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Methyl Chloride Via Oxyhydrochlorination of Methane

Quarterly Technical Progress Report No.6
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Contractor

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Contract Objective

The purpose of this contract is to develop a process for converting light alkane gases to methyl chloride via oxyhydrochlorination using highly selective, stable catalysts in fixed-bed reactors designed to remove the large amount of heat generated, so as to control the reaction temperature. Further, the objective is to obtain the engineering data base necessary for developing a commercially feasible process and to evaluate the economics of the process.

Task 1.0 Catalyst Definition and Separation Unit Operation Development

Task 2.0 Process Development Unit (PDU) Design Engineering

Task 3.0 PDU Construction and Procurement

Task 4.0 PDU Start-Up

Task 5.0 Evaluation of Packed Bed Technology

Task 6.0 Separation Optimization

Task 7.0 Process Optimization

Task 8.0 Economic Evaluation

Task 9.0 Preliminary Engineering Design Phase II

Task 10.0 Scale-Up Decision and Business Plan to Phase II

Summary of Technical Progress

Significant progress was made this quarter toward the development of a stable heterogenous packed bed catalyst for the oxyhydrochlorination of methane. The short term target for selectivity and conversion of the methane reactant is 80% MeCl selectivity and 20% methane conversion. This quarter's data shows a catalyst which gave an average 18% methane conversion and 78% MeCl selectivity for a 12 day period of time. This encouraging result, which was acheived using a $CH_4/O_2/HCl$ ratio of 100/23/30 with a fluid velocity of 9.0 cm/s and a residence time of about 3 seconds, puts the development on track to meet this short term target.

The development of the product separation system was moved forward a bit more slowly. The reduction to practice in the laboratory environment was plagued with a number of minor operational difficulties. Still, significant progress was made up the learning curve toward demonstration of this technology. Next quarter should bring significant results.

The PDU design engineering effort made significant progress this quarter. Two significant activities occurred. The first is that a bid on a modular unit by Xytel Corp. was received and evaluated. Xytel is a contract engineering firm that specializes in the design and construction of small scale modular processes for the chemical and petrochemical industry. This pre-engineering estimate showed that costs were considerably higher than the original project capital estimates. The primary driver for this cost increase was an increase in the cost of the recovery system. As a result of this work, a rigorous effort was made to eliminate all non-essential equipment and scope of work. A reduced scope was agreed upon and in the second round both Xytel and the Dow Corning in-house facilities engineering team were allowed to bid on the package. This work is in progress. Next quarter the new bids will be recieved and a design and construction partner will be chosen.

Technical Results

Task 1. Catalyst Definition and Separation Unit Operation Development.

Catalyst Definition-

The primary focus of this quarter's catalyst definition work was the evaluation of catalyst stability. The first "long" experiment for the quarter is reported in Data Set 1. The catalyst was a Cu_6Al cluster supported on silica. As shown on page 2 of this data set, this catalyst , #518, showed a rapid drop in activity from the 15-17% methane conversion range down to a steady 10-11% conversion that remained fairly stable for the 95 hour experiment. The selectivity for this 340 C experiment is plotted on page 3 of the data set and shows very good results , with 93% MeCl. However, due to the low activity the experiment was not extended longer. The initial development goal for this catalyst system is 20% methane conversion and 80% MeCl selectivity. This experiment , as well as all others performed this quarter, was performed at atmospheric pressure with a $CH_4/O_2/HCl$ feed ratio of 100/23/30. Most of the experiments were performed at a set point temperature of 340 C for the 3 zone tube furnace that is used to control temperature. Table 1 provides the average conversions and selectivities for this experiment and all others from this reporting period. In addition, the space velocities, temperatures and Cu loading for the catalyst are shown as well.

The next experiment was performed to serve as a baseline for the supported Cu catalyst stability testing. In this experiment a simple supported Cu salt catalyst was used. This catalyst, #511, was made from a $CuCl_2.2H2O$ salt and was not promoted in any fashion. More details on this catalyst and others used during this reporting period are found in appendix B. Focusing on the conversion vs time graph found on page 2 of Data Set 2, it is clear that this catalyst was fairly low in activity. In addition the activity dropped from 9-10% conversion to 6-7% conversion, or about 35% in the 140 hour experiment. This catalyst gave an average MeCl selectivity of 87% which is slightly lower at comparable conversion to the previous experiment on the Cu-Al supported cluster catalyst. Note the experimental noise on the selectivity vs time graph on page 3 of Data Set 2. This noise , due to a GC malfunction, was corrected at about 100 hours into the experiment. The apparent shift in selectivity at 100 hours is probably not real. However, the precipitous drop in selectivity at about 130 hours that was matched by a significant rise in the oxygenated by-products is apparently real. An explanation for this sudden shift is not available. This unexplained shift, combined with the low activity of the catalyst was a motivation to evaluate other, modified Cu catalysts for their stability.

Data Set 3 shows the results obtained in the evaluation of another simple Cu salt catalyst. Catalyst #516 was based on a Cu(I) salt. The results are very similar to those found in the above Cu(II) based catalyst. The average methane conversion was 12% and average MeCl selectivity 83%. The experimental record for conversion is found on page 2 of the data set and the selectivity record on page 3. A possible difference in this case is that while the activity is similar to that of the other simple Cu catalyst, there is not the same evidence of deactivation noted. It is possible this is due the increase in copper loading to 2.2% vs. the 1.0% found in catalyst #511.

While it is not immediately obvious from the preceding two experiments, the primary mode of catalyst deactivation in this system is most likely Cu loss from the catalyst surface. As such, one mechanism of coping with this issue would be to use a catalyst with a very high Cu loading to extend the lifetime of the catalyst. Catalyst 163C was evaluated to assess this strategy. This was a purchased catalyst with about 30% weight loading of Cu as CuO. Before use this catalyst was reduced in H_2 to remove the oxide coating and then dried in flowing dry N_2 for 1 hour at 340 C. During this experiment, because experiences from earlier evaluations of this catalyst, thermocouples were placed in the reactor and wired to the outside of the reactor to attempt to measure the exotherm that was expected. The results of this experiment were very interesting. On page 2 of Data Set 4 the conversion vs time graph for this experiment is shown. Note that the data is much more erratic than in most of the previous experiments in this system. While erratic , this data when combined with the selectivity data shown on page 3 of the same data set shows that the first 50 hours of this experiment gave results very close to the 20% conversion, 80% selectivity target. The conversion however, took steep drop at about 50 hours. In order to make some sense of this data the thermocouple profiles are shown on page 4 of the data set. They show the sporadic conversion data was quite understandable. The 3 traces show the furnace setpoint which holds steady at 340 C throughout the experiment. The next trace shows the outside reactor temperature which gives a spike to 400 C about 35 hours into the experiment. It is worth noting that the outside thermocouple was mounted about 2/3 of the way down the long axis of the reactor. The temperature measured in the bed gave two different exotherms , 460 C at 25 hours and 410 C at 45 hours. Clearly, this was not a steady state reactor during this experiment. A possible explanation for the drop in activity seen at 50 hours is that at this point the bed was not able to generate the exotherm needed for the higher conversions.

Another high Cu loading catalyst was evaluated to compare with the result just described. A PETC catalyst, received and pretreated in H_2 before use, was evaluated under our experimental conditions. This catalyst was a CuCl catalyst promoted with Li and La. The Cu weight loading was nominally 30 wt% . Data Set 5 contains our results. As in the experiment just described a thermocouple was put in the reactor bed. In this case, as shown on page 2 of the data set, the temperature at about 35 hours into the run was 560 C! This thermocouple was about 1/2 down the length of the bed. Note that at about 70 hours or twice the exotherm time, the conversion as reported on page 3 plummets. This drop from 25-30% to 11-13% methane conversion occurred over about a 1.5 hour time period. Note also on page 4 and page 1 that the selectivity abruptly changes at this point and the total oxygenate selectivity drops by about 20%, this is accompanied by a corresponding increase in the MeCl selectivity. This temperature impact seems to show very clearly that, in this case, the high initial conversion was caused by an exothermic wave moving through the bed that increase both methane conversion and combustion side reactions. When the wave left the bed both the conversion and the combustion dropped significantly. A similar signal was not seen in the experiment described in Data Set 3, presumably because the apparent existence of multiple exothermic waves confused the experiment.

The experiment described in Data Set 6 is an attempt to determine the 'initiation' temperature for the high metal loading catalysts. Catalyst 163C was used again. In this experiment the temperature was raised slowly by 10 C increments. Data included shows that the reaction was extraordinarily slow starting. A temperature of 340 C was maintained for a significant period of time with very low conversion. It was discovered later, that this oxide catalyst had not been reduced prior to reaction. As such the results are not surprising.

Data Set 7 shows the first experiment that evaluated the use of a copper tetrakis acetonitrile hexafluorophosphate salt as a precursor for the supported catalyst. Catalyst #535 uses this salt and is promoted with lanthanum and lithium salts. This catalyst, while using the PETC promoters, is a significantly different catalyst due to it's low metal loading (about 2% Cu) and the use of the flourophosphate salt as a Cu source. Page 2 of the data set shows the conversion vs time profile for this experiment, note that much of the data prior to 35 hours was lost due to a computer malfunction on the CAMILE control system used for these experiments. The conversion data remaining shows a very flat profile with < 10% loss in conversion in the 140 hour experiment. Page 3 shows that the selectivity was fairly stable also, averaging 75% with some variation after 75 hours. This 21% conversion, 75% selectivity result that was sustained for 140 hours is a very encouraging result that is near the target for our PDU system. Note on page 4 that even with the 2% metal loading an exotherm was found by a thermocouple in the catalyst bed. This exotherm was only on the order of 10-20 C , but may still be significant. The differential between the 370 C outside reactor temperature and the 340 C furnace control temperature is real and is not a function of the heat of reaction. This condition remains constant throughout the work performed in this experimental apparatus.

Given the success of catalyst #535 in the 140 hour experiment , an extended trial was performed to see the impact of extended reaction time. Data Set 8 shows a 14 day experimen. under the same conditions as the data found in Data Set 7. The page 2 conversion graph shows the catalyst increasing in conversion for the first 10-20 hours. After this the data shows a slow steady decline that is slightly more exaggerated than that seen in the previous experiment. The gap seen between 75 and 90 hours is again due to a computer malfunction. The deactivation of this catalyst is approximately 35% over the first 12 days. The average conversion during this period was 18% with a selectivity of 79%, another very encouraging result.

