APPENDIX A

EXPERIMENTAL DATA

The data presented in Appendix A represents the majority of the successful runs performed in support of this project. Data has been omitted where runs were either too short to be meaningful (due to equipment malfunctions) or the data was incomplete for the format used here (this was the case with the earliest runs). This data has been selected for inclusion because it is the basis for essentially all of our conclusions and recommendations. While the layout of the data on each page is fairly self-explanatory, a few clarifying comments are warranted:

1. Due to our instrumentation, no single consistent set of units has been used. Thus, pressures are in psia, temperatures in degrees centigrade, gas flows in liters per minute, and liquid volumes in milliliters. The average flow rates were determined over 10 minute intervals due to fluctuations in the flow which affected the reliability of more frequent measurements.

2. Except for values which were read directly from instruments (system pressure, temperature, cumulative outlet of both water and gas, and gas compositions) the number of significant figures included does not reflect the precision of the experiment. The extra significant figures were included for calculational purposes only, and are an artifact of the data processing methods employed.

3. The "water in" and "water out" readings are cumulative.

4. The normalized gas composition data has been adjusted to exclude non-reacting species (oxygen and nitrogen). The nitrogen is residual material from startup of the system and the oxygen is attributed to sample handling by syringe.

5. The water consumption has been estimated based upon the reaction stoichiometry and the calculated average reaction rate. The liquid volume in the reactor has been estimated based upon the density of pure water under the reaction temperature. Agreement between estimated and measured ending liquid volumes was generally within 10%.

6. The units for the calculated values are shown in most cases. Where these units are not indicated alongside the data, they are as follows: mol/liter·hr psi for average and standard deviation of the k values on the row above.

7. The following catalysts and conditions were used in the experiments:

Run #	Catalyst	temp (°C)	press psig
7	0.6M potassium carbonate	250	1000
8	0.6M potassium carbonate	250	1000
15	0.6M sodium carbonate	320	2500
16	0.6M sodium carbonate	330	2500
17	0.6M sodium carbonate	337	2500
18	0.6M sodium carbonate	300	2400
19	0.6M sodium carbonate	300	2500
20	0.6M sodium carbonate	300	2000
22	0.6M sodium carbonate	300	3000
23	0.6M sodium carbonate	330	3000
24	0.6M sodium carbonate	350	3000
25	0.6M sodium citrate	300	3000
26	0.6M cadmium hydroxide	300	3000
27	no catalyst	300	3000
28	no catalyst	300	3000
29	0.6M sodium carbonate	300	3000
30	0.6M ammonium hydroxide	300	3000
31	0.6M ammonium hydroxide	300	3000

The intent of this appendix is to give the reader adequate information to be able to check any of the results or conclusions presented in the body of the report. To this end, every attempt was made to present raw data, rather than pre-processed information.

run #	7						
catalyst temperature	250						
initial catalyst vol. (cc)	470	dip tube experiments					
pressure	2550	standard dip tube					
water density @ temp.	0.799298						
water vap. press. @ temp.	548						
system pressure	1000	1008	1008	1005	1006	1006	1006
time	0.1	20	40	60	80	100	120
outlet flow	0.38	1.5	1.47	0.84	0.72	0.76	0.78
avg outlet flow (liter/min)	0.1	1.205527	1.5	0.836	0.83	1.294	0.774
cumulative outlet	0.01	24	54	70.72	87.32	113.2	128.68
H2	0	0.67	1.62	2.6	3.04	3.08	3.08
CO2	0	25.69	3.11	2.82	3.12	3.36	3.55
CO	1	61.08	92.29	91.25	90.86	92.55	90.56
water out	1	1	1	1	1	1	1
water in	0	0	0	0	0	0	0
10 min avg inlet	0.1	1.023816	1.463435	0.812563	0.803650	1.251908	0.747600
fractional conv.	0	0.177484	0.024985	0.028842	0.032786	0.033622	0.035312
liq. vol.	586.7648	585.8390	583.4899	582.9184	582.4537	581.8170	581.1740
10 min avg rate	0	0.771001	0.155768	0.099937	0.112449	0.179830	0.112913
CO overpressure	4.52	280.968	424.534	417.0125	416.1388	423.879	414.7648
turnover	0	81.96895	16.49407	10.57184	11.88596	18.98741	11.90885
k	0	0.002744	0.000366	0.000239	0.000270	0.000424	0.000272
0.0003146545							
0.0000694861							
normalized H2	0	0.007662	0.016697	0.026895	0.031333	0.031114	0.031690
" CO2	0	0.293801	0.032055	0.029171	0.032158	0.033942	0.036526
" CO	1	0.698536	0.951247	0.943932	0.936507	0.934942	0.931783
avg. of CO2 & H2	0	0.150731	0.024376	0.028033	0.031746	0.032528	0.034108
water consumed (grams)		0.739981	2.617665	3.074457	3.445844	3.954823	4.468755
10 min avg molar inlet	0.004142	0.042415	0.060627	0.033663	0.033294	0.051864	0.030971

