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SUPPORTING INFORMATION (SI)

Improving Energy Efficiency with Heat Exchanger and Optimizing Operating Conditions for Sorbitol Production from Dextrose

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Table S1. Heat and material balance of modified process using Aspen HYSYS

HEAT AND MATERIAL BALANCE										
Stream Number	**Unit**	**Dextrose**	**Water**	**3**	**6**	**5**	**Hidrogen**	**10**	**5a**	**5c**
Total Phase Properties										
Vapour Fraction		0	0	0	0.885930239	1	1	1	1	1
Temperature	*C*	30.00	30.00	30.00	118.21	86.90	30.00	87.73	426.46	495.69
Pressure	*kPa*	101.32	101.32	101.32	4000.00	303.97	303.97	303.97	2000.00	3000.00
Molar Flow	*kgmole/h*	21.85731763	327.8436648	349.7009824	2305.492227	1955.791244	28.29784328	1927.493401	1955.791244	1955.791244
Mass Flow	*tonne/year*	3.449E+04	5.174E+04	8.623E+04	1.208E+05	3.456E+04	502.3847939	3.406E+04	3.456E+04	3.456E+04
Liquid Volume Flow	*m3/h*	3.335509532	5.91757815	9.253087682	114.0003988	104.7473111	1.515005053	103.2323061	104.7473111	104.7473111
Heat Flow	*kJ/h*	-2.783E+07	-9.358E+07	-1.214E+08	-1.094E+08	3.488E+06	-41.25332019	3.488E+06	2.294E+07	2.693E+07
Stream Number	**Unit**	**Dextrose**	**Water**	**3**	**6**	**5**	**Hidrogen**	**10**	**5a**	**5c**
Composition										
Comp Mole Frac (Dextrose)	*mole %*	0.999943808	0	0.062499365	0.00948001	8.67E-16	0	8.80E-16	8.67E-16	8.67E-16
Comp Mole Frac (Sodium-Sulfate)	*mole %*	2.54E-05	0	1.59E-06	2.40E-07	2.43E-48	0	2.46E-48	2.43E-48	2.43E-48
Comp Mole Frac (Sodium-Chloride)	*mole %*	3.08E-05	0	1.93E-06	2.92E-07	3.02E-31	0	3.06E-31	3.02E-31	3.02E-31
Comp Mole Frac (Hydrogen)	*mole %*	0	0	0	0.848239356	0.999906942	0.999311191	0.999915689	0.999906942	0.999906942
Comp Mole Frac (Methane)	*mole %*	0	0	0	7.20E-05	8.49E-05	0.000126328	8.43E-05	8.49E-05	8.49E-05
Comp Mole Frac (Sorbitol)	*mole %*	0	0	0	2.75E-16	3.24E-16	0	3.28E-16	3.24E-16	3.24E-16
Comp Mole Frac (Water)	*mole %*	0.000562481	0	8.14E-06	8.14E-06	8.14E-06	8.14E-06	0.053727142	0.906520306	0.143567725
Total	***mole %***	**1.00E+00**	**0.00E+00**	**6.25E-02**	**8.58E-01**	**1.00E+00**	**9.99E-01**	**1.05E+00**	**1.91E+00**	**1.14E+00**

Stream Number	**Unit**	**7out**	**12**	**13**	**15**	**Sorbitol**	**8a**	**3i**	**5ai**	**3ii**
Total Phase Properties										
Vapour Fraction		0.85413122	1	0	1	0	1	0	1	0
Temperature	*C*	75.00	74.47	74.47	50.20	50.20	75.00	90.00	388.56	150.00
Pressure	*kPa*	4000.00	101.32	101.32	10.13	10.13	303.97	101.32	2000.00	4000.00
Molar Flow	*kgmole/h*	2283.657994	1.382095135	331.73231	215.3619151	116.3703949	1950.543588	349.7009824	1955.791244	349.7009824
Mass Flow	*tonne/year*	1.208E+05	91.93115556	8.378E+04	3.398E+04	4.979E+04	3.692E+04	8.623E+04	3.456E+04	8.623E+04
Liquid Volume Flow	*m3/h*	112.2366556	0.05695504	8.334960227	3.887839312	4.447120915	103.8447404	9.253087682	104.7473111	9.253087682
Heat Flow	*kJ/h*	-1.179E+08	-1.142E+05	-1.164E+08	-5.189E+07	-5.615E+07	-1.424E+06	-1.192E+08	2.077E+07	-1.168E+08
Stream Number	**Unit**	**7out**	**12**	**13**	**15**	**Sorbitol**	**8a**	**3i**	**5ai**	**3ii**
Composition										
Comp Mole Frac (Dextrose)	*mole %*	9.57E-06	3.19E-14	6.59E-05	1.67E-14	0.000187815	8.71E-16	0.062499365	8.67E-16	0.062499365
Comp Mole Frac (Sodium-Sulfate)	*mole %*	2.43E-07	8.22E-47	1.67E-06	7.40E-49	4.76E-06	2.44E-48	1.59E-06	2.43E-48	1.59E-06
Comp Mole Frac (Sodium-Chloride)	*mole %*	2.95E-07	1.09E-29	2.03E-06	1.93E-30	5.79E-06	3.03E-31	1.93E-06	3.02E-31	1.93E-06
Comp Mole Frac (Hydrogen)	*mole %*	0.846788361	0.651293715	4.57E-05	7.05E-05	4.95E-10	0.990933859	0	0.999906942	0
Comp Mole Frac (Methane)	*mole %*	7.27E-05	0.000934916	1.52E-06	2.35E-06	4.86E-10	8.42E-05	0	8.49E-05	0
Comp Mole Frac (Sorbitol)	*mole %*	0.009561078	1.16E-14	0.065818832	2.07E-15	0.187627045	3.25E-16	0	3.24E-16	0
Comp Mole Frac (Water)	*mole %*	0.143567725	0.347771369	0.934064315	0.999927195	0.812174585	0.008981915	0.937497123	8.14E-06	0.937497123
Total	***mole %***	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**