Separation Process Definition-

The primary emphasis of the separation process definition work undertaken this quarter focused on the startup of a laboratory absorber unit described in last quarter's report. This unit is a direct contact gas in liquid absorber column which is attached to a laboratory screening reactor. This will be used as a screening tool for process solvent selection and as an aid in PDU column design. The successful operation of a small column like this in a laboratory setting is quite challenging. Continuous work throughout the quarter made major progress toward successful operation, but at quarter's end it had still not successfully recovered a significant amount of MeCl due to an array of operational difficulties. Some of the operational problems will be briefly discussed here to illustrate the development of this laboratory experiment.

A key issue in the successful operation of this continuous liquid absorber is the delivery of a continuous, but extremely small, stream of a cooled process solvent to the absorber column. Work was performed with two different process solvents, Mobil SHC-624 oil and Multitherm 503. The target set temperature for solvent introduction to the column is -20 C. This created a number of problems associated with water freezing in the chiller reservoir and plugging the micropump being used for moving the solvent from the chiller to the column. The total delivery rate of solvent is in the 1-5 ml/min range, depending on desired L/G loading of the column.

An additional issue that proved to be very hard to solve was generating the appropriate pressure drops through the system. In order to get solvent flow down through the column and countercurrent gas flow up through the column the pressure drop across the column must be carefully coordinated with pressures downstream of the column. The basic problem is that the column sits above a phase separator where the processed solvent falls containing the absorbed MeCl. The gas flow enters the column above the phase separator. With this common design, the pressure in the phase separator must be slightly higher than the entering gas stream , this allows the gas to flow up through the column. To balance this and allow the liquid to flow down into the slightly higher pressure, the void volume of the column packing must be large. This problem was addressed by studying the flow dynamics via simple observation and observing which flow condition, packing combinations allowed appropriate flow. One additional problem was that the tubing from the column bottom to the phase separator was too small and solvent blockage of this line caused a vapor lock in the system. Replacement with a larger line solved this problem.

Work in the next quarter will continue on demonstrating this removal technology in the laboratory. Proper packing selection should allow this column to operate, and allow process solvents to be evaluated. In addition the plans for extensive solvent testing are in place for next quarter. Limited acid stability and thermal stability tests were completed this quarter, however the bulk of this work will occur next quarter and the few results from this quarter will be included in that report.

Task 2.0 Process Development Unit Design Engineering

Process Description and Definition-

The initial pre-engineering estimate from Xytel Corporation was received this quarter. The estimate for design and construction of a modular process unit to be built off-site and shipped to Carrollton was much higher than anticipated. The principal cost inflation as compared with historical estimates was the impact of the proposed absorber/stripper unit for MeCl recovery from the reactor effluent stream. Several decisions were made in light of this cost inflation. The first, as discussed at a March project management team meeting, was the elimination of the distillation column and associated equipment for the separation of a pure MeCl stream This technology has been previously demonstrated, and the technological impact of this scope reduction was felt to be minimal. Several other small deletions were also made. After these changes in scope the process design package was sent again to Xytel for re-bidding. In addition DCC in house engineering was contacted and a bid on the process was requested for this internal option for design and construction. This limited the Process Development Unit (PDU) design engineering progress made during this period. Both estimates will be received next quarter and a decision will be made as to how to proceed with design, procurement and construction of the PDU.

List of Tables

Table 1 - Copper Based Catalysts for the Oxyhydrochlorination of Methane

Table 1 Copper Based Catalysts for the Oxyhydrochlorination of Methane

Catalyst Number	PETC	511	516	518	163C	535	535
%Cu on Catalyst	30	1.0	2.2	1.9	30	1.9	1.9
Temperature (C)	315	340	340	340	340	340	340
Space Velocity (cm/s)	9	9	9	9	9	9	9
CH_4 Conversion	19	8	12	11	20	18	21
HCl Conversion	55	25	36	38	61	69	80
O_2 Conversion	50	20	29	26	54	47	56
% CH_3Cl	74	87	83	93	77	79	75
%CH_2Cl_2	7	2	4	5	6	14	18
%$CHCl_3$	0	0	0	0	0	0	0
%CCl_4	0	0	0	0	0	0	0
%CO	7	0	7	0	0	2	2
%CO_2	12	11	6	2	16	4	4

*all data in this table taken at atmospheric pressure, $CH_4/O_2/HCl$: 100/22.8/29.6, HCl and O_2 conversions are calculated.

Data Appendices

Data Appendix A- Experimental Data Sets

Data Appendix B- Catalyst Synthesis Information

Data Appendix A

Experimental Data Sets

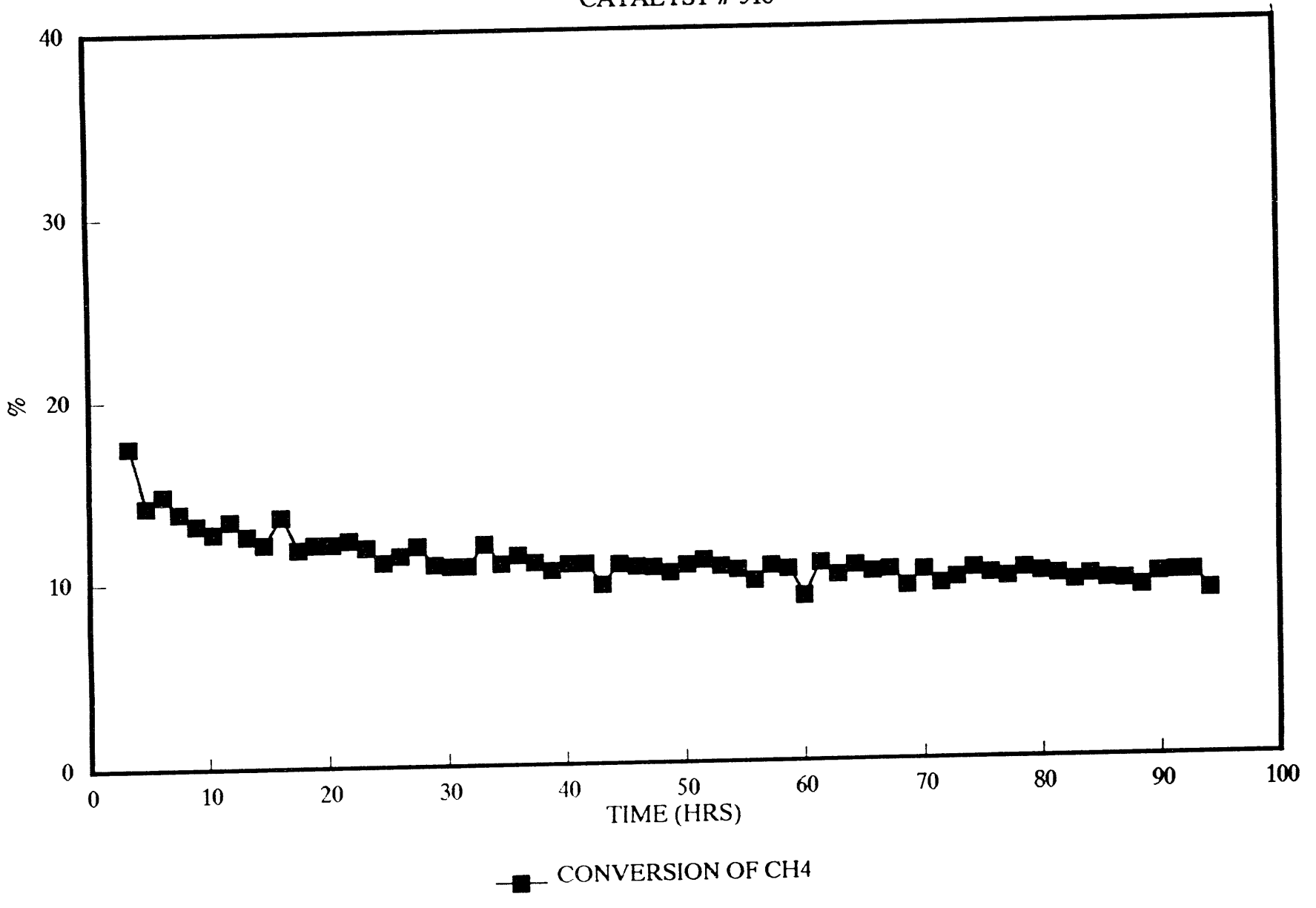
00006701 OPERATOR NAME: B. CRUM DATE: 31-DEC-92
00006701 LOG BOOK #: 10346 PAGE #: 128
00006701 RUN #: 10346057 CATALYST #: 518
00006701 CATALYST NAME: _____
00006701 COMMENTS: CAT 518 RUN AT 340
00006701
00006701
00006701 MASS OF CATALYST (g): 3.09 FLUID VELOCITY 9.0 CM/SEC
00006701 REACTOR INSIDE DIAM (CM): 0.6 RUNTIME 95 HRS
00006701 CATALYST BED HEIGHT (CM): 24

