

Production of cyanide using thermal plasma: thermodynamic analysis and experimental specific energy consumption

Supporting information

Figure SI F1 Detailed Thermodynamic profile of C-N-H species (1:2:4), e.g. feed of nitrogen and methane

Figure SI F2: Detailed Thermodynamic profile of C-H-N species same as figure 1 but excluding condensed carbon

Figure SI F3: Process diagram

Table SI T1: Experimental data and mass balance (Nitrogen and Propane)

Table SI T2: Experimental data and mass balance (Nitrogen and Methane)

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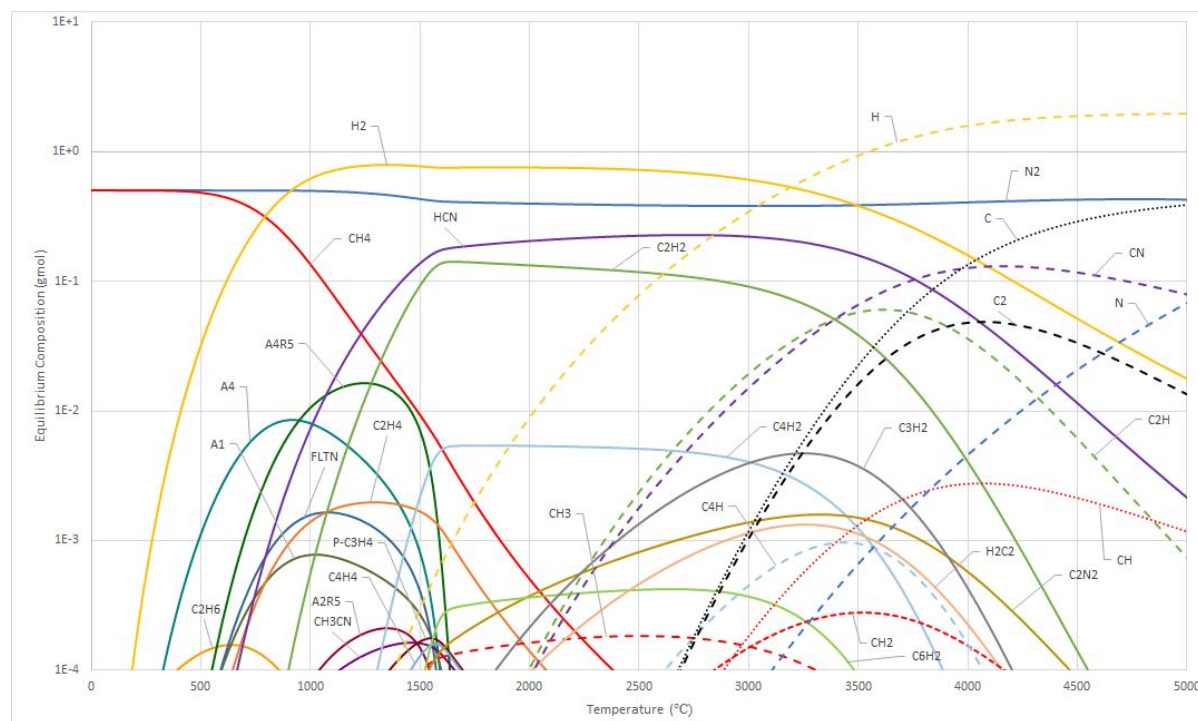


Figure SI-F1 Detailed Thermodynamic profile of C-N-H species (1:2:4), e.g. feed of nitrogen and methane

