

APPENDIX E: CATALYST ACTIVATION

The catalyst activation run, AF-A1, was conducted over the period 29 April 1991 to 1 May 1991.

489 pounds of catalyst was slurried with mineral oil and transferred to the reactor on 29 April. At 18:30 the reduction gas composition was lined-up at a nominal composition of:

1.2% H₂, 1.8% CO, 0.5% CO₂, 96.5% N₂

The reduction gas flow was approximately 15,000 SCFH. The catalyst activation took place at 100 psig. The temperature in the reactor was ramped while under reduction gas in accordance with established procedures.

The initial temperature of the slurry was 220°F. By 11:00 on 30 April the temperature was at the first hold point of 391-392°F. At this point the uptake of H₂ and CO was complete. The slurry temperature was held at 392°F for 12 hours.

At 23:00 on 30 April the ramp to the second hold temperature (464°F) began. By 04:00 on 1 May the slurry temperature was at 464°F. The temperature was held for one hour then cooldown began.

The reduction data, which includes: gas composition in-to and out-of the reactor, slurry temperature, and reduction gas flow, is presented in Table E1.

The compositions were measured using both GCs (GC#1 and CG#2). A comparison of the agreement between the two GCs is shown in Figures E1 and E2 for inlet and outlet compositions, respectively.

The instantaneous total-gas uptake is computed as:

$$U_i = F_{GAS} (\Delta Y_{H_2} + \Delta Y_{CO}) / M_{CAT}$$

where,

U _i	=	instantaneous uptake (SCF/lb-hr)
F _{GAS}	=	flow of gas to reactor (SCFH)
ΔY _{H2}	=	change in composition of H ₂ (in-out, mole fraction)
ΔY _{CO}	=	change in composition of CO (in-out, mole fraction)
M _{CAT}	=	mass of catalyst, oxide basis (lb)

The total uptake is computed by integrating the instantaneous uptake over the period of the activation. The cumulative uptake is displayed in Figure E3 as a function of slurry temperature. Note that the final uptake was 2.27 SCF/lb oxide which is 80% of the theoretical maximum (if all the copper in the catalyst were reduced the uptake would be 2.82 SCF/lb).

TABLE E1

REDUCTION DATA: MEASURED COMPOSITIONS

GC #	Day	Time	H2 In mole%	CO In mole%	GC #	Day	Time	H2 out mole%	CO out mole%	Day	Time	Temp (F)	Flow (SCFH)
2	4/29/91	18:34	1.105	1.585	1	4/29/91	18:45	1.239	1.731	4/29/91	18:30	220.0	15,200
2	.	19:07	1.288	1.827	2	.	18:51	1.137	1.790	.	18:58	221.1	15,202
1	.	19:35	1.370	1.838	1	.	19:18	1.284	1.603	.	19:17	221.1	15,107
2	.	19:40	1.402	1.895	1	.	19:51	1.192	1.302	.	19:31	221.4	14,928
2	.	20:14	1.390	1.924	2	.	19:57	1.174	1.149	.	20:00	225.6	14,621
1	.	20:41	1.562	1.828	1	.	20:25	1.143	0.907	.	20:30	229.1	14,613
2	.	20:47	1.470	1.826	2	.	21:03	0.914	0.861	.	21:00	229.8	15,224
2	.	21:20	1.284	1.758	1	.	21:39	1.021	0.861	.	21:31	229.0	15,325
2	.	21:53	1.442	1.809	2	.	22:10	0.901	0.899	.	22:00	236.5	14,681
1	.	21:55	1.429	1.737	1	.	22:12	0.980	0.885	.	22:30	246.8	14,289
2	.	22:27	1.475	1.860	1	.	22:45	1.035	0.941	.	23:00	250.6	14,177
2	.	23:01	1.499	1.800	2	.	23:17	1.072	1.083	.	23:31	250.6	13,907
1	.	23:02	1.491	1.797	1	.	23:18	1.174	1.102	4/30/91	0:00	257.7	15,204
2	.	23:34	1.499	1.800	1	.	23:54	1.215	1.003	.	0:30	268.0	15,679
2	4/30/91	0:07	1.442	1.770	2	4/30/91	0:24	1.135	1.075	.	1:00	276.0	15,127
1	.	0:10	1.431	1.744	1	.	0:27	1.230	1.064	.	1:30	280.2	15,015
2	.	0:40	1.341	1.748	1	.	0:49	1.393	1.131	.	2:00	290.1	15,038
1	.	1:05	1.441	1.757	1	.	1:22	1.499	1.405	.	2:31	300.7	15,224
2	.	1:14	1.323	1.769	2	.	1:30	1.546	1.461	.	3:06	306.4	14,669
2	.	1:47	1.335	1.787	1	.	1:55	1.495	1.441	.	3:30	307.7	13,748
1	.	2:11	1.485	1.781	1	.	2:28	1.561	1.380	.	4:01	312.1	14,737
2	.	2:20	1.455	1.787	2	.	2:37	1.464	1.421	.	4:32	319.4	14,508
2	.	2:53	1.491	1.842	1	.	3:02	1.636	1.503	.	5:00	324.5	14,979
1	.	3:18	1.499	1.832	1	.	3:35	1.710	1.657	.	5:30	328.6	14,684
2	.	3:27	1.521	1.833	2	.	3:43	1.618	1.584	.	6:01	333.1	14,443
2	.	4:00	1.390	1.852	1	.	4:08	1.623	1.620	.	6:36	340.4	13,928