00006567 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00006567 ----------
00006567 INITIAL FINAL ABSOLUTE
00006567 TEMP TEMP RAMP RATE
00006567 (DEG C) (DEG C) (DEG C / MIN)
00006567 ----------
00006567 BOTTOM: 340 340 2
00006567 MIDDLE: 340 340 2
00006567 TOP : 340 340 2
00006567
00006567 (INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)
00006567
00006567 CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8
00006567 HCl FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
12063	0	26	26	74	0	0	0	1	100	17	44	340	
17149	0	2	2	88	9	0	0	1	83	14	51	340	
22248	0	1	1	91	7	0	0	1	82	15	53	340	
27347	0	1	1	92	7	0	0	1	84	14	49	340	
32447	0	1	1	92	7	0	0	1	85	13	47	340	
37547	0	1	1	92	6	0	0	1	85	13	45	340	
42641	0	1	1	92	6	0	0	1	86	13	47	340	
47741	0	1	1	92	6	0	0	1	87	13	45	340	
52848	0	1	1	93	6	0	0	1	87	12	43	340	
57947	0	1	1	93	6	0	0	1	87	14	48	340	
63064	0	1	1	93	6	0	0	1	87	12	41	340	
68148	0	1	1	93	6	0	0	1	88	12	43	340	
73248	0	1	1	93	6	0	0	1	88	12	43	340	
78340	0	1	1	93	6	0	0	1	88	12	43	340	
83448	0	1	1	93	5	0	0	1	88	12	42	340	
88548	0	1	1	93	5	0	0	1	89	11	39	340	
93640	0	1	1	94	6	0	0	1	89	11	40	340	
98748	0	1	1	93	5	0	0	1	89	12	41	340	
103848	0	1	1	93	5	0	0	1	89	11	38	340	
108947	0	1	1	93	5	0	0	1	89	11	37	340	
114047	0	1	1	93	5	0	0	1	89	11	38	340	
119149	0	1	1	93	5	0	0	1	89	12	41	340	
124248	0	1	1	93	5	0	0	1	89	11	38	340	
129347	0	1	1	94	5	0	0	1	89	11	40	340	
134447	0	1	1	94	5	0	0	1	89	11	38	340	
139549	0	1	1	94	5	0	0	1	89	10	37	340	
144648	0	1	1	93	5	0	0	1	90	11	38	340	
149748	0	1	1	94	5	0	0	1	90	11	38	340	
154865	0	1	1	94	5	0	0	1	91	10	34	340	
159947	0	1	1	94	5	0	0	1	90	11	37	340	
165047	0	1	1	94	5	0	0	1	90	11	37	340	
170166	0	1	1	94	5	0	0	1	90	11	37	340	
175272	0	1	1	94	5	0	0	1	90	10	36	340	
180381	0	1	1	94	5	0	0	1	90	11	37	340	
185507	0	1	1	94	4	0	0	1	90	11	38	340	
190641	0	1	1	94	4	0	0	1	91	11	37	340	
195760	0	1	1	94	4	0	0	1	91	10	36	340	
200901	0	2	2	94	5	0	0	1	91	10	34	340	
206044	0	1	1	94	5	0	0	1	91	11	36	341	
211144	0	1	1	94	4	0	0	1	91	10	36	340	
216228	0	1	1	95	4	0	0	1	91	9	31	340	
221328	0	1	1	94	4	0	0	1	92	11	37	340	
226445	0	2	2	94	5	0	0	1	93	10	35	340	
231529	0	1	1	95	4	0	0	1	91	10	36	340	
236629	0	1	1	94	4	0	0	1	91	10	35	340	
241762	0	1	1	94	4	0	0	1	91	10	36	340	
246869	0	1	1	95	4	0	0	1	91	9	32	340	
251969	0	1	1	95	4	0	0	1	92	10	36	340	
257086	0	1	1	95	4	0	0	1	92	9	33	340	
262186	0	1	1	95	4	0	0	1	91	10	34	340	
267288	0	1	1	95	4	0	0	1	91	10	35	340	
272388	0	1	1	95	4	0	0	1	91	10	34	341	
277488	0	1	1	95	4	0	0	1	91	10	34	340	
282580	0	1	1	95	4	0	0	1	90	10	35	340	
287681	0	1	1	95	4	0	0	1	91	10	35	340	
292788	0	1	1	95	4	0	0	1	91	10	34	341	
297888	0	1	1	95	4	0	0	1	91	9	33	340	
302988	0	1	1	95	4	0	0	1	91	10	34	340	
308089	0	2	2	94	4	0	0	1	93	10	33	340	
313189	0	1	1	95	4	0	0	1	91	9	32	340	
318289	0	1	1	95	4	0	0	1	92	9	32	340	
323388	0	1	1	95	4	0	0	1	91	10	34	340	
328489	0	1	1	95	4	0	0	1	92	10	34	340	
333581	0	1	1	95	4	0	0	1	92	10	34	340	
338667	0	1	1	95	3	0	0	1	91	9	30	340	
Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
AVG	0	2	2	93	5	0	0	1	90	11	38	340	
STD	0	3	3	3	1	0	0	0	3	2	5		

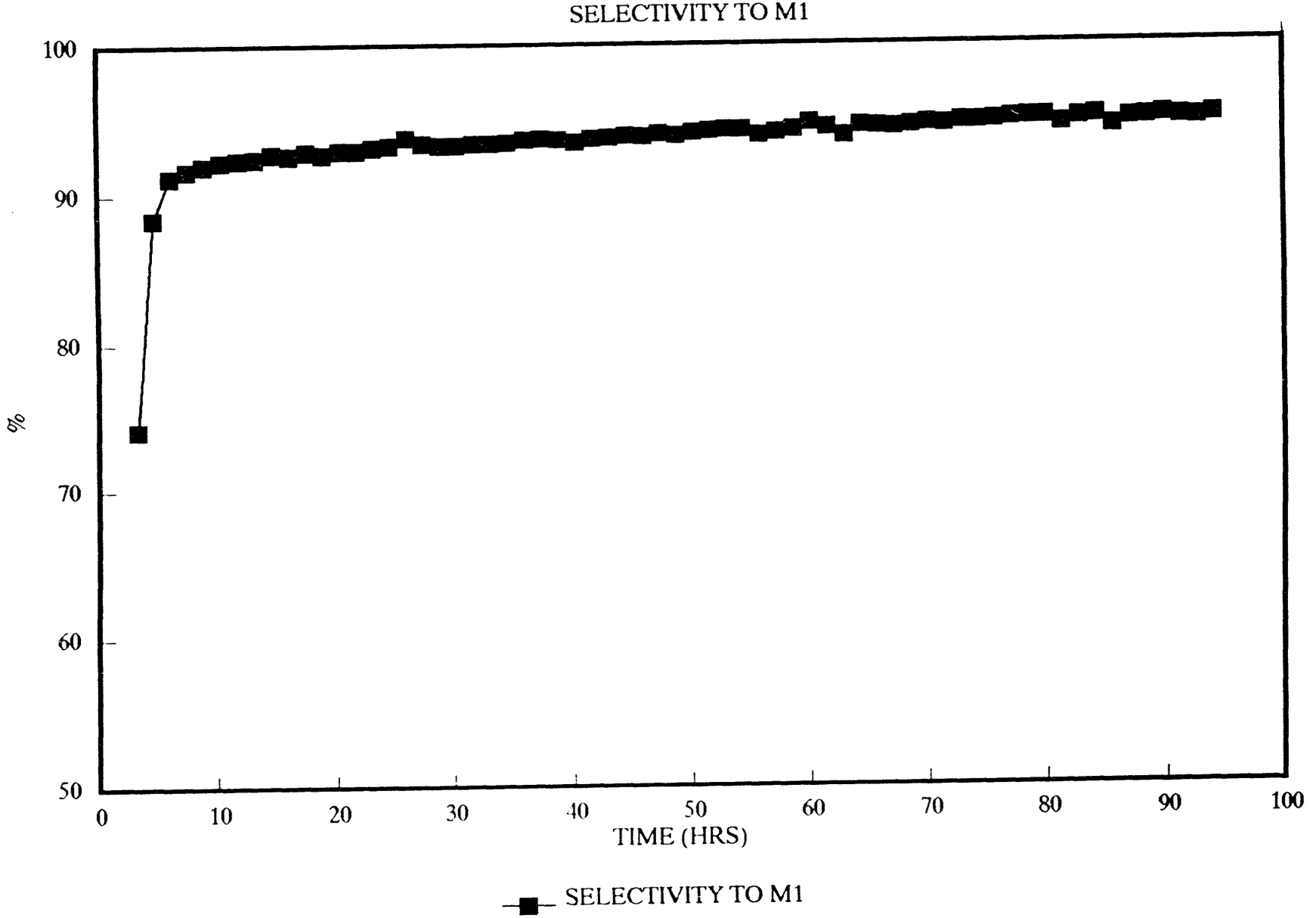
RUN 10346057 CONVERSION

CATALYST # 518



Data Set 1 - pa

RUN 10346057 SELECTIVITY



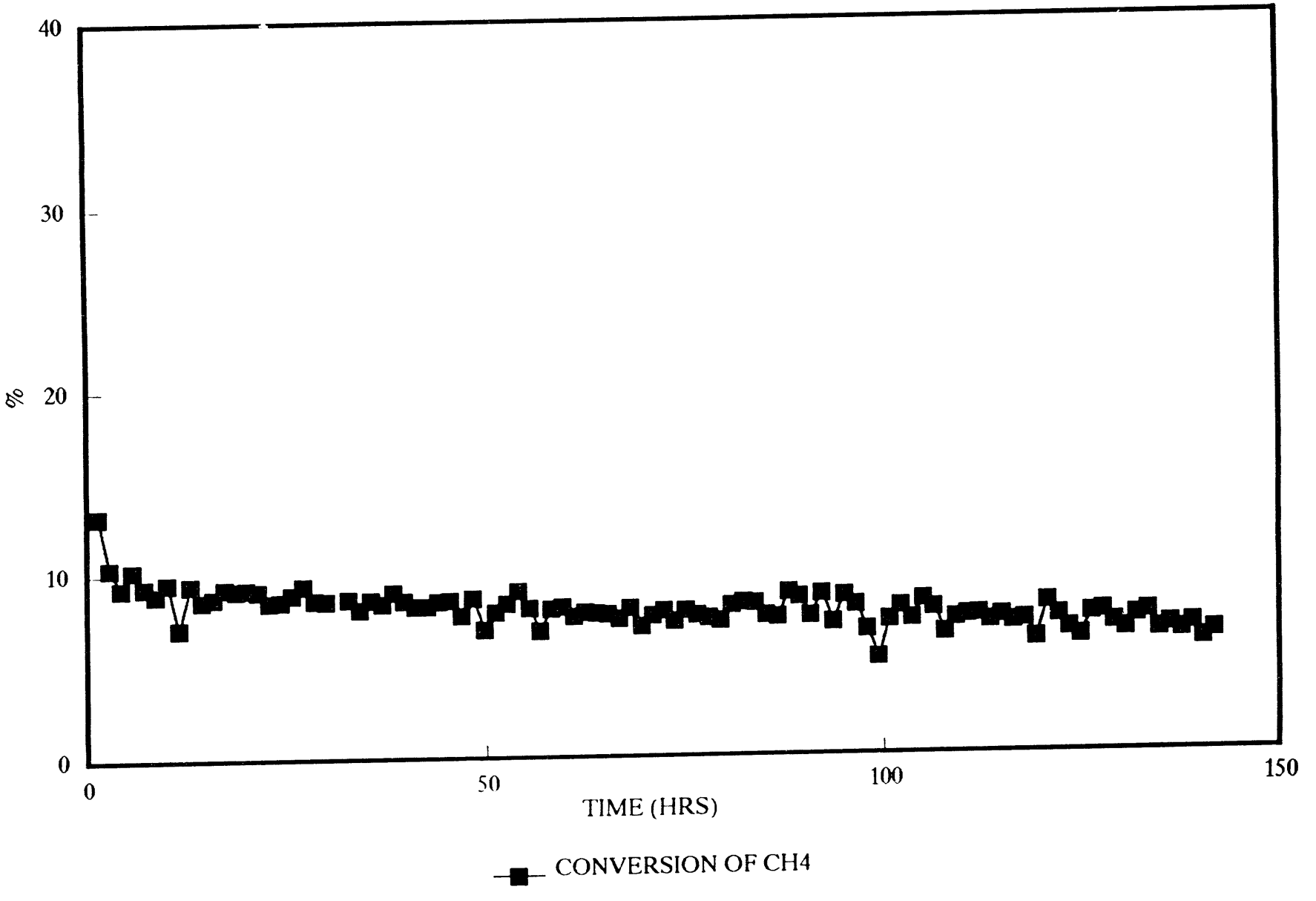
00000048 OPERATOR NAME: B. CRUM DATE 08—JAN—93
00000048 LOG BOOK #: 10046 PAGE #: 132
00000048 RUN #: 10046058 CATALYST # 611
00000048 CATALYST NAME : CuCl2 on CS1040
00000048 COMMENTS: SINGLE TEMP (340) LONG RUN
00000048
00000048
00000048 MASS OF CATALYST (g): 2.84 FLUID VELOCITY 9.0 CM/SEC
00000048 REACTOR INSIDE DIAM.(CM): 0.6 RUN TIME 140 HRS
00000048 CATALYST BED HEIGHT (CM): 24