run #	8									
catalyst temperature	250									
initial catalyst vol. (cc)	470	dip tube experiments								
pressure	2550	4' x.0625" dip tube								
water density @ temp.	0.799298									
water vap. press. @ temp.	548									
system pressure	981	991	987	984	986	997	996	994	991	992
time	0.1	20	60	80	100	120	150	170	190	210
outlet flow	1.24	0.52	0.66	0.57	0.61	0.58	0.8	0.82	0.81	0.86
avg outlet flow (liter/min)	0.1	0.681407	0.26625	0.5845	0.5845	0.58	0.759333	0.847	0.7615	0.8515
cumulative outlet	0.01	13.57	24.22	35.91	47.6	59.2	81.98	98.92	114.15	131.18
H2	0	0.34	1.82	3.12	3.87	3.91	3.4	3.4	3.44	3.46
C02	0	34.73	18.41	9.86	6.24	4.99	3.52	3.52	3.4	3.37
CO	1	18.62	62.22	78.51	85.45	88.05	90.37	90.37	90.23	90.64
water out	0	0	0	0	0	0	0	0	0	0
water in	0	0	0	0	0	0	0	0	0	0
10 min avg inlet	0.1	0.458861	0.233586	0.543037	0.553580	0.553378	0.732328	0.816877	0.734670	0.821666
fractional conv.	0	0.484995	0.139835	0.076352	0.055853	0.048108	0.036875	0.036875	0.036518	0.036308
liq. vol.	588.0159	586.7579	582.7213	581.9381	581.2618	580.7250	579.9604	579.4275	578.8963	578.3675
10 min avg rate	0	0.942781	0.139333	0.177104	0.132223	0.113951	0.115742	0.129223	0.115202	0.128218
CO overpressure	4.33	82.4866	273.1458	342.3036	374.271	395.3445	404.8576	403.0502	399.7189	402.4416
turnover	0	100.3889	14.73437	18.70348	13.94750	12.00900	12.18168	13.58808	12.10257	13.45771
k	0	0.011429	0.000510	0.000517	0.000353	0.000288	0.000285	0.000320	0.000288	0.000318
0.0003091377										
0.0000244466										
normalized H2	0	0.006332	0.022073	0.034102	0.040498	0.040330	0.034947	0.034947	0.035438	0.035498
" C02	0	0.646861	0.223286	0.107771	0.065299	0.051469	0.036180	0.036180	0.035026	0.034574
" CO	1	0.346805	0.754639	0.858126	0.894202	0.908200	0.928872	0.928872	0.929535	0.929927
avg. of C02 & H2	0	0.326597	0.122680	0.070936	0.052898	0.045899	0.035563	0.035563	0.035232	0.035036
water consumed (grams)		1.005557	4.231981	4.857997	5.398564	5.827651	6.438746	6.864752	7.289341	7.711953
10 min avg molar inlet	0.004142	0.019009	0.009677	0.022497	0.022934	0.022925	0.030339	0.033842	0.030436	0.034040

run #	15											
catalyst temperature	320											
initial catalyst vol. (cc)	470											
pressure	2550											
water density @ temp.	0.670292											
water vap. press. @ temp.	1602											
system pressure (psig)	2548	2553	2555	2555	2555	2555	2549	2550	2549	2549	2547	2546
time (min)	10	30	50	70	90	110	130	160	180	200	220	230
outlet flow (liter/min)	1.94	5	4.1	3.2	3.5	5.6	5.4	3	3.3	1.2	0.4	0.24
avg. outlet (liter/min)	2.54	3.6875	4.155	4.0125	3.525	4.35	5.955	3.433333	3.3125	1.6325	0.61	0.3
cumulative outlet	25.4	99.15	182.25	262.5	333	420	539.1	642.1	708.35	741	753.2	756.2
H2	0.314	11.4	13.74	17.07	20.18	12.4	12.19	16.25	16.47	30.83	38.09	42.73
CO2	0.532	14.2	15.02	17.92	21.31	12.21	11.63	15.61	17.45	27.92	33.89	35.13
CO	2.017	67.69	69.63	63.45	57.26	73.27	74.86	67.02	64.76	39.21	25.61	20.47
water out (ml)	13	50	100	142	172	258	380	477	511	522	522	522
water in (ml)	0	25	80	135	190	250	295	380	430	490	530	530
inlet flow (liter/min)	1.653370	4.313967	3.500772	2.631288	2.764734	4.895995	4.748256	2.516686	2.732833	0.840159	0.252484	0.144981
10 min avg inlet	2.164722	3.181550	3.547734	3.299388	2.784482	3.803139	5.236272	2.880208	2.743185	1.142966	0.385039	0.181226
fractional conv.	0.173360	0.159025	0.171170	0.216134	0.265944	0.143791	0.137259	0.192043	0.207537	0.428300	0.584253	0.655387
liq. vol.	681.7915	654.0039	649.1034	653.7463	674.7289	620.9254	491.9182	451.7142	463.0852	522.4426	573.5116	571.5592
avg rate	1.368207	1.922991	2.325497	2.711433	2.728079	2.189214	3.631803	3.043759	3.055923	2.329134	0.975023	0.516546
CO overpressure (psia)	19.08082	643.7319	663.5739	604.6785	545.6878	698.2631	708.9242	635.3496	613.2772	371.3187	242.0145	193.2368
turnover (mol/liter hr)	79.56417	107.2683	128.7489	151.1896	157.0002	115.9422	152.3804	117.2703	120.7028	103.7879	47.69481	25.18166
k (mol/hr liter psi)	0.071705	0.002987	0.003504	0.004484	0.004999	0.003135	0.005122	0.004790	0.004982	0.006272	0.004028	0.002673
0.0042710486												
0.0010541029												
normalized H2	0.109675	0.122199	0.139648	0.173405	0.204354	0.126685	0.123530	0.164340	0.166903	0.314720	0.390306	0.434557
" CO2	0.185819	0.152213	0.152657	0.182039	0.215797	0.124744	0.117855	0.157868	0.176834	0.285014	0.347269	0.357266
" CO	0.704505	0.725586	0.707693	0.644555	0.579848	0.748569	0.758613	0.677791	0.656262	0.400265	0.262424	0.208176
avg. of CO2 & H2	0.147747	0.137206	0.146153	0.177722	0.210075	0.125715	0.120693	0.161104	0.171868	0.299867	0.368787	0.395911
water consumed (grams)		6.625777	14.91059	24.79846	35.73400	45.79811	55.27069	70.21915	78.59726	87.81042	93.57922	94.88788
avg molar inlet	0.089681	0.131807	0.146977	0.136688	0.115357	0.157558	0.216931	0.119322	0.113646	0.047351	0.015951	0.007507