Table S1. Continued

HEAT AND MATERIAL BALANCE									
Stream Number	**Unit**	**5d**	**5e**	**7v**	**7l**	**7feed**	**8**	**11**	**9**
Total Phase Properties									
Vapour Fraction		1	1	1	0	0.894651381	1	0	1
Temperature	*C*	150.00	198.03	125.74	125.74	125.74	75.00	75.00	87.73
Pressure	*kPa*	3000.00	4000.00	4000.00	4000.00	4000.00	4000.00	4000.00	303.97
Molar Flow	*kgmole/h*	1955.791244	1955.791244	2043.077777	240.5802169	2283.657994	1950.543588	333.1144051	1933.023973
Mass Flow	*tonne/year*	3.456E+04	3.456E+04	5.148E+04	6.931E+04	1.208E+05	3.692E+04	8.387E+04	3.416E+04
Liquid Volume Flow	*m3/h*	104.7473111	104.7473111	105.5251048	6.711550812	112.2366556	103.8447404	8.391915267	103.5285113
Heat Flow	*kJ/h*	7.089E+06	9.840E+06	-2.053E+07	-8.886E+07	-1.094E+08	-1.424E+06	-1.165E+08	3.498E+06
Stream Number	**Unit**	**5d**	**5e**	**7v**	**7l**	**7feed**	**8**	**11**	**9**
Composition									
Comp Mole Frac (Dextrose)	*mole %*	8.67E-16	8.67E-16	1.04E-12	9.08E-05	9.57E-06	8.71E-16	6.56E-05	8.79E-16
Comp Mole Frac (Sodium-Sulfate)	*mole %*	2.43E-48	2.43E-48	2.83E-42	2.30E-06	2.43E-07	2.44E-48	1.66E-06	2.46E-48
Comp Mole Frac (Sodium-Chloride)	*mole %*	3.02E-31	3.02E-31	2.25E-27	2.80E-06	2.95E-07	3.03E-31	2.02E-06	3.06E-31
Comp Mole Frac (Hydrogen)	*mole %*	0.999906942	0.999906942	0.946191975	0.00262371	0.846788361	0.990933859	0.002747776	0.999915011
Comp Mole Frac (Methane)	*mole %*	8.49E-05	8.49E-05	8.09E-05	3.47E-06	7.27E-05	8.42E-05	5.40E-06	8.50E-05
Comp Mole Frac (Sorbitol)	*mole %*	3.24E-16	3.24E-16	2.16E-12	0.090756562	0.009561078	3.25E-16	0.065545749	3.28E-16
Comp Mole Frac (Water)	*mole %*	0.008981915	0.931631779	0	1	0	0	0.93163177900131178	0
Total	*mole %*	**1.01E+00**	**1.93E+00**	**9.46E-01**	**1.09E+00**	**8.56E-01**	**9.91E-01**	**6.84E-02**	**1.00E+00**

Stream Number	**Unit**	**5ei**	**19**	**5ci**	**19i**	**16**	**10A**	**17**
Total Phase Properties								
Vapour Fraction		1	0.934007706	1	1	0	1	1
Temperature	*C*	156.43	45.98	425.00	454.88	87.73	87.73	87.73
Pressure	*kPa*	4000.00	10.13	3000.00	100.00	303.97	303.97	303.97
Molar Flow	*kgmole/h*	1955.791244	234.2636262	1955.791244	234.2636262	17.51961599	1913.693733	19.33023973
Mass Flow	*tonne/year*	3.456E+04	3.684E+04	3.456E+04	3.684E+04	2764.838098	3.381E+04	341.5566745
Liquid Volume Flow	*m3/h*	104.7473111	4.26102342	104.7473111	4.26102342	0.316229069	102.4932262	1.035285113
Heat Flow	*kJ/h*	7.457E+06	-5.693E+07	2.286E+07	-5.286E+07	-4.923E+06	3.463E+06	3.498E+04
Stream Number	**Unit**	**5ei**	**19**	**5ci**	**19i**	**16**	**10A**	**17**
Composition								
Comp Mole Frac (Dextrose)	*mole %*	8.67E-16	1.55E-14	8.67E-16	1.55E-14	0	8.79E-16	8.79E-16
Comp Mole Frac (Sodium-Sulfate)	*mole %*	2.43E-48	1.17E-48	2.43E-48	1.17E-48	0	2.46E-48	2.46E-48
Comp Mole Frac (Sodium-Chloride)	*mole %*	3.02E-31	1.84E-30	3.02E-31	1.84E-30	0	3.06E-31	3.06E-31
Comp Mole Frac (Hydrogen)	*mole %*	0.999906942	0.003907238	0.999906942	0.003907238	0	0.999915011	0.999915011
Comp Mole Frac (Methane)	*mole %*	8.49E-05	7.67E-06	8.49E-05	7.67E-06	0	8.50E-05	8.50E-05
Comp Mole Frac (Sorbitol)	*mole %*	3.24E-16	1.97E-15	3.24E-16	1.97E-15	0	3.28E-16	3.28E-16
Comp Mole Frac (Water)	*mole %*	8.14E-06	0.996085088	8.14E-06	0.996085088	1	0	0
Total	*mole %*	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**	**1.00E+00**