00000126 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00000126 ==========
00000126 INITIAL FINAL ABSOLUTE
00000126 TEMP TEMP RAMP RATE
00000126 (DEG C) (DEG C) (DEG C / MIN)
00000126 ----------
00000126 BOTTOM: 340 340 2
00000126 MIDDLE: 340 340 2
00000126 TOP : 340 340 2
00000126
00000126 (INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)
00000126
00000126 CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8
00000126 HCl FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0
00000126
00000126 TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 850

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
6481	0	3	3	87	10	0	0	1	94	13	48	340	
10641	0	2	2	93	8	0	0	1	89	10	36	340	
18882	0	2	2	93	6	0	0	1	91	9	32	341	
20817	0	3	3	93	4	0	0	1	91	10	36	340	
26862	0	6	6	89	7	0	0	1	96	9	32	340	
31052	0	3	3	93	4	0	0	1	92	9	30	340	
36160	0	6	6	89	6	0	0	1	96	9	32	340	
41253	0	6	6	89	6	0	0	1	114	7	24	340	
46362	0	3	3	96	3	0	0	1	89	9	32	340	
51450	0	9	9	82	9	0	0	1	101	6	26	340	
54651	0	7	7	87	6	0	0	1	100	9	29	340	
61643	0	6	6	88	5	0	0	1	112	9	31	340	
66783	0	4	4	93	3	0	0	1	93	9	30	340	
71841	0	7	7	86	6	0	0	1	98	9	30	340	
78852	0	9	9	86	6	0	0	1	99	9	30	340	
82991	0	7	7	88	5	0	0	1	98	8	26	340	
87210	0	8	8	87	5	0	0	1	96	8	28	340	
92313	0	4	4	93	3	0	0	1	92	9	29	340	
97413	0	4	4	94	2	0	0	1	89	9	31	340	
102611	0	8	8	88	5	0	0	1	98	9	28	340	
107612	0	8	8	87	5	0	0	1	96	8	27	340	
112703	0	9	9	86	5	0	0	1					
117811	0	9	9	86	5	0	0	1	99	9	28	340	
122904	0	8	8	93	2	0	0	1	92	8	27	340	
128012	0	8	8	88	4	0	0	1	100	8	28	340	
133112	0	8	8	93	2	0	0	1	92	8	27	340	
138211	0	8	8	88	4	0	0	1	101	8	29	340	
143311	0	8	8	93	2	0	0	1	92	8	28	340	
148412	0	8	8	88	4	0	0	1	98	8	28	340	
153504	0	8	8	93	2	0	0	1	92	8	27	340	
158605	0	11	11	84	5	0	0	1	101	8	27	340	
163713	0	4	4	96	2	0	0	1	86	8	28	341	
168812	0	9	9	87	4	0	0	1	99	8	24	340	
173912	0	8	8	93	2	0	0	1	93	9	28	340	
179010	0	16	16	79	6	0	0	1	103	7	21	340	
184113	0	8	8	93	2	0	0	1	92	8	26	340	
189229	0	5	5	93	2	0	0	1	89	8	27	340	
194311	0	8	8	92	2	0	0	1	91	9	29	340	
199429	0	9	9	87	4	0	0	1	97	8	26	340	
204512	0	10	10	87	4	0	0	1	96	7	22	340	
209610	0	10	10	86	4	0	0	1	96	8	25	340	
214730	0	13	13	83	5	0	0	1	99	8	26	340	
219810	0	11	11	86	4	0	0	1	99	8	24	339	
224912	0	8	8	92	2	0	0	1	92	8	26	340	
230013	0	8	8	92	2	0	0	1	90	8	26	340	
235111	0	11	11	86	4	0	0	1	95	8	24	340	
240204	0	11	11	86	4	0	0	1	96	7	23	340	
245312	0	8	8	92	2	0	0	1	92	8	26	340	
250411	0	12	12	86	4	0	0	1	96	7	22	340	
255513	0	17	17	78	5	0	0	1	101	8	22	340	
260612	0	11	11	86	3	0	0	1	98	8	24	340	
265713	0	11	11	86	3	0	0	1	96	7	23	340	
270812	0	8	8	93	1	0	0	1	90	8	26	340	
275910	0	13	13	84	3	0	0	1	96	8	23	340	
281012	0	8	8	92	2	0	0	1	90	7	24	341	
286113	0	13	13	84	3	0	0	1	99	7	22	340	
291212	0	12	12	86	3	0	0	1	99	8	24	340	
296312	0	8	8	92	1	0	0	1	92	8	26	340	
301412	0	7	7	92	1	0	0	1	91	8	26	340	
306512	0	7	7	92	1	0	0	1	91	7	24	340	
311612	0	7	7	92	1	0	0	1	91	7	24	340	
316712	0	7	7	91	2	0	0	1	88	8	29	340	
321811	0	4	4	96	0	0	0	1	84	8	27	340	
326912	0	12	12	86	3	0	0	1	96	7	23	340	
332012	0	7	7	92	1	0	0	1	91	8	26	340	
337112	0	7	7	92	1	0	0	1	90	7	23	340	
342210	0	7	7	92	1	0	0	1	93	8	27	340	
347311	0	7	7	92	1	0	0	1	92	8	26	340	
352430	0	7	7	92	1	0	0	1	92	7	21	340	
357511	0	7	7	93	0	0	0	1	92	6	19	340	
362611	0	11	11	89	0	0	0	1	96	7	22	340	
367712	0	12	12	86	0	0	0	1	96	8	24	340	
372812	0	12	12	86	0	0	0	1	96	7	21	340	
377912	0	11	11	86	0	0	0	1	96	8	26	340	
383012	0	12	12	86	0	0	0	1	99	8	23	340	
388113	0	13	13	87	0	0	0	1	96	6	19	340	
393213	0	12	12	86	0	0	0	1	99	7	21	341	
398313	0	12	12	86	0	0	0	1	99	7	22	340	
403410	0	13	13	87	0	0	0	1	96	7	22	340	
408511	0	13	13	87	0	0	0	1	96	7	21	340	
413611	0	17	17	83	0	0	0	1	99	7	21	341	
418711	0	16	16	82	0	0	0	1	101	7	19	340	
423811	0	13	13	87	0	0	0	1	96	7	21	340	
428911	0	13	13	87	0	0	0	1	96	6	18	341	
434012	0	14	14	86	0	0	0	1	96	6	24	340	
439112	0	14	14	86	0	0	0	1	96	7	21	341	
444212	0	14	14	86	0	0	0	1	96	7	19	340	
449312	0	14	14	86	0	0	0	1	97	6	18	340	
454406	0	14	14	86	0	0	0	1	96	7	22	341	
459511	0	14	14	86	0	0	0	1	97	6	22	340	
464611	0	14	14	86	0	0	0	1	97	7	20	340	
469712	0	14	14	86	0	0	0	1	97	7	19	340	
474812	0	14	14	86	0	0	0	1	97	7	21	340	
479910	0	31	31	69	0	0	0	1	102	7	17	340	
485012	0	31	31	69	0	0	0	1	102	6	15	340	
490113	0	31	31	69	0	0	0	1	102	7	16	340	
495211	0	32	32	68	0	0	0	1	102	6	15	340	
500312	0	32	32	68	0	0	0	1	102	7	16	340	
505410	0	32	32	68	0	0	0	1	102	6	14	340	
510511	0	33	33	67	0	0	0	1		6	0	340	
Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
AVERAGES	0	10	10	87	2	0	0	1	96	8	25	340	
STD	0	7	7	6	2	0	0	0	6	1	6		