run #	16											
catalyst temperature	330											
initial catalyst vol. (cc)	470											
pressure	2540											
water density @ temp.	0.640461											
water vap. press. @ temp.	1836											
system pressure	2541	2543	2535	2541	2544	2543	2543	2542	2541	2540	2538	2537
time	10	30	50	80	100	120	140	160	180	210	230	240
outlet flow	2.9	1.2	0.13	2.6	2.66	2.8	1.34	1.43	1.8	1	1.05	1.07
avg. outlet	3.16	1.949	0.896	1.754	2.6815	2.5625	2.0975	1.369	1.5235	1.303333	0.955	1.06
cumulative flow	31.6	70.58	88.5	141.12	194.75	246	287.95	315.33	345.8	384.9	404	414.6
H2	1	22.1	36.97	26.43	30.98	30.37	36.32	39.63	39.06	43.75	44.48	43.41
CO2	1.455	31.61	37.58	31.96	30.99	31.23	32.42	37.27	39.73	38.61	40.13	41.06
CO	8.204	33.2	16.96	39.56	36.21	36.49	29.17	21.11	19.22	16.57	14.36	14.17
water out	10	10	10	24	30	30	30	30	30	30	30	30
water in	0	0	0	0	50	50	65	65	95	95	95	95
inlet flow		2.566033	0.829202	0.077046	1.825043	1.820520	1.920807	0.869610	0.869001	0.855213	1.050742	0.572547	0.600418
10 min avg inlet flow		2.796091	1.346763	0.531030	1.231202	1.835235	1.757881	1.361200	0.831931	0.911131	0.760815	0.546782	0.606136
fractional conv.		0.130148	0.447173	0.687286	0.424623	0.461120	0.457720	0.540919	0.645567	0.672097	0.713073	0.746580	0.748781
liq. vol.		718.2326	704.3085	691.9066	652.9364	705.8248	686.6044	668.4708	676.7427	663.3715	689.9888	678.8773	673.8589
10 min avg rate		1.259441	2.125470	1.311174	1.990277	2.980301	2.912957	2.737933	1.972680	2.294601	1.954441	1.494689	1.674199
CO overpressure		57.8382	234.724	118.5504	278.898	256.3668	257.9843	206.2319	149.0366	135.501	116.6528	100.8072	99.3317
turnover (mol/liter hr)		77.15373	127.6827	77.37878	110.8404	179.4200	170.5904	156.1058	113.8660	129.8308	115.0214	86.54785	96.22548
k (mol/liter hr psi)		0.021775	0.009055	0.011060	0.007136	0.011625	0.011291	0.013275	0.013236	0.016934	0.016754	0.014827	0.016854
	0.0129136759												
	0.0031092078												
normalized H2		0.093817	0.254286	0.403999	0.269831	0.315542	0.309613	0.370952	0.404346	0.398530	0.442231	0.449429	0.440085
" CO2		0.136504	0.363709	0.410665	0.326288	0.315644	0.318381	0.331120	0.380267	0.405366	0.390275	0.405476	0.416261
" CO		0.769678	0.382004	0.185334	0.403879	0.368812	0.372005	0.297926	0.215386	0.196102	0.167492	0.145094	0.143653
avg. of CO2 & H2		0.115160	0.308997	0.407332	0.298060	0.315593	0.313997	0.351036	0.392306	0.401948	0.416253	0.427452	0.428173
water consumed (grams)			8.917852	16.86075	27.81964	37.94672	50.25660	61.87049	71.57269	80.13636	93.08903	100.2055	103.4196
10 min avg molar inlet		0.115837	0.055794	0.021999	0.051006	0.076031	0.072826	0.056392	0.034465	0.037746	0.031519	0.022652	0.025111

run #	17	stir rate=2									
catalyst temperature	337										
initial catalyst vol. (cc)	470										
pressure	2540										
water density @ temp.	0.619283										
water vap. press. @ temp.	2015.9										
system pressure	2533	2537	2538	2535	2535	2534	2536	2536	2537	2536	2534
time	10	30	50	70	90	110	130	150	180	200	220
outlet flow	1.9	2.95	3.42	2.83	1.81	1.73	1.2	1	2	1.2	1.55
avg flow (liter/min)	1.61	2.195	3.15	3.12	2.18	2.075	1.34	0.8575	1.095	1.44	1.1675
cumulative flow	16.1	60	123	185.4	229	270.5	297.3	314.45	347.3	376.1	399.45
H2	0.26	23.05	28.98	24.62	30.63	26.94	39.77	38.54	32.65	35.3	34.48
CO2	0.877	33.93	31.81	34.2	25.21	25.89	34.75	35.33	34.87	32.41	38.18
CO	0	28.95	37.5	38.95	41.8	45	23.56	23.5	31.12	30.73	25.34
water out	0	0	3	130	265	380	423	460	460	505	538
water in	0	0	0	40	100	150	205	265	345	400	465
inlet flow	0.95	1.971930	2.362406	1.978713	1.292433	1.262884	0.744127	0.620673	0.657745	1.312169	0.755142
10 min avg inlet flow	0.805	1.467250	2.175900	2.181478	1.556632	1.514730	0.830942	0.532227	0.720231	0.944762	0.734691
fractional conv.	1	0.495995	0.447676	0.430222	0.400458	0.369880	0.612627	0.611152	0.520345	0.524192	0.589103
liq. vol.	758.9419	738.4756	712.9322	549.4157	409.6123	209.6686	207.0963	226.1182	310.2058	356.2517	380.5194
10 min avg rate	2.636563	2.449609	3.396299	4.246135	3.782874	6.642231	6.110062	3.575711	3.003062	3.455473	2.827289
CO overpressure	0	150.8584	195.7875	202.1894	216.9838	233.145	122.5355	122.2235	162.1663	159.8267	131.2865
turnover (liter/mole hr)	169.4736	153.2105	205.0736	197.5833	131.2352	117.9513	107.1700	68.47837	78.89870	104.2605	91.11766
k (mol/liter hr psi)	ERR	0.016237	0.017346	0.021000	0.017433	0.028489	0.049863	0.029255	0.018518	0.021620	0.021535
0.0241301938											
0.0095652761											
normalized H2	0.228671	0.268241	0.294841	0.251815	0.313703	0.275375	0.405485	0.395809	0.331001	0.358594	0.351836
" CO2	0.771328	0.394856	0.323634	0.349800	0.258193	0.264642	0.354302	0.362842	0.353507	0.329236	0.389591
" CO	0	0.336902	0.381524	0.398383	0.428103	0.459981	0.240212	0.241347	0.315490	0.312169	0.258571
avg. of CO2 & H2	0.5	0.331548	0.309237	0.300808	0.285948	0.270009	0.379893	0.379326	0.342254	0.343915	0.370714
water consumed (grams)		12.67443	25.49303	39.75607	51.33394	60.15570	68.74872	74.96879	82.89473	89.37926	96.35068
10 min avg molar flow	0.033349	0.060786	0.090144	0.090375	0.064489	0.062753	0.034424	0.022049	0.029838	0.039140	0.030437