TABLE B1

REDUCTION DATA: MEASURED COMPOSITIONS (continued)

GC #	Day	Time	H2 in mole%	CO in mole%	GC #	Day	Time	H2 out mole%	CO out mole%	Day	Time	Temp (F)	Flow (SCFH)
2	4/30/91	4:33	1.526	1.839	2	4/30/91	4:50	1.630	1.656	4/30/91	7:30	346.7	14,912
2	.	5:05	1.497	1.780	1	.	5:15	1.549	1.568	.	7:59	346.7	15,015
1	.	5:31	1.512	1.765	1	.	5:48	1.551	1.562	.	8:29	349.6	14,746
2	.	5:39	1.335	1.704	2	.	5:56	1.607	1.586	.	9:00	356.9	14,610
2	.	6:13	1.568	1.743	1	.	6:21	1.579	1.596	.	9:28	362.9	14,590
1	.	6:38	1.549	1.796	1	.	6:54	1.507	1.544	.	10:02	372.7	14,539
2	.	6:46	1.327	1.675	2	.	7:03	1.391	1.581	.	10:30	380.3	13,843
2	.	7:21	1.573	1.761	1	.	7:31	1.470	1.663	.	11:00	390.5	14,192
1	.	7:48	1.445	1.839	1	.	8:04	1.470	1.763	.	11:30	389.5	14,255
2	.	7:54	1.591	1.833	2	.	8:10	1.618	1.751	.	12:00	390.8	15,211
2	.	8:27	1.473	1.907	1	.	8:37	1.519	1.854	.	12:29	390.5	14,992
1	.	8:54	1.526	1.985	1	.	9:10	1.556	1.908	.	13:00	391.1	14,621
2	.	9:00	1.640	1.978	2	.	9:17	1.636	1.894	.	13:59	391.4	14,127
2	.	9:33	1.633	1.965	1	.	9:44	1.566	1.935	.	14:30	391.7	14,268
1	.	10:01	1.503	1.988	1	.	10:17	1.581	1.971	.	14:59	391.4	14,160
2	.	10:06	1.642	1.981	2	.	10:23	1.731	1.955	.	15:30	391.7	14,938
2	.	10:40	1.536	2.105	1	.	10:50	1.636	2.039	.	16:00	391.4	16,314
1	.	11:07	1.546	2.099	1	.	11:24	1.604	2.038	.	16:33	391.7	14,802
2	.	11:13	1.509	2.067	2	.	11:30	1.727	2.019	.	17:00	391.4	13,662
2	.	11:46	1.601	1.943	1	.	11:57	1.514	1.890	.	17:30	391.4	14,566
1	.	12:13	1.460	1.955	1	.	12:30	1.499	1.892	.	18:00	391.4	14,881
2	.	12:20	1.439	1.928	2	.	12:36	1.649	1.870	.	18:35	391.7	13,317
2	.	12:53	1.620	1.947	1	.	13:03	1.499	1.904	.	19:06	390.2	13,879
1	.	13:20	1.516	1.972	1	.	13:37	1.524	1.957	.	20:05	391.5	14,222
2	.	13:26	1.638	1.956	2	.	13:43	1.660	1.927	.	20:33	391.4	14,398
2	.	13:59	1.474	1.957	1	.	14:10	1.552	1.778	.	21:19	391.4	13,919

TABLE E1

REDUCTION DATA: MEASURED COMPOSITIONS (continued)