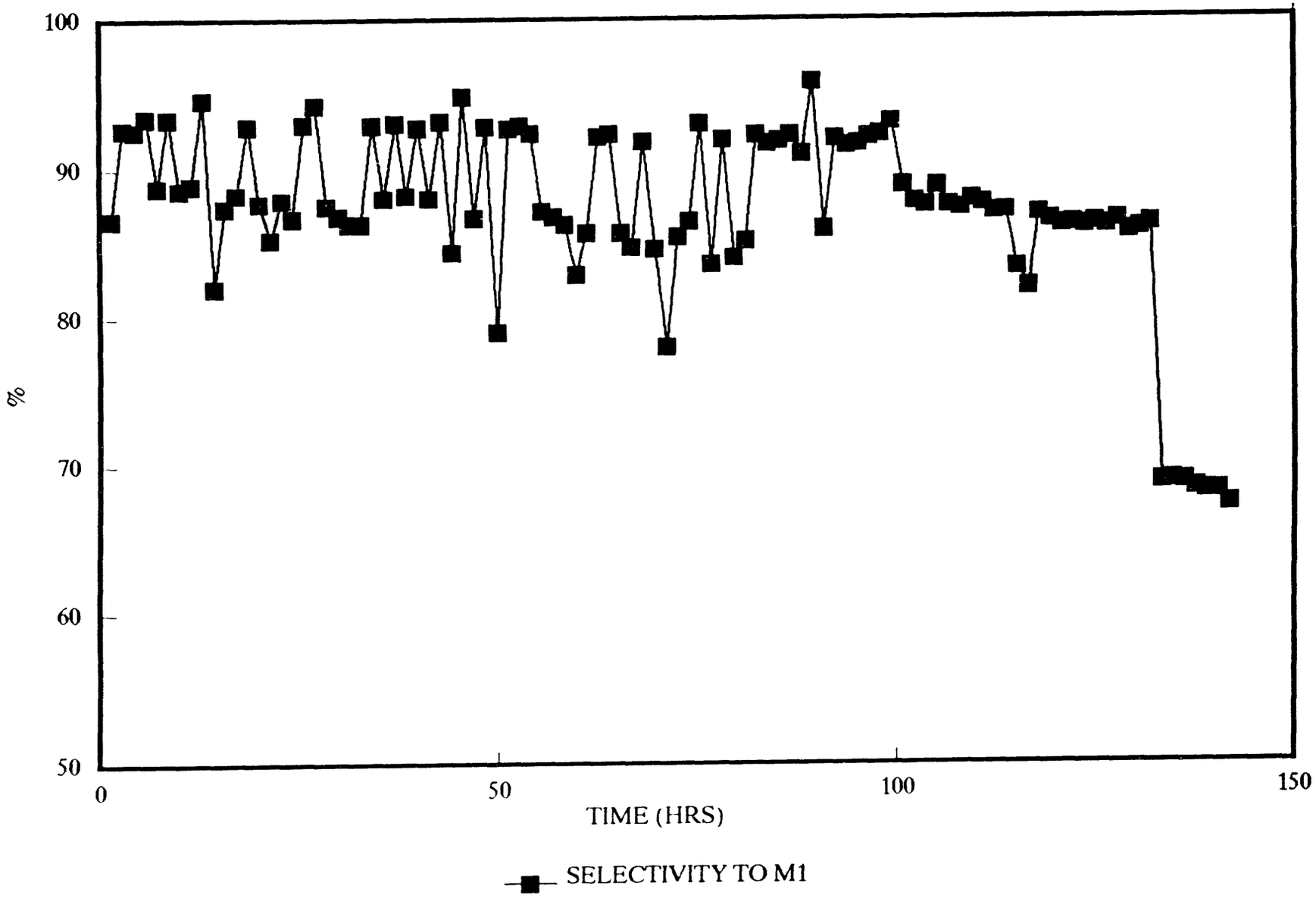
RUN10346059

CATALYST 511



RUN 10346059

CATALYST 511



00003970 HOOD #6 RAMPING EXPERIMENT DEFINITION
00003970 ==========
00003970
00003970 OPERATOR NAME: B. CRUM DATE 05-MAR-93
00003970 LOG BOOK #: 10348 PAGE #: 148
00003970 RUN #: 10348066 CATALYST #: 516
00003970 CATALYST NAME: CuCl on Silica
00003970 COMMENTS: Repeat of run 063 conditions with this cat. 2nd try
00003970
00003970
00003970 MASS OF CATALYST (g) 3.0
00003970 REACTOR INSIDE DIAM (CM): 0.6
00003970 CATALYST BED HEIGHT (CM): 25.4
00003951 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00003951 ==========

	INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)		
BOTTOM:	340	340	5	FLUID VELOCITY	9.0 CM/SEC
MIDDLE:	340	340	5	RUN TIME	170 HRS
TOP :	340	340	5		

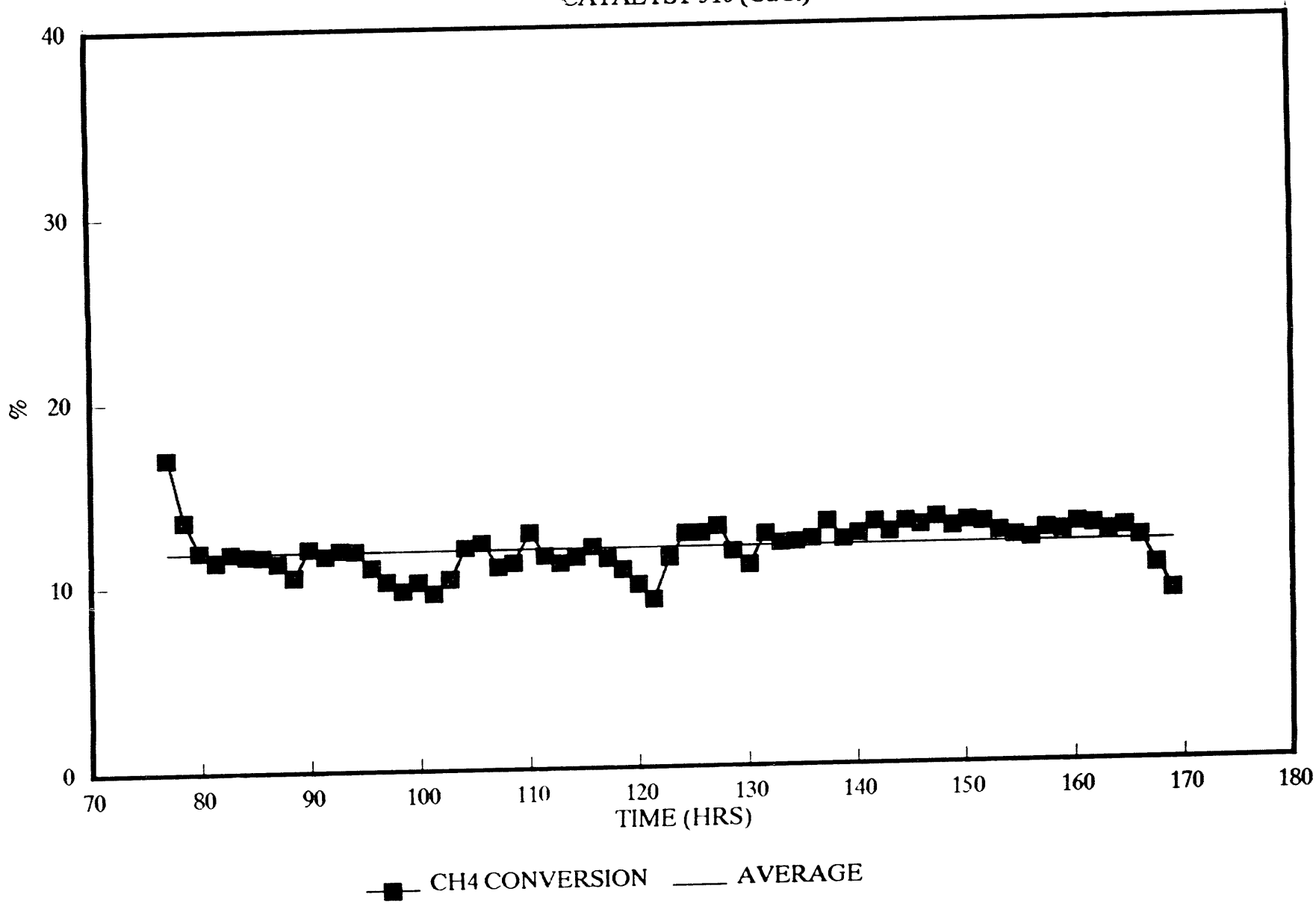
(INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)

CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8
HCl FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID8	MBO6	Q6CH4C	Q6HCLC	TQI612
277013	4	5	9	81	10	0	0	1	78	17	58	341
282172	4	3	7	86	7	0	0	1	85	14	46	341
287330	3	1	4	88	8	0	0	1	86	12	42	340
292492	5	3	8	86	6	0	0	1	89	11	37	340
297852	5	3	9	86	5	0	0	1	91	12	38	340
302811	5	4	9	87	3	0	0	1	91	12	37	340
307973	5	3	9	88	3	0	0	1	88	12	37	340
313132	6	4	10	87	4	0	0	1	91	11	36	340
318291	5	4	9	87	5	0	0	1	88	10	34	341
323453	7	5	11	89	0	0	0	1	92	12	36	341
328586	5	5	10	85	5	0	0	1	88	12	37	340
333711	7	6	13	87	0	0	0	1	92	12	35	340
338872	6	4	11	84	5	0	0	1	91	12	38	340
344030	7	5	11	84	5	0	0	1	90	11	34	340
349188	6	4	10	84	6	0	0	1	88	10	33	341
354292	7	6	14	80	6	0	0	1	91	10	30	340
359452	6	4	10	85	5	0	0	1	88	10	33	340
364611	7	5	12	83	4	0	1	1	90	9	30	340
369773	6	5	11	85	4	0	0	1	89	10	32	340
374984	7	5	12	82	6	0	0	1	91	12	38	341
380210	7	5	12	82	6	0	0	1	91	12	38	340
385371	7	6	13	82	5	0	0	1	91	11	34	340
390532	7	5	11	84	4	0	0	1	87	11	34	340
395752	8	6	14	80	6	0	0	1	91	13	39	340
400912	7	5	13	87	0	0	0	1	90	11	34	340
406073	7	6	13	81	6	0	0	1	88	11	34	340
411232	9	6	15	85	0	0	0	1	92	11	32	340
416451	8	6	14	81	4	0	0	1	90	12	36	340
421612	7	5	13	84	3	0	0	1	91	11	34	341
426772	8	6	14	82	4	0	0	1	91	11	32	340
431930	8	7	15	85	0	0	0	1	93	10	28	340
437092	7	6	13	87	0	0	0	1	91	9	26	340
442313	7	6	13	83	4	0	0	1	89	11	35	340
447533	8	7	14	80	5	0	0	1	88	13	39	340
452753	0	7	7	87	6	0	0	1	88	12	42	340
457972	9	8	17	83	0	0	0	1	92	13	37	339
463130	7	4	12	88	0	0	0	1	90	11	34	340
468350	7	6	14	82	4	0	0	1	89	11	33	340
473571	9	8	17	79	4	0	0	1	90	12	37	340
478701	8	6	14	81	5	0	0	1	87	12	37	340
483891	8	7	15	80	5	0	0	1	90	12	36	340
489052	9	7	16	78	6	0	0	1	88	12	37	339
494212	9	7	16	79	5	0	0	1	85	13	39	340
499372	9	8	17	77	6	0	0	1	89	12	36	340
504532	9	7	16	78	5	0	0	1	88	12	37	341
509752	9	7	16	81	4	0	0	1	88	13	39	340
514889	8	7	16	82	2	0	0	1	87	12	36	340
520070	9	7	16	78	5	0	0	1	88	13	39	340
525292	9	7	17	78	5	0	0	1	90	13	39	340
530511	8	6	14	80	6	0	0	1	83	13	41	340
535732	10	8	18	81	0	1	0	1	90	13	36	340
540929	9	8	17	79	4	0	0	1	85	13	38	340
546052	10	8	18	78	4	0	0	1	87	13	38	340
551248	8	7	15	80	5	0	0	1	87	12	38	341
556409	8	7	16	81	3	0	0	1	86	12	36	340
561592	10	8	17	78	4	0	0	1	90	12	35	340
566750	10	8	18	78	4	0	0	1	90	12	37	340
571972	8	7	15	80	5	0	0	1	87	12	38	340
577131	9	8	18	77	5	0	0	1	89	13	38	341
582291	9	7	16	80	3	0	0	1	88	13	37	340
587451	9	8	18	82	0	0	0	1	89	12	34	340
592611	9	8	17	78	5	0	0	1	87	13	37	340
597832	10	8	18	79	3	0	0	1	87	12	34	340
603054	0	8	8	86	6	0	0	1	86	10	35	340
608271	9	8	17	75	5	3	0	1	89	9	28	340
Time AVERAGES	AI6CO 7	AI6CO2 6	AI6COX 13	AI6M1 83	AI6M2 4	AI6M3 0	AI6M4 0	ID8 1	MBO8 89	Q6CH4C 12	Q6HCLC 36	TQI612 340
	2	2	3	3	2	0	0	0	2	1	4	