run #	19														
catalyst temperature	300														
initial catalyst vol. (cc)	470														
pressure	2600														
water density @ temp.	0.71222														
water vap. press. @ temp.	1205														
system pressure	2573	2590	2591	2598	2601	2596	2600	2603	2604	2603	2605	2605	2607	2609	2608
time	20	40	60	80	100	120	140	165	185	205	225	245	270	290	310
outlet flow	3.47	3.55	3.75	2.6	2.88	2.93	2.95	2.15	2	1.9	1.4	0.8	0.72	0.73	0.66
avg. flow (liter/min)	2.9625	3.5	4.0375	3.445	3	3.05	2.775	2.442	2.0775	1.91	1.5325	1.4075	0.988	0.71	0.8375
cumulative outlet	59.25	129.25	210	278.9	338.9	399.9	455.4	516.45	558	596.2	626.85	655	679.7	693.9	710.65
H2	4.202	9.482	7.651	10.39	12.5	12.86	12.53	15.61	16.4	17.26	20.11	20.09	25.4	27.89	30.74
CO2	5.279	11.4	9.692	10.17	12.05	12.52	12.4	14.9	16.74	16.64	18.8	19.56	24.21	28.25	29.18
CO	46.52	73.37	80.45	77.25	73.15	72.43	72.78	68.25	64.86	64.05	58.96	58.02	48.97	41.73	37.82
water out	47	91	138	182	223	259	292	332	358	382	402	426	428	428	428
water in	40	95	145	200	230	285	320	365	390	415	435	455	465	465	465
10 min avg inlet	2.711723	3.112278	3.679486	3.082924	2.623080	2.654288	2.420989	2.064795	1.726232	1.579479	1.227863	1.121806	0.739396	0.506365	0.580783
fractional conv.	0.092478	0.124577	0.097299	0.117445	0.143693	0.149083	0.146225	0.182683	0.203487	0.209259	0.248103	0.254672	0.336225	0.402148	0.442018
liq. vol.	650.0800	658.9067	655.2299	663.0721	639.8268	658.4151	653.3770	650.7423	641.6740	635.9351	629.2134	617.4126	621.4482	616.6327	611.8282
10 min avg rate	0.958894	1.462670	1.358176	1.357341	1.464322	1.493926	1.346800	1.440849	1.360735	1.291923	1.203469	1.150206	0.994382	0.820872	1.042979
CO overpressure	636.3936	1016.174	1115.037	1076.092	1021.174	1007.501	1015.281	954.135	907.3914	895.419	825.44	812.28	686.5594	585.8892	530.6146
turnover (liter/mole hr)	53.16814	82.20237	75.90385	76.76511	79.91218	83.89634	75.05524	79.97267	74.47358	70.07505	64.58727	60.57106	52.70747	43.17337	54.42759
k (mol/liter hr psi)	0.001506	0.001439	0.001218	0.001261	0.001433	0.001482	0.001326	0.001510	0.001499	0.001442	0.001457	0.001416	0.001448	0.001401	0.001965
0.0014502617															
0.0001651111															
normalized H2	0.075034	0.100602	0.078236	0.106226	0.127942	0.131479	0.128236	0.158059	0.167346	0.176212	0.205476	0.205692	0.257658	0.284969	0.314507
" CO2	0.094266	0.120952	0.099107	0.103977	0.123336	0.128003	0.126906	0.150870	0.170816	0.169882	0.192091	0.200266	0.245587	0.288648	0.298547
" CO	0.830699	0.778445	0.822656	0.789796	0.748720	0.740517	0.744857	0.691069	0.661836	0.653905	0.602431	0.594041	0.496753	0.426381	0.386944
avg. of CO2 & H2	0.084650	0.110777	0.088671	0.105101	0.125639	0.129741	0.127571	0.154465	0.169081	0.173047	0.198784	0.202979	0.251623	0.286809	0.306527
water consumed (grams)		4.713424	10.33215	15.74676	21.30255	27.06353	32.65182	39.52831	44.98689	50.07423	54.86161	59.26638	64.39214	67.82182	71.24366
10 min avg inlet molar	0.112342	0.128937	0.152435	0.127721	0.108670	0.109963	0.100298	0.085541	0.071515	0.065435	0.050868	0.046474	0.030632	0.020977	0.024061

run #	20													
catalyst temperature	300													
initial catalyst vol. (cc)	470													
pressure	2040													
water density @ temp.	0.71222													
water vap. press. @ temp.	1205													
system pressure	2021	2016	2044	2044	2042	2041	2041	2042	2043	2044	2045	2045	2045	2048
time	20	40	60	80	105	125	145	165	190	210	230	250	270	295
outlet flow	2.65	3	2.9	1.85	2.45	2.4	2.24	1.4	1.45	1	0.96	0.98	0.52	0.52
avg outlet flow (liter/min)	2.3325	2.9525	2.8475	1.9925	2.42	2.33	2.43	1.51	1.438	1.005	0.9725	0.975	0.6675	0.502
cumulative outlet	46.65	105.7	162.65	202.5	263	309.6	358.2	388.4	424.35	444.45	463.9	483.4	496.75	509.3
H2	4.348	5.171	5.292	9.369	13.46	13.39	13.88	15.24	17.48	22.78	24.22	23.38	25.49	30.43
CO2	9.477	5.992	6	9.247	11.6	13.34	13.98	17.91	18.65	21.74	23.06	23.34	24.59	31.15
CO	81.64	86.68	86.44	78.82	73.35	71.37	69.68	64.59	62.54	53.55	50.8	51.14	48.32	36.43
water out	65	121	183	222	265	268	268	268	268	268	268	268	268	268
water in	50	100	150	215	275	305	305	305	305	305	305	305	305	305
10 min avg inlet	2.163606	2.784073	2.682999	1.802157	2.111874	2.012564	2.082963	1.253930	1.174723	0.776884	0.738100	0.742259	0.497640	0.344295
fractional conv.	0.078061	0.060496	0.061312	0.105619	0.145901	0.157727	0.166606	0.204213	0.224117	0.293628	0.317571	0.313557	0.341330	0.458048
liq. vol.	638.8475	626.8342	606.4992	639.0852	656.5120	687.8657	680.9118	674.4339	667.6264	662.3367	657.4891	652.5980	648.3471	643.9428
10 min avg rate	0.657152	0.667896	0.674199	0.740333	1.166636	1.147104	1.266877	0.943777	0.980232	0.856105	0.886173	0.886497	0.651229	0.608760
CO overpressure	666.1824	702.9748	725.2316	661.2998	613.9395	596.6532	582.5248	540.6183	524.0852	449.2845	426.72	429.576	405.888	307.1049
turnover (liter/mol hr)	35.80778	35.70885	34.87647	40.35525	65.32689	67.30087	73.57655	54.29039	55.81829	48.36373	49.69600	49.34430	36.01266	33.43550
k (mol/liter psi hr)	0.000986	0.000950	0.000929	0.001119	0.001900	0.001922	0.002174	0.001745	0.001870	0.001905	0.002076	0.002063	0.001604	0.001982
0.0017111947														
0.000415333														
normalized H2	0.045545	0.052849	0.054148	0.096155	0.136774	0.136493	0.142300	0.155923	0.177156	0.232283	0.246941	0.238912	0.259044	0.310478
" CO2	0.099271	0.061240	0.061392	0.094903	0.117874	0.135983	0.143325	0.183241	0.189013	0.221678	0.235114	0.238503	0.249898	0.317824
" CO	0.855182	0.885909	0.884459	0.808941	0.745351	0.727522	0.714373	0.660834	0.633829	0.546038	0.517944	0.522583	0.491056	0.371696
avg. of CO2 & H2	0.072408	0.057045	0.057770	0.095529	0.127324	0.136238	0.142813	0.169582	0.183085	0.226980	0.241027	0.238708	0.254471	0.314151
water consumed (grams)		2.556077	5.039070	7.830699	12.41897	17.08825	22.04097	26.65466	31.50305	35.27054	38.72304	42.20663	45.23421	48.37099
10 min avg molar inlet	0.089635	0.115340	0.111152	0.074660	0.087491	0.083377	0.086294	0.051948	0.048667	0.032185	0.030578	0.030750	0.020616	0.014263

