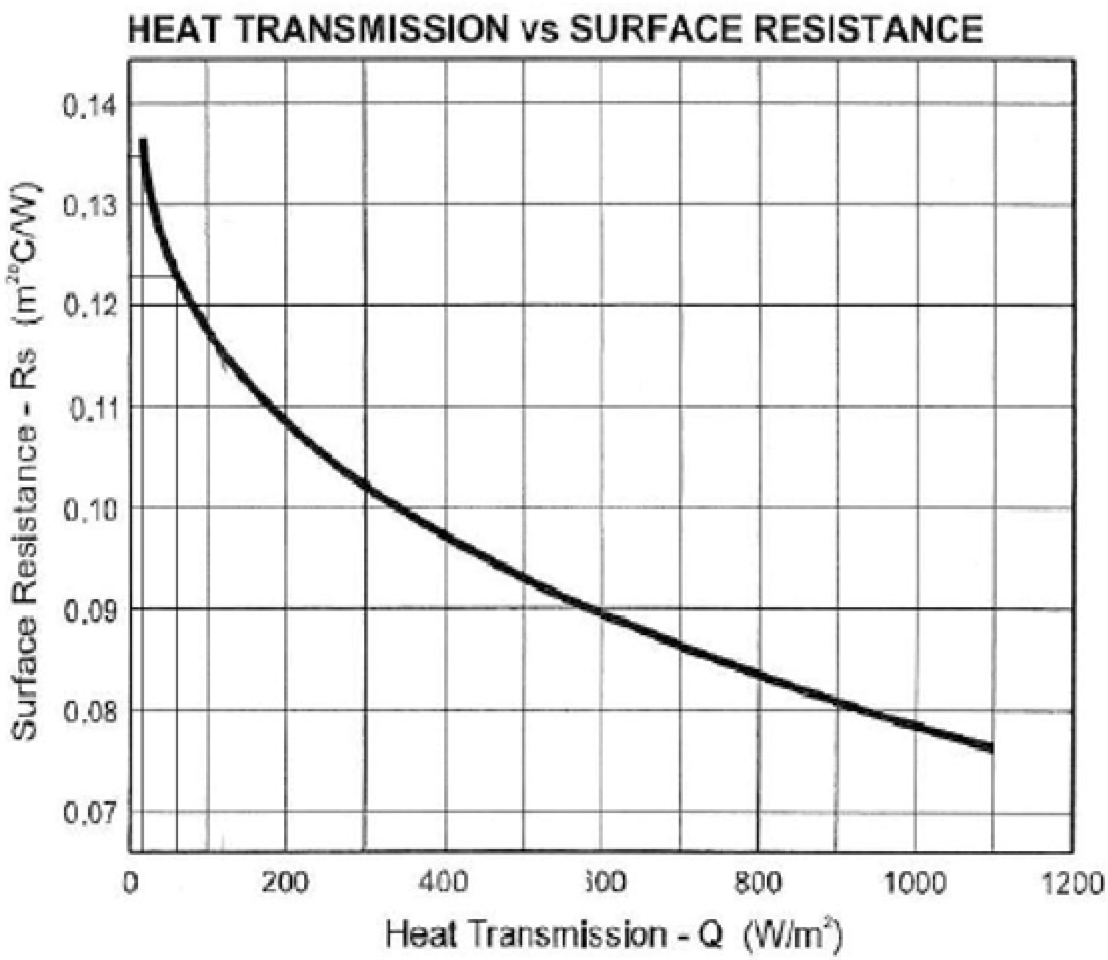

Figure F.2 – Heat transmission vs. Surface resistance

Table F.2 – Calculation of losses with insulation

Insulation heat losses	Thickness	Transfer coefficient	Resistance	Surface resistance	Delta_T	Q
	T [m]	k	R	Rs	[°C]	[W]
Cook Tank	0.05	0.045	1.11	0.122	85.00	68.93
Fermentation tank	0.05	0.045	1.11	0.135	17.00	13.64
Distillation	0.05	0.045	1.11	0.122	81.50	66.09

Appendix G - Conventional system selection criteria

Table G.1 – Properties of steam for heating of tanks

Boiler	Temperature		Enthalpy	Pressure
	[°C]	[K]	[kJ/kg.K]	[kPa]
Heat exchanger in	120.25	393.4	2707	200
Saturated liquid out	105.05	378.2	440.2	120.8
Feedwater	80	353.2	335	120.8
Boiler steam exit	179.85	453	2778	1000

Table G.2 – Boiler selection criteria

Boiler selction		
Q_required	120.00	[kW]
Mass flow	0.05	[kg/s]
Mass flow	190.58	[kg/h]
Mass_Blowdown	19.06	[kg/h]
Mass flow_total	**211.75**	**[kg/h]**
Q_boiler	143.70	[kW]
Boiler rating	**146.63**	**[kW]**