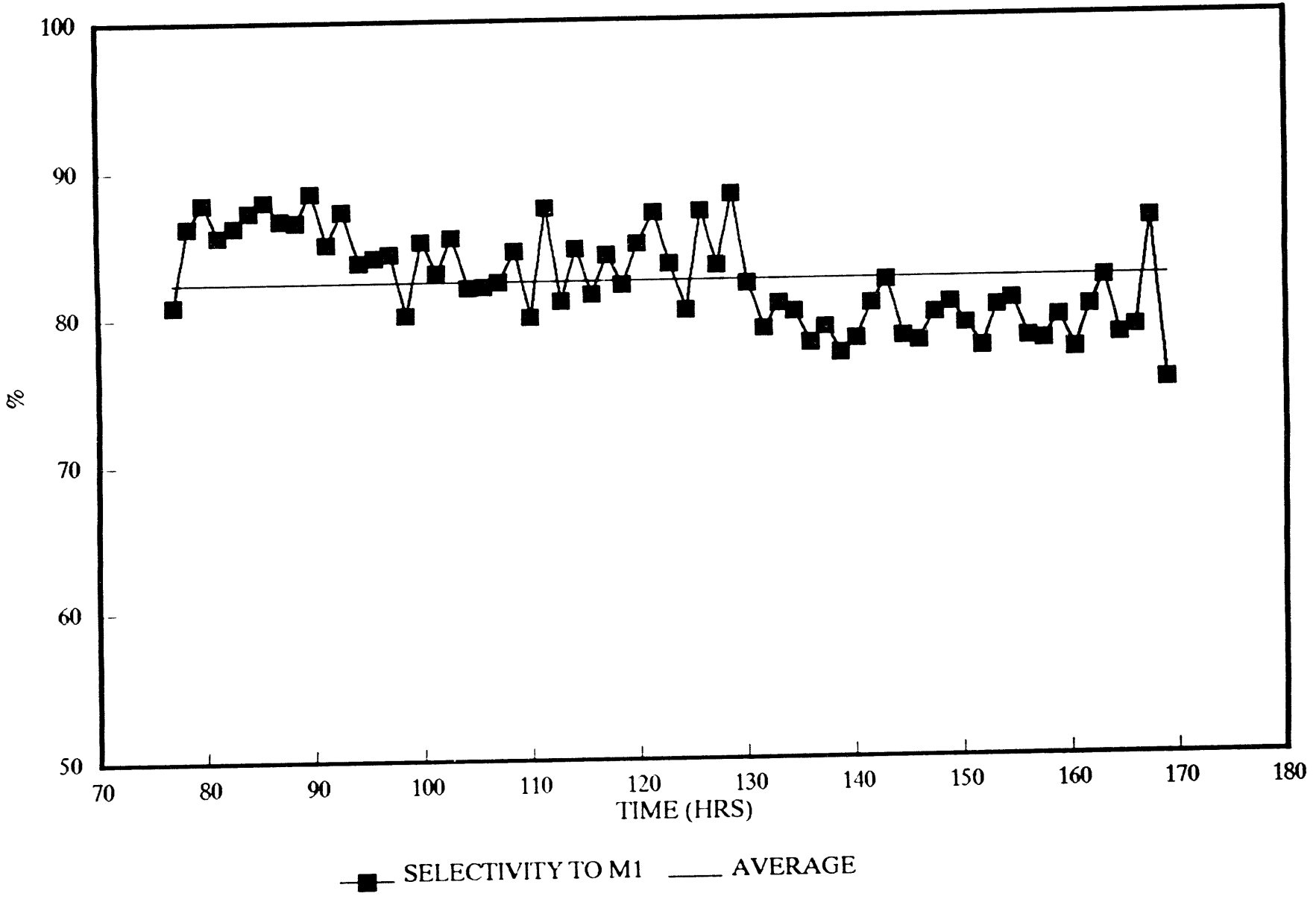
RUN 10346066

CATALYST 516 (CuCl)



RUN 10346066

CATALYST 516 (CuCl)