GC #	Day	Time	H2 In mole%	CO In mole%	GC #	Day	Time	H2 out mole%	CO out mole%	Day	Time	Temp (F)	Flow (SCFH)
1	4/30/91	14:26	1.516	1.713	1	4/30/91	14:43	1.542	1.707	4/30/91	22:15	391.4	14,473
2	.	14:33	1.668	1.693	2	.	14:49	1.637	1.660	.	22:40	391.7	14,829
2	.	15:06	1.715	1.650	1	.	15:16	1.633	1.836	.	22:55	391.4	14,214
1	.	15:33	1.541	1.664	1	.	15:49	1.642	1.830	.			
2	.	15:39	1.555	1.790	2	.	15:56	1.780	1.759	.			
2	.	16:12	1.763	1.780	1	.	16:23	1.677	1.856	.			
1	.	16:39	1.498	1.943	1	.	16:56	1.488	2.027	.			
2	.	16:46	1.575	1.880	2	.	17:02	1.609	1.987	.			
2	.	17:50	1.418	1.970	2	.	17:34	1.458	1.898	.			
1	.	17:59	1.363	1.939	1	.	17:42	1.374	1.899	.			
2	.	18:24	1.510	2.005	1	.	18:15	1.358	1.904	.			
2	.	18:57	1.538	2.126	2	.	18:40	1.600	2.142	.			
1	.	19:05	1.470	2.052	1	.	18:48	1.549	2.216	.			
2	.	19:30	1.360	2.072	1	.	19:22	1.411	1.966	.			
2	.	20:07	1.527	2.132	2	.	19:47	1.392	2.099	.			
1	.	20:15	1.405	2.085	1	.	19:58	1.444	2.111	.			
2	.	20:57	1.255	1.788	1	.	20:31	1.414	2.061	.			
1	.	21:21	1.417	2.180	1	.	21:05	1.329	2.045	.			
2	.	21:30	1.468	2.182	2	.	21:13	1.382	2.003	.			
2	.	22:03	1.379	2.052	1	.	21:40	1.394	2.130	.			
1	.	22:30	1.310	2.181	1	.	22:14	1.378	2.151	.			
2	.	22:36	1.407	2.140	2	.	22:20	1.433	2.117	.			