run #	22													
catalyst temperature	300													
initial catalyst vol. (cc)	470													
pressure	2950													
water density @ temp.	0.71222													
water vap. press. @ temp.	1205													
system pressure	2918	2958	2944	2943	2981	2981	2983	2981	2982	2985	2985	2988	2991	2993
time	20	40	60	80	105	125	145	165	190	215	235	255	280	300
outlet flow	4.2	4.2	5.08	4.4	3.7	3.52	2.65	2.65	2.8	1.5	1.6	1.5	0.89	0.93
avg outlet flow (liter/min)	3.9375	4.135	4.4525	4.42	3.748	3.625	2.6925	2.565	2.728	1.866	1.5725	1.5525	1.076	0.875
cumulative outlet	78.75	161.45	250.5	338.9	432.6	505.1	558.95	610.25	678.45	725.1	756.55	787.6	814.5	832
H2	3.301	9.697	10.9	11.78	15.24	15.63	20.18	20.19	17.62	23.01	26.21	25.79	30.93	32.22
CO2	14.81	10.72	11.2	11.92	15.3	15.69	19.71	19.92	19.54	25.68	27.5	28.09	30.79	33.02
CO	55.87	75.55	75.71	74.04	68.35	66.8	58.11	57.8	61.63	49.29	44.26	44.09	36.68	33.09
water out	52	94	124	135	139	139	139	139	141	141	141	141	141	141
water in	40	80	135	150	155	155	155	155	155	155	155	155	155	155
10 min avg inlet	3.455537	3.695138	3.949482	3.884119	3.169256	3.046448	2.144521	2.039608	2.214929	1.402356	1.141454	1.125590	0.738547	0.584727
fractional conv.	0.139475	0.119037	0.127362	0.137967	0.182611	0.189910	0.255524	0.257594	0.231641	0.330617	0.377627	0.379276	0.456914	0.496423
liq. vol.	643.0597	630.5742	655.8146	650.5497	637.1568	625.0349	612.9301	601.6904	585.2613	571.9520	562.5201	553.5370	543.3365	536.7322
10 min rate	1.862997	1.733924	1.906569	2.047569	2.257827	2.300852	2.222304	2.170504	2.179104	2.015001	1.904739	1.917080	1.543814	1.344309
CO overpressure	957.0531	1324.391	1316.596	1286.815	1213.896	1186.368	1033.195	1026.528	1095.165	877.362	787.828	786.1247	655.1048	591.6492
turnover (liter mol hr)	102.1827	93.25676	106.6467	113.6143	122.7018	122.6611	116.1792	111.3904	108.7782	98.29893	91.38765	90.51090	71.54477	61.54188
k (mol/liter hr psi)	0.001946	0.001309	0.001448	0.001591	0.001859	0.001939	0.002150	0.002114	0.001989	0.002296	0.002417	0.002438	0.002356	0.002272
0.0020142096														
0.0003575148														
normalized H2	0.044619	0.101045	0.111440	0.120523	0.154110	0.159294	0.205918	0.206209	0.178358	0.234843	0.267530	0.263243	0.314329	0.327672
" CO2	0.200186	0.111705	0.114507	0.121956	0.154717	0.159906	0.201122	0.203452	0.197793	0.262094	0.280698	0.286720	0.312906	0.335807
" CO	0.755193	0.787249	0.774051	0.757519	0.691172	0.680799	0.592959	0.590338	0.623848	0.503061	0.451770	0.450035	0.372764	0.336519
avg. of CO2 & H2	0.122403	0.106375	0.112974	0.121240	0.154413	0.159600	0.203520	0.204830	0.188075	0.248469	0.274114	0.274982	0.313617	0.331740
water consumed (grams)		6.892419	13.91569	21.66548	32.20412	40.83757	49.45892	57.46399	67.16514	76.64434	83.36189	89.75987	97.02487	101.7285
10 min molar flow	0.143157	0.153084	0.163621	0.160913	0.131297	0.126209	0.088844	0.084498	0.091761	0.058097	0.047288	0.046631	0.030596	0.024224