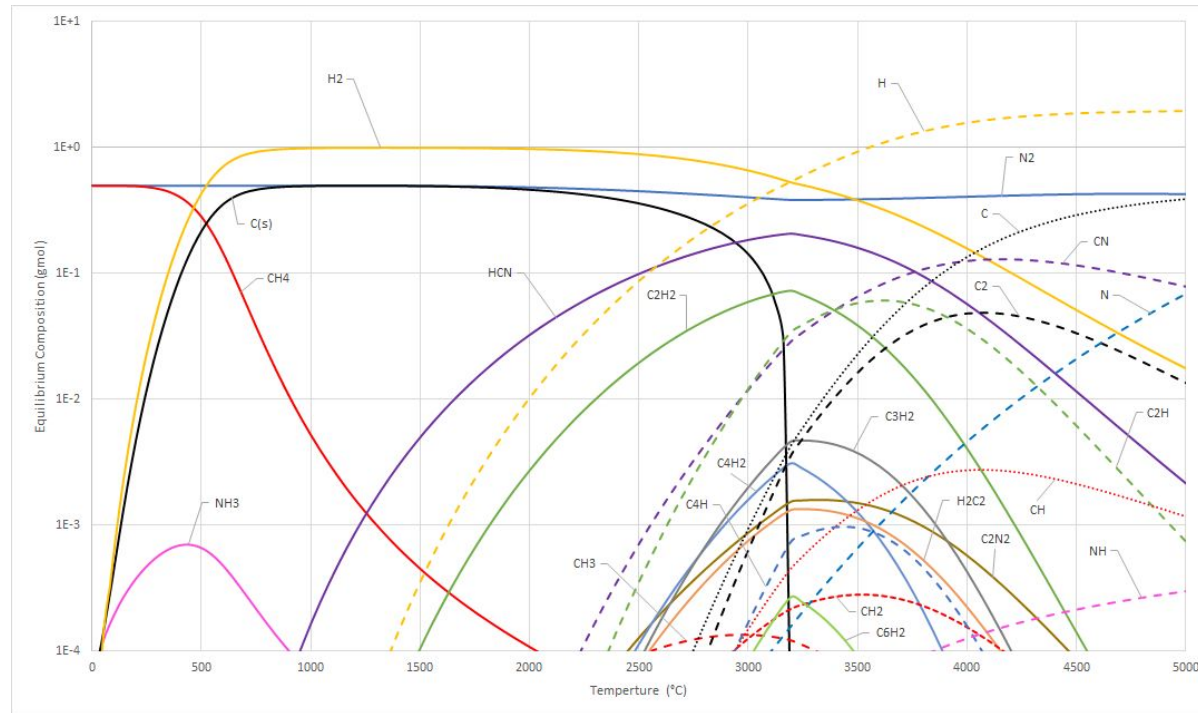


Figure SI-F2: Detailed Thermodynamic profile of C-H-N species same as figure 1 but excluding condensed carbon