FIGURE E1

REDUCTION DATA : INLET COMPOSITION

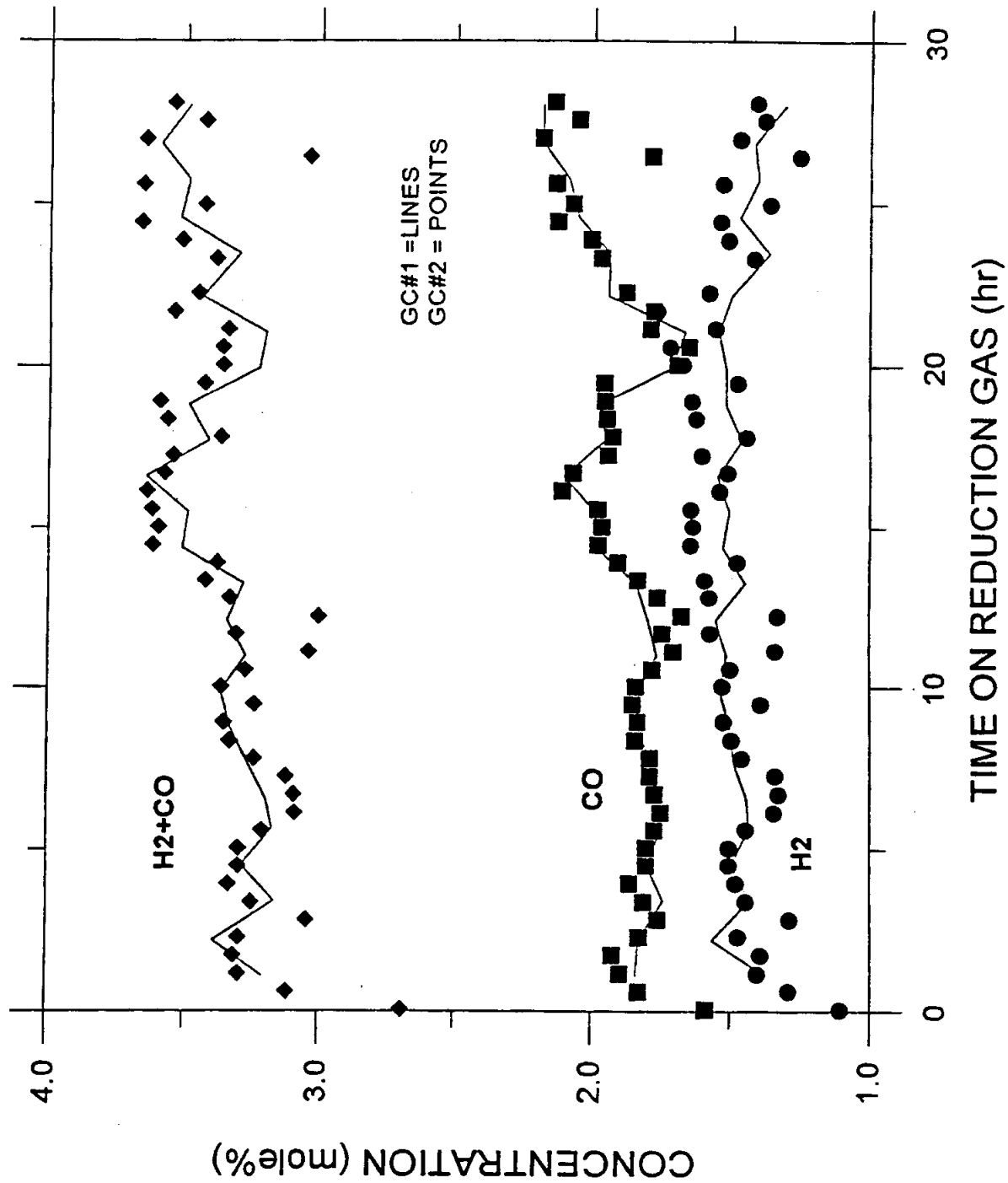


FIGURE E2

REDUCTION DATA: OUTLET COMPOSITION

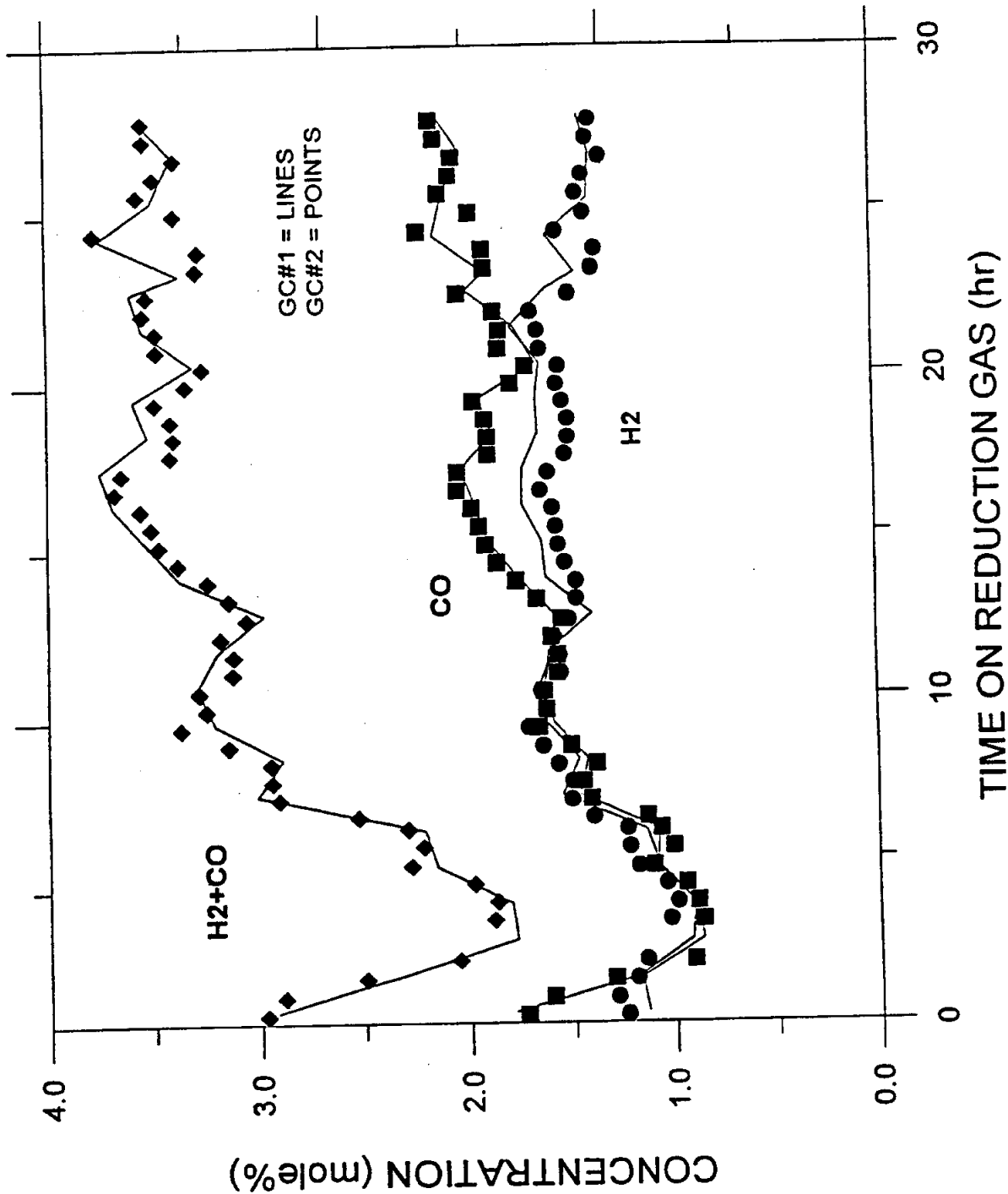


FIGURE E3

ACTIVATION A2: Reduction Gas Uptake vs. Temperature