run #	23													
catalyst temperature	330													
initial catalyst vol. (cc)	470													
pressure	2950													
water density @ temp.	0.640461													
water vap. press. @ temp.	1836													
system pressure	2966	2986	2985	2987	2987	2987	2987	2986	2986	2986	2990	2991	2993	2992
time	20	40	60	80	105	125	145	165	185	205	230	255	275	295
outlet flow	4.55	3.22	4.3	3.9	3	1.75	1.8	1.55	1.2	0.87	1.25	0.93	1.08	0.98
avg outlet flow (liter/min)	3.4625	4.225	4.085	3.8275	3.116	1.9375	1.765	1.6875	1.11	0.945	0.82	1.052	0.98	0.995
cumulative flow	69.25	153.75	235.45	312	389.9	428.65	463.95	497.7	519.9	538.8	559.3	585.6	605.2	625.1
H2	12.92	22.46	22.9	22.26	22.79	30.6	34.53	35.31	39.37	45.47	45.79	43.23	43.1	41.52
CO2	22.33	24.98	21.17	21.18	25.12	35.58	32.79	34.6	42.23	39.56	40.17	43.37	43.85	45.04
CO	40.21	49.55	53.81	54.55	50.72	32.58	30.84	28.3	16.38	12.89	12.62	12.1	11.34	11.43
water out	65	140	220	310	410	467	515	565	598	628	655	683	700	721
water in	50	105	160	210	280	335	390	445	500	560	625	690	720	740
inlet flow by 10 min avg	2.653772	3.191728	3.165374	2.979114	2.359193	1.288331	1.159764	1.086883	0.647783	0.534698	0.462487	0.590484	0.546532	0.555530
fractional conv.	0.304746	0.323734	0.290526	0.284777	0.320790	0.503883	0.521860	0.552604	0.713536	0.767349	0.773021	0.781588	0.793122	0.791080
liq. vol.	710.4257	657.8106	596.0429	513.0085	442.6425	422.0079	418.3186	412.0722	433.6361	470.2829	518.4372	564.2958	574.1700	562.4446
rate (10 min avg)	2.829660	3.904491	3.835168	4.110735	4.249935	3.823733	3.596399	3.623054	2.649543	2.168673	1.714139	2.032968	1.876578	1.942225
CO overpressure	454.373	569.825	618.2769	627.8705	583.7872	374.9958	354.9684	325.45	188.37	148.235	145.6348	139.755	131.2038	132.1308
turnover (mol/liter hr)	171.4616	219.0681	194.9736	179.8697	160.4535	137.6328	128.3184	127.3392	97.99649	86.98961	75.79774	97.84785	91.90119	93.17371
k (mol/liter hr psi)	0.006227	0.006852	0.006202	0.006547	0.007279	0.010196	0.010131	0.011132	0.014065	0.014629	0.011770	0.014546	0.014302	0.014699
0.0109505646														
0.0032297676														
normalized H2	0.171216	0.231570	0.233959	0.227166	0.231065	0.309842	0.351772	0.359535	0.401816	0.464358	0.464495	0.437993	0.438498	0.423716
" CO2	0.295918	0.257552	0.216285	0.216144	0.254689	0.360267	0.334046	0.352306	0.431006	0.404003	0.407486	0.439412	0.446128	0.459638
" CO	0.532865	0.510877	0.549754	0.556689	0.514245	0.329890	0.314180	0.288158	0.167176	0.131638	0.128017	0.122593	0.115372	0.116644
avg. of CO2 & H2	0.233567	0.244561	0.225122	0.221655	0.242877	0.335054	0.342909	0.355920	0.416411	0.434180	0.435991	0.438703	0.442313	0.441677
water consumed (grams)		13.69795	28.25771	41.43802	56.50473	67.72033	77.08321	86.08377	94.27294	100.8021	107.9611	115.5905	122.2664	128.7761
molar inlet (10 min avg)	0.109941	0.132228	0.131136	0.123420	0.097737	0.053373	0.048047	0.045027	0.026836	0.022151	0.019160	0.024462	0.022642	0.023014

run #	24										
catalyst temperature	350										
initial catalyst vol. (cc)	470										
pressure	2950										
water density @ temp.	0.5743										
water vap. press. @ temp.	2380										
system pressure	2995	2982	2988	2996	3006	2987	2995	2997	2986	2982	2989
time	20	40	60	80	110	130	150	170	195	215	235
outlet flow	2.7	4.2	3	3.12	1.2	0.31	0.21	0.62	0.35	0.24	0.81
avg outlet flow (liters/min	2.365	3.645	3.435	3	1.77	0.6485	0.398	0.4395	0.7612	0.82	0.8595
cumulative flow	47.3	120.2	188.9	248.9	302	314.97	322.93	331.72	350.75	367.15	384.34
H2	18.6	39.4	35.59	30.9	41.57	53.36	52.49	49.61	44.91	45.04	44.08
CO2	18.9	36.6	40	36.66	41.66	37.76	40.89	41.74	41.93	41.57	42.05
CO	7.396	20.41	22.35	30.45	15.15	6.955	4.982	5.458	9.622	11.29	11.57
water out	48	97	178	310	501	560	572	572	572	572	572
water in	68	95	150	205	285	340	385	430	475	490	490
inlet flow by 10 min avg	1.377300	2.208323	2.109435	1.966023	1.021285	0.347244	0.209079	0.232139	0.418564	0.457281	0.480642
fractional conv.	0.717126	0.650573	0.628398	0.525922	0.733110	0.867561	0.903584	0.893258	0.818596	0.793204	0.788230
liq. vol.	853.2126	783.0661	701.9408	537.3219	307.4153	286.2283	337.2924	410.5015	479.8179	496.7714	487.1415
rate (10 min avg)	2.877520	4.560489	4.694089	4.783290	6.053990	2.616216	1.392271	1.255631	1.775034	1.814944	1.933176
CO overpressure	45.4854	122.8682	135.888	187.572	94.839	42.21685	30.6393	33.67586	58.30932	67.9658	70.4613
turnover (mole/liter hr)	209.4062	304.5957	281.0384	219.2175	158.7380	63.87048	40.05386	43.96337	72.64356	76.90135	80.32312
k (mol/liter hr psi)	0.063262	0.037116	0.034543	0.025501	0.063834	0.061970	0.045440	0.037285	0.030441	0.026703	0.027436
0.039027511											
0.0132386337											
normalized H2	0.414290	0.408671	0.363385	0.315273	0.422545	0.544073	0.533641	0.512457	0.465571	0.460061	0.451177
" CO2	0.420972	0.379628	0.408413	0.374043	0.423460	0.385011	0.415709	0.431162	0.434678	0.424616	0.430399
" CO	0.164736	0.211700	0.228200	0.310682	0.153994	0.070915	0.050649	0.056379	0.099749	0.115321	0.118423
avg. of CO2 & H2	0.417631	0.394149	0.385899	0.344658	0.423002	0.464542	0.474675	0.471810	0.450125	0.442339	0.440788
water consumed (grams)		18.28512	38.87536	56.41598	77.45137	85.61905	89.29292	92.24893	97.44055	102.7041	108.2346
molar inlet (10 min avg)	0.057059	0.091487	0.087390	0.081449	0.042310	0.014385	0.008661	0.009617	0.017340	0.018944	0.019912