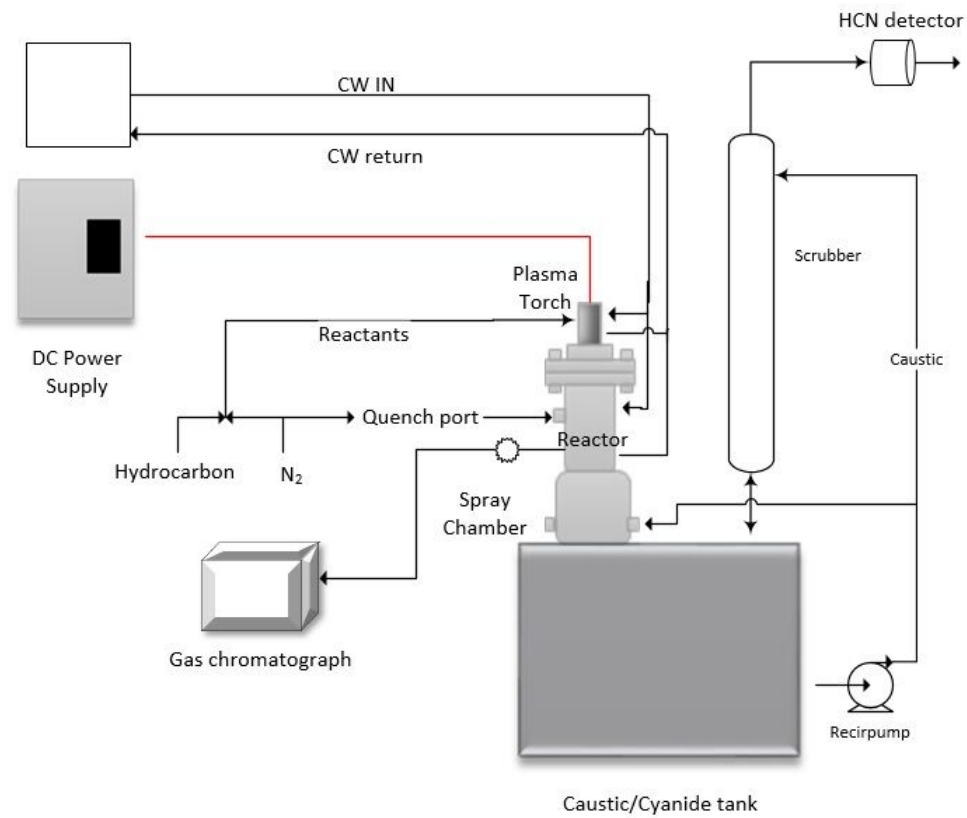


Figure SI-F3: Process flow diagram

34 Table SI-T1: Experimental parameters and mass balance – Nitrogen and Propane

Test No	Nitrogen Flow	Propane Flow	N:C	Nitrogen Mol %	Power	HCN yield	Cyanide conv	SEC (NaCN)	N ₂	C ₃ H ₈	Carbon **	Carbon to Acetylene	Carbon to Soot
	SLPM	SLPM		%	kW	g/min	%	kw-hr/Kg	mol/min	mol/min	mol/min		
1	46.5	7.75	4.00	85.7 %	23	9.25	37%	22.8	1.88	0.31	0.94	36%	27%
2	51	6.25	5.44	89.1 %	23	9.67	47%	21.8	2.06	0.25	0.76		
3	64	7	6.10	90.1 %	23	11.44	50%	18.5	2.58	0.28	0.85		
4	64.25	6	7.14	91.5 %	23	13.57	69%	15.57	2.59	0.24	0.73	19%	12%
5	63.5	4	10.58	94.1 %	23	9.70	74%	21.8	2.56	0.16	0.48	16%	10%
6	64	4	10.67	94.1 %	23	9.73	74%	21.7	2.58	0.16	0.48		
7	63.5	2	21.17	96.9 %	23	5.19	79.45 %	40.8	2.56	0.08	0.24	12%	9%
8	57.5	8	4.79	87.8 %	27	12.27	47%	20.2	2.32	0.32	0.97		
9	64	9	4.74	87.7 %	27	13.16	45%	18.8	2.58	0.36	1.09		
11	72	8.9	5.39	89.0 %	27	15.30	53%	16.2	2.91	0.36	1.08		

12	72	9	5.33	88.9 %	27	16.06	55%	15.4	2.91	0.36	1.09		
13	72	10	4.8	87.8	27	12.40	37.93	19.99	2.91	0.41	1.25		
14	32	1	21.3	97.0 %	14.5	2.42	74%	55.0	1.29	0.04	0.12	15%	11%
15	32	2	10.6	94.1 %	14.5	4.1	63%	32.5	1.29	0.08	0.24		
16	32	3	7.1	91.4 %	14.5	7.17	73%	18.57	1.29	0.12	0.36	19%	8%
17	33.5	4.2	5.3	88.9 %	14.5	6.62	48%	20.1	1.35	0.17	0.51	35%	17%
18	32	4.2	5.1	88.4 %	14.5	6.57	48%	20.3	1.29	0.17	0.51	34%	18%

** The carbon (soot) production was not measured experimentally. It is determined by the mass balance after deducting moles of acetylene and cyanide produced from total carbon supplied. Almost 100% propane was consumed since no major peak was observed in the product analysis. Trace amounts (<10ppm) of benzene was detected. A few small peaks of long chain compounds were found but not characterised.

Test No	Nitrogen Flow	Propane Flow	N:C	Nitrogen Mol %	Power	HCN yield	Cyanide conv	SEC (NaCN)	N2	CH4	Carbon **
	SLPM	SLPM		%	kW	g/min	%	kw-hr/Kg	mol/min	mol/min	mol/min
M1	64	19	6.74	77.1 %	25	12.2	59.5 %	18.7	2.58	0.77	0.77
M2	64	17	7.53	79 %	25	12.07	65 %	19	2.58	0.69	0.69
M3	64	17	7.53	79 %	25	12.1	65 %	19	2.58	0.69	0.69
M4	64.75	13	9.96	83 %	25	11.57	82 %	19.75	2.61	0.52	0.52
M5	65	14	9.15	82%	26	12.95	85%	19.13	2.85	0.62	0.62
M6	64	10	13	87%	25	9.21	85%	24.92	2.90	0.44	0.44
M7	64	7.5	17	90%	25	7.15	87%	32.12	2.90	0.33	0.33
M8	64	7.5	17	90%	25	6.82	85%	34.96	2.85	0.33	0.33
M9	64	5	25.5	93%	25	5.04	92%	45.62	2.85	0.22	0.22

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46 ** The carbon (soot) production was not measured experimentally. It is determined by the mass balance after deducting moles of acetylene and cyanide
47 produced from total carbon supplied. 100% methane was consumed since no major peak was observed in the product analysis.

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