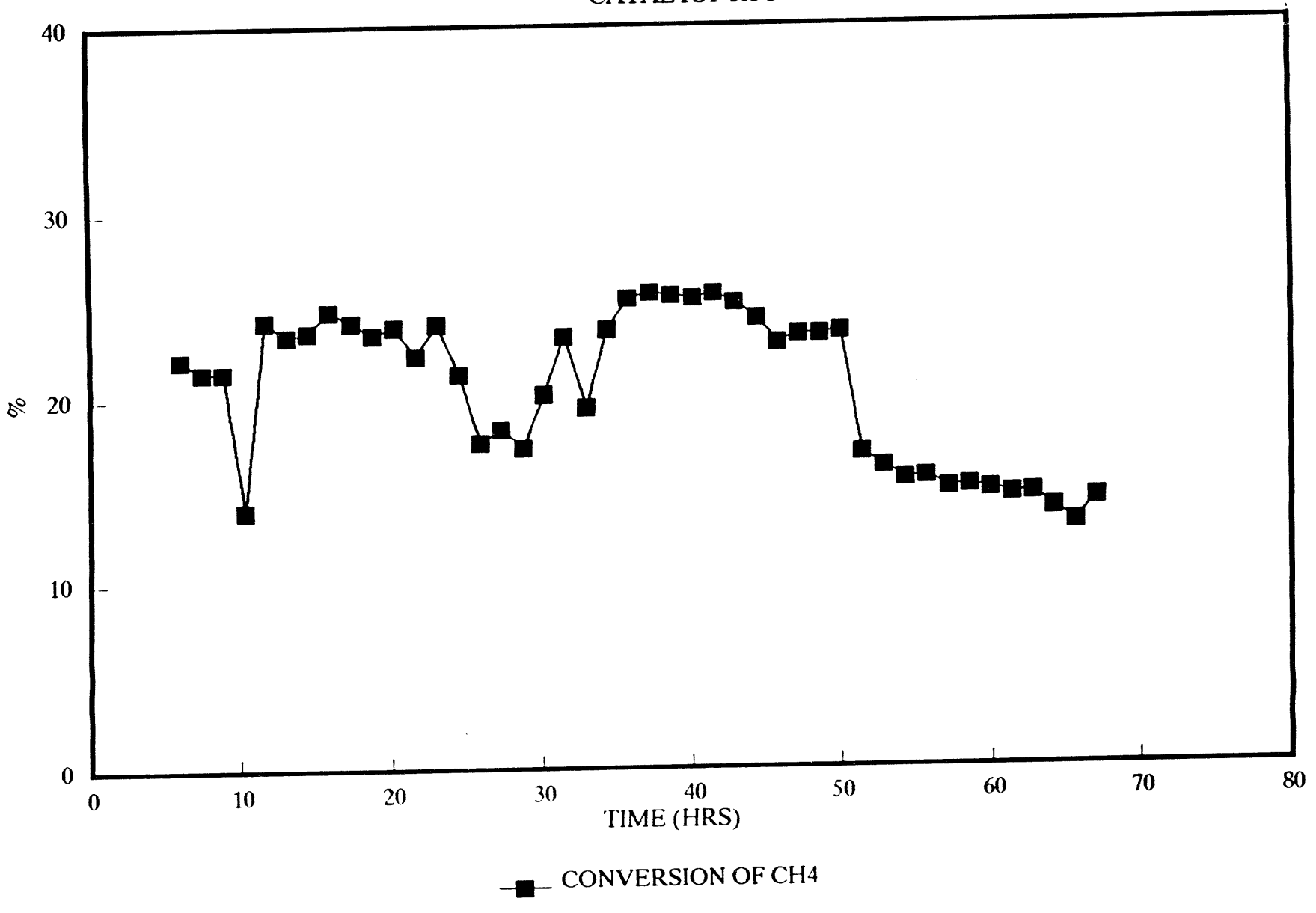


00016083 HOOD #6 RAMPING EXPERIMENT DEFINITION
00016083 ==========
00016083
00016083 OPERATOR NAME: B. CRUM DATE: 22-JAN-93
00016083 LOG BOOK #: 10346 PAGE #: 134
00016083 RUN #: 10346060 CATALYST #: 163c
00016083 CATALYST NAME: PURCHASED CuO CRUSHED
00016083 COMMENTS: SEE RUNSHEET – REDUCED CAT W H2 2HR 300C THEN 1HR N2 340
00016083 SEE TEMP DATA WHEN LOOKING AT RESULTS
00016083
00016083 MASS OF CATALYST (g): 6.36
00016083 REACTOR INSIDE DIAM (CM): .6
00016083 CATALYST BED HEIGHT (CM): 25.4
00015710 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00015710 ==========
00015710 INITIAL FINAL ABSOLUTE
00015710 TEMP TEMP RAMP RATE
00015710 (DEG C) (DEG C) (DEG C / MIN)
00015710 ==========
00015710 BOTTOM: 340 340 2 SPACE VELOCITY 9.0 CM/SEC
00015710 MIDDLE: 340 340 2 RUN TIME 70 HRS
00015710 TOP 340 340 2
00015710
00015710 (INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)
00015710
00015710 CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8
00015710 HCl FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612
26724	0	15	15	80	4	0	0	1	69	22	66	
31868	0	15	15	78	7	0	0	1	67	21	66	
36985	0	15	15	78	7	0	0	1	74	21	67	
42128	0	16	16	76	8	0	0	1	69	14	43	
47229	0	16	16	76	8	0	0	1	67	24	76	
52334	0	16	16	76	8	0	0	1	66	23	72	
57416	0	16	16	75	8	0	0	1	68	24	74	
62533	0	17	17	75	8	0	0	1	68	25	77	
67636	0	17	17	75	8	0	0	1	66	24	74	
72742	0	18	18	74	8	0	0	1	70	23	71	
77877	0	18	18	74	8	0	0	1	68	24	72	
82977	0	18	18	74	8	0	0	1	70	22	68	
88096	0	19	19	74	8	0	0	1	70	24	73	
93194	0	19	19	73	8	0	0	1	70	21	64	
98295	0	17	17	79	5	0	0	1	71	18	52	
103454	0	15	15	79	6	0	0	1	72	18	56	
108548	0	13	13	80	6	0	0	1	73	17	54	
113648	0	12	12	82	6	0	0	1	72	20	63	
118749	0	16	16	74	10	0	0	1	59	23	61	
123832	0	15	15	77	8	0	0	1	83	19	62	
128948	0	14	14	79	7	0	0	1	69	24	75	
134049	0	14	14	77	8	0	0	1	68	25	81	
139131	0	15	15	76	9	0	0	1	65	26	82	
144250	0	15	15	77	9	0	0	1	65	26	81	
149347	0	16	16	76	9	0	0	1	66	25	79	
154449	0	16	16	76	8	0	0	1	66	26	81	
159549	0	16	16	76	8	0	0	1	66	25	79	
164650	0	16	16	75	8	0	0	1	68	24	76	
169747	0	15	15	77	8	0	0	1	68	23	72	
174848	0	15	15	76	8	0	0	1	70	23	72	
179948	0	14	14	77	8	0	0	1	68	23	74	
185048	0	16	16	75	9	0	0	1	70	24	74	
190149	0	19	19	77	4	0	0	1	74	17	48	
195249	0	20	20	77	3	0	0	1	73	16	45	
200332	0	20	20	77	3	0	0	1	73	15	44	
205450	0	18	18	79	3	0	0	1	73	16	44	
210547	0	18	18	79	4	0	0	1	77	15	43	
215649	0	17	17	80	3	0	0	1	72	15	44	
220748	0	17	17	80	3	0	0	1	73	15	43	
225849	0	17	17	80	3	0	0	1	73	15	42	
230947	0	18	18	80	3	0	0	1	73	15	42	
236048	0	17	17	80	2	0	0	1	72	14	40	
241174	0	17	17	81	2	0	0	1	75	13	37	
246309	0	15	15	84	1	0	0	1	71	14	39	
254367	0	14	14	84	2	0	0	1	750	0	0	
Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612
AVG	0	16	16	77	6	0	0	1	85	20	61	
STD	0	2	2	3	2	0	0	0	100	5	17	