run #	25									
catalyst temperature	300	Sodium Citrate								
initial catalyst vol. (cc)	470									
pressure	2950									
water density @ temp.	0.712224									
water vap. press. @ temp.	1205									
system pressure	3003	2979	2078	3013	3014	3021	3028	3031	3031	3031
time	20	40	65	85	105	125	145	170	190	200
outlet flow	3.3	3.16	2.4	2.8	1.3	1.6	1.52	1.02	0.97	0.95
avg outlet flow (liter/min)	3.1275	2.9625	2.704	2.6	1.85	1.5235	1.529	1.124	0.944	0.887
cumulative flow	62.55	121.8	189.4	241.4	278.4	308.87	339.45	367.55	386.43	395.3
H2	1.394	11.32	17.51	15.81	22.9	26.06	26.84	32.18	34.43	35.36
CO2	15.11	14.04	17.63	18.18	21.94	25.37	26.34	30.01	33.16	33.82
CO	40.46	63.13	62.63	64.35	53.13	46.14	44.45	35.88	30.51	28.37
water out	28	53	74	104	126	144	160	176	181	181
water in	25	55	85	105	135	155	175	200	200	200
inlet flow by 10 min avg	2.674439	2.537994	2.218070	2.150671	1.426635	1.121974	1.112569	0.767613	0.618796	0.572480
fractional conv.	0.169403	0.167260	0.219077	0.208924	0.296757	0.357873	0.374296	0.464277	0.525542	0.549396
liq. vol.	655.6925	653.5260	654.1385	630.3092	632.0714	626.1453	623.1965	625.5154	611.3110	607.9591
rate (10 min avg)	1.717539	1.614623	1.846519	1.771991	1.664941	1.594000	1.660995	1.416229	1.322342	1.285947
CO overpressure	727.4708	1119.926	546.7599	1163.448	961.1217	837.9024	810.3235	655.1688	557.1126	518.0362
turnover (mol/liter hr)	96.05519	90.00118	103.0238	95.26406	89.75921	85.12899	88.28915	75.55888	68.94777	66.68247
k (mol/liter hr psi)	0.002360	0.001441	0.003377	0.001523	0.001732	0.001902	0.002049	0.002161	0.002373	0.002482
0.002115997										
0.0005574508										
normalized H2	0.024471	0.127924	0.179093	0.160768	0.233745	0.267090	0.274915	0.328132	0.350968	0.362480
" CO2	0.265255	0.158661	0.180321	0.184868	0.223946	0.260018	0.269794	0.306005	0.338022	0.346694
" CO	0.710273	0.713413	0.640585	0.654362	0.542308	0.472891	0.455290	0.365861	0.311009	0.290825
avg. of CO2 & H2	0.144863	0.143293	0.179707	0.172818	0.228845	0.263554	0.272354	0.317069	0.344495	0.354587
water consumed (grams)		6.543039	15.10684	22.07864	28.82354	35.04428	41.14446	48.49288	53.60958	55.99689
molar inlet (10 min avg)	0.110798	0.105145	0.091891	0.089099	0.059103	0.046481	0.046092	0.031801	0.025635	0.023717

run #	26											
catalyst temperature	300		Cadmium Hydroxide									
initial catalyst vol. (cc)	470											
pressure	2950											
water density @ temp.	0.712224											
water vap. press. @ temp.	1205											
system pressure	2995	3034	3029	3025	3024	3027	3031	3031	3034	3037	3038	3025
time	20	40	60	80	105	125	150	170	190	215	235	245
outlet flow	2.63	3.62	3.77	4.12	2.2	1.95	1.16	1.26	0.93	0.82	0.9	0.92
avg outlet flow (liter/min)	2.865	3.42	3.7	4.005	2.528	2.1325	1.234	1.225	1.1575	0.814	0.845	0.898
cumulative flow	57.3	125.7	199.7	279.8	343	385.65	416.5	441	464.15	484.5	501.4	510.38
H2	2.83	6.839	6.877	6.538	9.821	10.71	11.34	15.38	13.73	16.65	19.13	18.88
CO2	0.682	6.502	7.521	7.254	9.817	10.75	14.14	14.97	15.63	16.98	17.44	17.31
CO	32.27	78.31	83.12	83.98	78.94	76.84	72.79	68.01	68.93	64.91	61.76	61.23
water out	0	0	0	0	5	15	15	15	15	15	15	15
water in	0	0	0	0	10	35	35	40	40	40	40	40
inlet flow by 10 min avg	2.724400	3.171087	3.426857	3.722521	2.276195	1.899725	1.074020	1.036006	0.984622	0.675097	0.687867	0.731203
fractional conv.	0.051607	0.078494	0.079706	0.075883	0.110625	0.122530	0.148953	0.182424	0.175577	0.205750	0.228434	0.228112
liq. vol.	659.9047	655.8893	650.4249	644.6015	644.3004	660.2640	654.9810	658.3408	654.5538	650.4122	647.3141	645.6183
rate (10 min avg)	0.529607	0.943338	1.043861	1.089293	0.971464	0.876331	0.607135	0.713586	0.656512	0.530848	0.603394	0.642187
CO overpressure	577.633	1432.289	1516.108	1528.436	1435.918	1400.024	1329.145	1241.862	1260.729	1189.151	1132.060	1114.386
turnover (mole/liter hr)	29.80913	52.77303	57.91004	59.88941	53.38621	49.35146	33.91786	40.06923	36.65240	29.44920	33.31428	35.36320
k (mol/liter hr psi)	0.000916	0.000658	0.000688	0.000712	0.000676	0.000625	0.000456	0.000574	0.000520	0.000446	0.000533	0.000576
0.0005881935												
0.0000879287												
normalized H2	0.079090	0.074620	0.070520	0.066869	0.099626	0.108952	0.115396	0.156364	0.139688	0.168966	0.194548	0.193800
" CO2	0.019059	0.070943	0.077124	0.074193	0.099586	0.109359	0.143889	0.152196	0.159019	0.172315	0.177361	0.177684
" CO	0.901850	0.854436	0.852355	0.858937	0.800787	0.781688	0.740714	0.691439	0.701292	0.658717	0.628089	0.628515
avg. of CO2 & H2	0.049074	0.072781	0.073822	0.070531	0.099606	0.109155	0.129642	0.154280	0.149353	0.170641	0.185955	0.185742
water consumed (grams)		2.859868	6.751750	10.89930	16.11377	19.74406	23.50677	26.11385	28.81105	31.76081	33.96730	35.17511
molar inlet (10 min avg)	0.112867	0.131373	0.141969	0.154218	0.094299	0.078702	0.044495	0.042920	0.040791	0.027968	0.028497	0.030292