Table G.3 – Properties of water for cooling of tanks

Cooling tower	Temperature		Enthalpy	Pressure
	[°C]	[K]	[kJ/kg.K]	[kPa]
Liquid in	35	308.15	146.7	100
Liquid out	25	298.15	104.8	100

Table G.4 – Cooling tower selection criteria

Cooling tower selction		
Q_required	**65**	**[kW]**
Mass flow	1.55	[kg/s]
Volume flow	**0.001563**	**[m^3/s]**

Appendix H - Heat exchanger cost for TSHHP

Table H.1 – Heat exchanger cost analysis from ELROX engineering

Base model	Engineering	Drafting	AIA	Material	Fabrication	Total
Heat exchanger cost						
Absorber	R 2 500	R 3 500	R 2 500	R 29 300	R 43 950	R 81 750
Absorber/Desorber	R 2 500	R 3 500	R 2 500	R 36 100	R 54 150	R 98 750
Desorber	R 2 500	R 3 500	R 2 500	R 27 000	R 40 500	R 76 000
LT economizer	R 2 500	R 3 500	R 2 500	R 39 000	R 58 500	R 106 000
HT economizer	R 2 500	R 3 500	R 2 500	R 29 500	R 44 250	R 82 250
Total						R 444 750

Table H.2 – Cost interpolation for economizer reduction in heat transfer

Cost interpolation	Base model data			Optimized model data		
	[kW]	UA	R/UA	[kW]	UA	Material cost
LT economizer	22.05	2624.47	R 14.86	11.68	1390.48	R 20 662.70
HT economizer	9.55	1847.94	R 15.96	7.26	1403.29	R 22 401.76

Table H.3 – Heat exchanger cost for optimized model

Optimized model	Engineering	Drafting	AIA	Material	Fabrication	Total
Heat exchanger cost						
Absorber	R 2 500	R 3 500	R 2 500	R 29 300	R 43 950	R 81 750
Absorber/Desorber	R 2 500	R 3 500	R 2 500	R 36 100	R 54 150	R 98 750
Desorber	R 2 500	R 3 500	R 2 500	R 27 000	R 40 500	R 76 000
LT economizer	R 2 500	R 3 500	R 2 500	**R 20 663**	R 30 994	R 60 157
HT economizer	R 2 500	R 3 500	R 2 500	**R 22 402**	R 33 603	R 64 504
Total						R 381 161

Appendix I - Cost analysis

Table I.1 – Conventional cycle installation cost

Conventional cycle cost					
Component	**Supplier**	**Type**	**Price EA**	**Quantity**	**Cost**
Boiler	John thomson boilers	Electropac - 250	R 500 000	1	R 500 000
		Max 171 kw - 274 kg/h			
Condensate pump	denorco	Orbit B-Range B0104 Standard Cast Iron pump	R 6 244	1	R 6 244
		Base plate, coupling and v belt Standard mild steel	R 4 314	1	R 4 314
	Zest Electrical Motor	1.1kW;380V	R 1 920	1	R 1 920
Controls	Spirax Sarco	Pressure reducing station & trap set	R 30 871	2	R 61 742
		Trap set	R 4 866	8	R 38 928
		Temperature control unit	R 18 878	7	R 132 146
Evaporative cooling tower	BAC Aircoil	VXI 18-2 - 65kW	R 105 000	1	R 105 000
	Pump	CMB 100 - 1.5kW	R 3 600	1	R 3 600
Controls	Johnson control	Shut off valve - 25mm	R 2 218	4	R 8 872
		Temperature control valve - 25mm	R 2 218	2	R 4 436
		Electronic three port valve - 25 mm	R 2 324	4	R 9 295
Total					**R 876 497**

Table I.2 – TSHHP cycle installation cost

TSHHP cycle cost						
Component	**Supplier**	**Type**	**Price EA**	**Quantity**	**Base Model**	**Optimized model**
Compressor	Bitzer	OSKA 5341	R 45 843	2		R 91 686
		OSKA 7441	R 78 914	2	R 157 828	
Heat exchangers	Elrox design	Absorber		1	R 81 750	R 81 750
		Absorber/Desorber		1	R 98 750	R 98 750
		Desorber		1	R 76 000	R 76 000
		Econimizer LT		1	R 106 000	R 60 157
		Econimizer HT		1	R 82 250	R 64 504
Expansion valves	Bitzer		R 4 752	2	R 9 504	R 9 504
Recirculating Pumps	Nocchi	R2C-40-120T	R 5 029	2	R 10 058	
		VLR	R 2	2		
Electric motor	Zest	37 kW	R 19 099	2	R 38 198	R 38 198
Controls	Johnson control	Temperature control valve - 25mm	R 2 218	2	R 4 436	R 4 436
		Temperature control valve - 10mm	R 382	5	R 1 908	R 1 908
		Electronic three port valve - 25 mm	R 2 324	4	R 9 295	R 9 295
		Shut off valve - 25mm	R 2 218	6	R 13 307	R 13 307
Total					**R 689 284**	**R 549 496**