run #	28												
catalyst temperature	300		no catalyst										
initial catalyst vol. (cc)	470												
pressure	2950												
water density @ temp.	0.712224												
water vap. press. @ temp.	1205												
system pressure	3001	3007	3001	3010	3010	3010	3010	3009	3009	3010	3012	3012	3013
time	20	40	60	85	105	125	145	170	190	210	230	255	275
outlet flow	2.61	2.8	2.67	2.73	2.05	2.02	2.18	1.52	1.6	1.68	0.73	0.7	0.59
avg outlet flow	3.1105	2.562	2.756	2.8	2.2365	2.17	2.09	1.532	1.4875	1.4	0.805	0.6628	0.665
cumulative flow	62.21	113.45	168.57	238.57	283.3	326.7	368.5	406.8	436.55	464.55	480.65	497.22	510.52
H2	0.618	1.663	2.332	2.671	3.437	3.827	3.767	5.09	5.702	5.971	7.348	9.553	10.28
CO2	0.51	1.678	2.702	3.168	3.554	3.912	5.174	5.057	5.664	6.135	6.99	8.987	11.08
CO	47.07	83.74	90.35	92.34	91.5	90.92	88.82	88.16	86.74	85.94	83.28	79.67	76.59
water out	45	68	95	130	155	177	200	223	240	256	259	274	285
water in	55	75	95	130	160	180	200	240	260	275	285	300	310
inlet flow by 10 min avg	3.074101	2.512852	2.683274	2.716737	2.157125	2.084890	1.994426	1.452935	1.401333	1.313569	0.745881	0.600238	0.592491
fractional conv.	0.011840	0.019558	0.027103	0.030647	0.036796	0.040822	0.047920	0.054417	0.061489	0.065798	0.079260	0.104227	0.122378
liq. vol.	673.9452	668.8147	657.7170	655.6763	660.9757	656.4439	650.3366	671.8968	674.3771	671.1639	679.4283	677.8120	674.9930
rate (10 min avg)	0.134247	0.182661	0.274851	0.315652	0.298501	0.322278	0.365299	0.292502	0.317604	0.320103	0.216287	0.229428	0.267017
CO overpressure	845.3772	1508.994	1622.686	1666.737	1651.575	1641.106	1603.201	1590.406	1564.789	1551.217	1504.869	1439.636	1384.747
turnover (liter/mole hr)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
k (mol/liter hr psi)	0.000158	0.000121	0.000169	0.000189	0.000180	0.000196	0.000227	0.000183	0.000202	0.000206	0.000143	0.000159	0.000192
0.0001811623													
0.0000279326													
normalized H2	0.012822	0.019097	0.024448	0.027205	0.034896	0.038790	0.038532	0.051776	0.058120	0.060899	0.075273	0.097271	0.104951
" CO2	0.010581	0.019269	0.028327	0.032267	0.036084	0.039651	0.052924	0.051440	0.057733	0.062572	0.071605	0.091507	0.113118
" CO	0.976596	0.961633	0.947223	0.940526	0.929018	0.921558	0.908542	0.896782	0.884145	0.876527	0.853121	0.811220	0.781929
avg. of CO2 & H2	0.011701	0.019183	0.026388	0.029736	0.035490	0.039220	0.045728	0.051608	0.057927	0.061736	0.073439	0.094389	0.109035
water consumed (grams)		0.654078	1.558108	3.011583	4.237218	5.464882	6.814653	8.458923	9.692436	10.98092	12.09480	13.24598	14.25374
molar inlet (10 min avg)	0.127355	0.104103	0.111164	0.112550	0.089366	0.086373	0.082626	0.060192	0.058055	0.054419	0.030900	0.024867	0.024546

run #	30			
catalyst temperature	300			
initial catalyst vol. (cc)	470	Ammonia Hydroxide		
pressure	2600			
water density @ temp.	0.71222			
water vap. press. @ temp.	1205			
system pressure	3011	3001	2996	3030
time	20	40	75	108
outlet flow	3	3		
avg outlet flow (liter/min)	2.905	2.77	0.68	3.184848
cumulative outlet	58.1	113.5	137.3	242.4
H2	8.035	22.68	25.99	23.29
CO2	1.133	21	23.85	22.69
CO	34.39	46.33	37.78	50.7
water out	26	45	45	49
water in	25	45	45	45
10 min avg inlet	2.867218	2.446869	0.587452	2.811119
fractional conv.	0.200074	0.417305	0.500891	0.405870
liq. vol.	658.5043	642.7329	617.2080	584.9721
10 min avg rate	2.165432	3.948987	1.185048	4.848227
CO overpressure	621.0834	832.0868	676.6398	925.275
turnover (liter/mol hr)	121.6234	216.4861	62.38519	241.8979
k	0.003486	0.004745	0.001751	0.005239
normalized H2	0.184466	0.251972	0.296621	0.240897
" CO2	0.026011	0.233307	0.272198	0.234691
" CO	0.789522	0.514720	0.431180	0.524410
avg. of CO2 & H2	0.197472	0.368625	0.432720	0.358243
water consumed (grams)		12.23273	30.41207	49.37111
10 min avg inlet molar	0.118784	0.101370	0.024337	0.116460

run #	31		
catalyst temperature	300		
initial catalyst vol. (cc)	470		
pressure	2600		
water density @ temp.	0.71222		
water vap. press. @ temp.	1205		
system pressure	3000	3001	
time	20	40	
outlet flow			
avg outlet flow (liter/min)	2.57	2.99	
cumulative outlet	51.4	111.2	
H2	5.57	21.49	
CO2	6.779	18.5	
CO	20.64	45.48	
water out	0	0	
water in	0	0	
10 min avg inlet	2.305941	2.666406	
fractional conv.	0.302690	0.403306	
liq. vol.	659.9084	641.5306	
10 min avg rate	2.629147	4.166724	
CO overpressure	370.488	816.8208	
turnover (liter/mol hr)	147.9832	227.9954	
k	0.007096	0.005101	
normalized H2	0.168844	0.251433	
" CO2	0.205492	0.216450	
" CO	0.625663	0.532116	
avg. of CO2 & H2	0.271590	0.359658	
water consumed (grams)		13.08900	
10 min avg inlet molar	0.095531	0.110465	