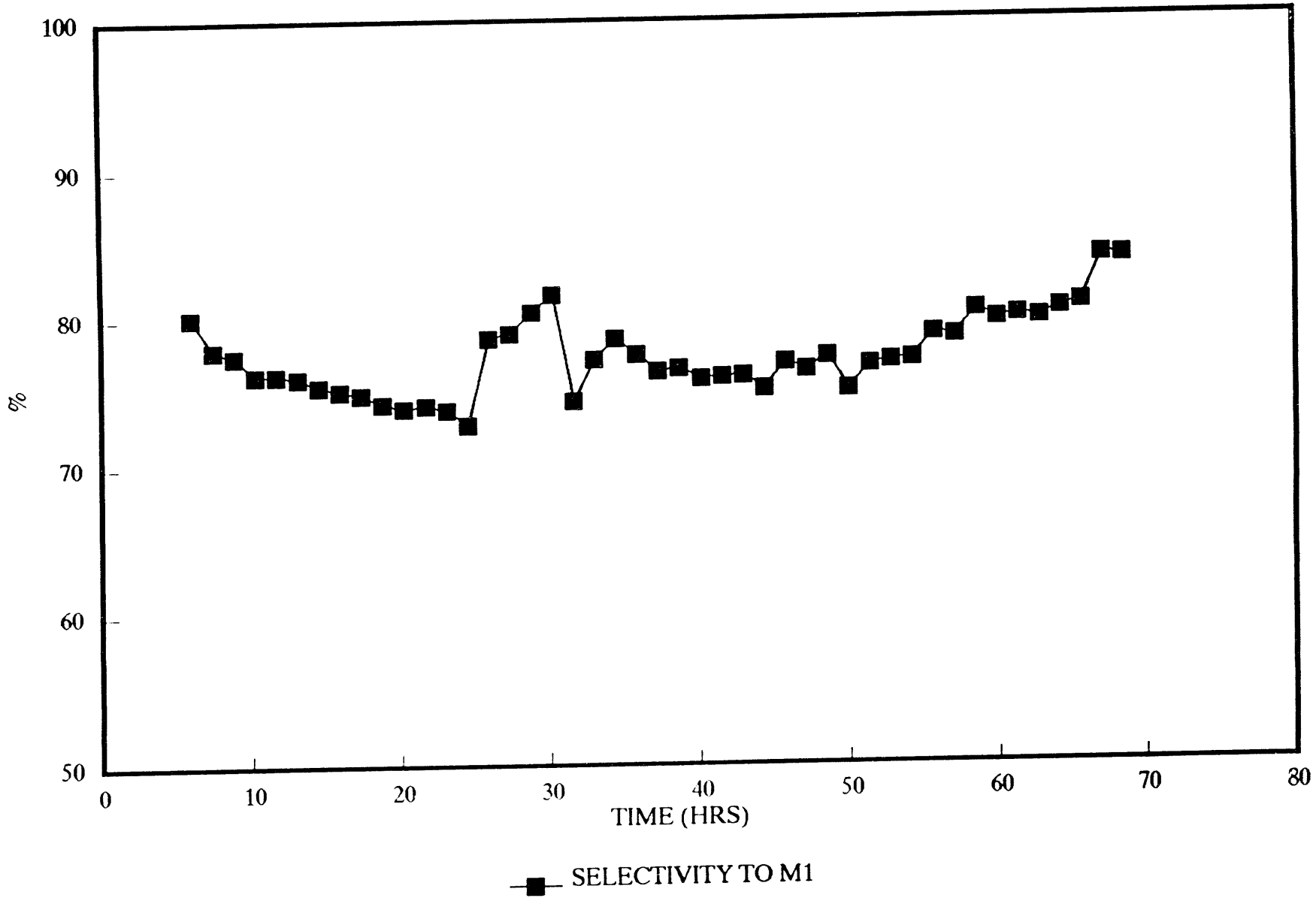
RUN 10346060

CATALYST 163C



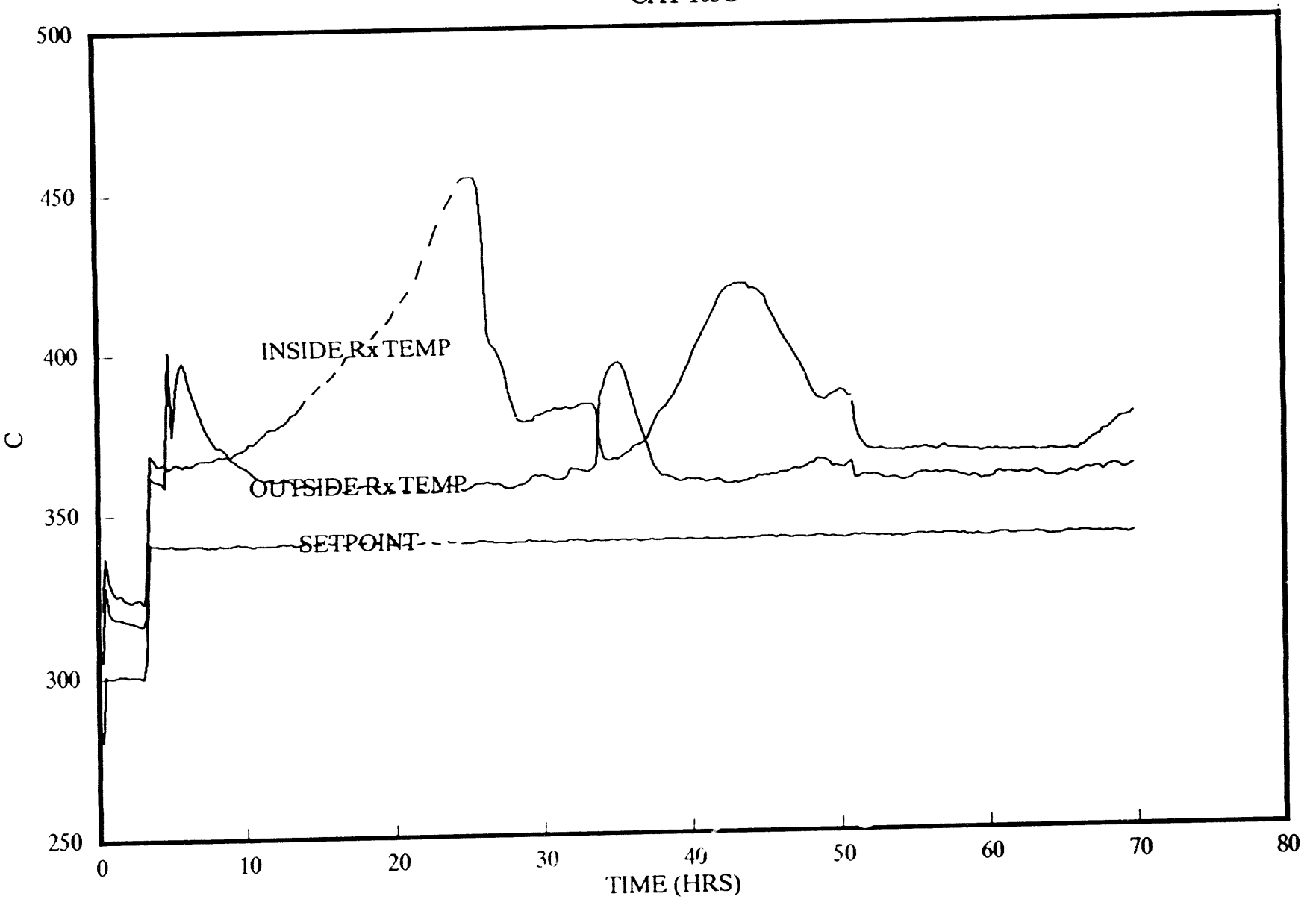
RUN 10346060

CATALYST 163C



RUN 10346060

CAT 163C



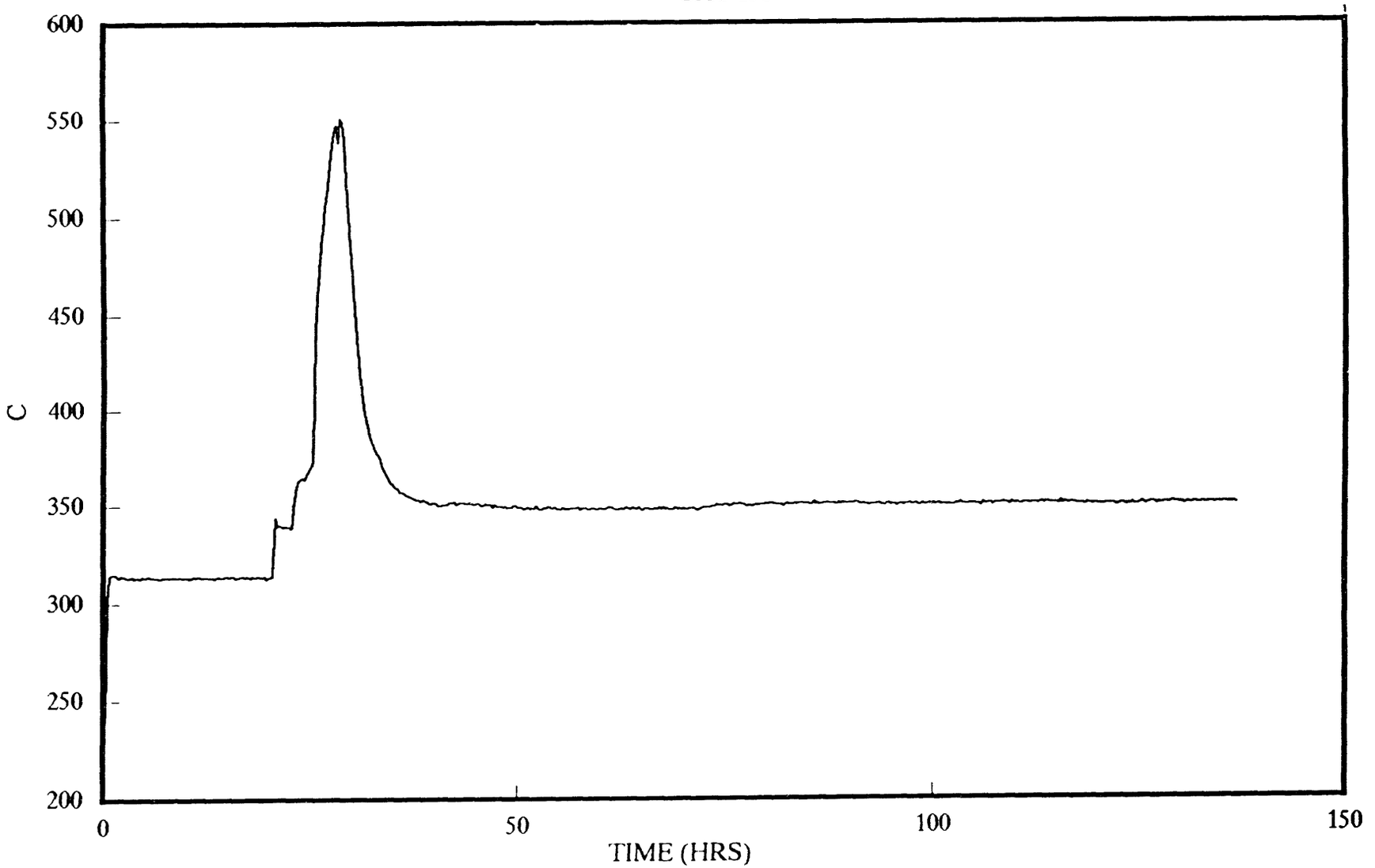
00081123 OPERATOR NAME: B CRUM DATE 23-FEB-93
00081123 LOG BOOK # 10346 PAGE # 144
00081123 RUN # 10346065 CATALYST # 158
00081123 CATALYST NAME: petc catalyst
00081123 COMMENTS CAT SCREENED BETWEEN 18 & 35 MESH PRETREAT 1 hr with H2 AT 290C
00081123 CAMILE SHUT DOWN 3 TIMES DURING THIS RUN SEE BOOK FOR DETAILS
00081123
00081123 MASS OF CATALYST (g): 4.2
00081123 REACTOR INSIDE DIAM (CM): 6
00081123 CATALYST BED HEIGHT (CM): 25.4
00080777 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00080777 ==========
00080777 INITIAL FINAL ABSOLUTE
00080777 TEMP TEMP RAMP RATE
00080777 (DEG C) (DEG C) (DEG C / MIN)
00080777 ==========
00080777 BOTTOM 315 315 1 FLUID VELICITY 9.0 CM/SEC
00080777 MIDDLE 315 315 1 RUN TIME 135 HRS
00080777 TOP 315 315 1
00080777
00080777 (INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)
00080777
00080777 CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8
00080777 HCl FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612
91847	11	17	28	64	8	0	0	1	64	29	79	321
96984	9	20	29	59	12	0	0	1	56	28	78	315
102148	9	23	32	57	12	0	0	1	62	29	77	315
107309	10	20	30	60	10	0	0	1	74	28	76	315
112471	13	21	34	57	9	0	0	1	65	28	71	315
117629	14	21	35	56	10	0	0	1	99	26	65	315
122791	16	19	35	56	9	0	0	1	93	26	66	315
127951	14	15	29	65	7	0	0	1	67	28	72	316
133110	16	20	36	57	8	0	0	1	66	27	67	315
138269	16	20	36	57	7	0	0	1	70	26	64	315
143431	14	20	33	59	8	0	0	1	80	26	65	315
148568	13	15	28	67	8	0	0	1				315
153690	16	20	36	56	8	0	0	1	93	27	66	315
158848	18	20	38	53	9	0	0	0	122	25	59	315
167190	14	21	35	55	10	0	0	1	56	28	71	315
172351	15	21	36	55	9	0	0	1	83	28	68	315
177510	14	20	34	57	9	0	0	1	57	28	71	315
182671	14	21	35	55	9	0	0	1	59	28	71	314
187829	14	20	34	57	9	0	0	1	60	29	73	315
192992	13	19	32	59	9	0	0	1	61	28	73	316
198150	12	17	28	64	7	0	0	1	62	29	77	315
203309	13	18	31	61	8	0	0	1	64	29	74	315
208470	13	19	32	59	9	0	0	1	56	28	72	315
213630	9	14	23	71	5	0	0	1	61	28	78	315
218791	13	21	33	58	9	0	0	1	77	26	67	315
223949	13	20	33	57	10	0	0	1	66	27	70	316
229108	9	24	33	56	11	0	0	1	115	22	58	316
234270	14	22	36	53	10	0	0	1	62	26	66	315
239431	15	20	35	55	9	0	0	1	63	27	69	315
244590	12	21	33	57	10	0	0	1	100	25	66	315
249748	13	20	33	58	10	0	0	1	95	25	65	315
254911	12	19	31	60	9	0	0	1	69	28	72	315
260069	15	23	38	52	11	0	0	1	65	27	66	315
265220	13	20	34	57	9	0	0	1	123	30	76	316
270389	10	19	29	62	9	0	0	1	76	26	70	315
275549	8	18	26	63	10	0	0	1	105	21	61	315
280708	1	9	9	86	5	0	0	1	102	9	28	315
285870	2	7	9	83	8	0	0	1	92	12	41	315
291029	1	3	4	92	4	0	0	1	109	11	37	315
296188	1	2	3	96	1	0	0	1	74	13	43	315
301351	1	3	4	94	1	0	0	1	123	11	36	315
306510	2	6	8	85	7	0	0	1	83	13	44	315
311668	1	5	6	88	6	0	0	1	81	13	43	315
316824	0	3	3	95	2	0	0	1	123	10	34	315
321988	5	8	13	77	10	0	0	1	147	15	48	315
327150	3	8	11	78	11	0	0	1	102	13	44	315
332311	2	8	11	78	11	0	0	1	85	13	46	315
337469	2	9	11	78	11	0	0	1	88	13	43	315
342629	1	3	4	92	4	0	0	1	108	12	30	315
347790	2	6	8	86	7	0	0	1	110	11	36	315
352948	1	5	6	88	5	0	0	1	93	12	40	316
358110	1	4	5	91	4	0	0	1	98	11	38	315
363269	1	3	3	94	3	0	0	1	87	12	39	315
368429	1	3	4	95	2	0	0	1	122	12	39	315
373588	1	3	4	95	2	0	0	1	95	13	44	315
378748	1	3	4	93	3	0	0	1	108	12	42	315
383909	1	4	5	90	5	0	0	1	93	13	43	315
389071	1	4	5	91	4	0	0	1	76	13	44	315
394236	1	4	5	91	4	0	0	1	83	13	43	316
399396	1	6	7	85	7	0	0	1	88	13	44	315
404556	1	5	7	87	7	0	0	1	86	14	46	316
409716	1	4	5	90	5	0	0	1	84	13	45	315
414879	1	6	7	87	6	0	0	1	90	14	47	315
420031	1	5	6	89	5	0	0	1	88	13	45	315
425189	1	4	5	91	4	0	0	1	98	13	42	315
430356	1	4	5	91	4	0	0	1	84	13	43	316
435516	1	5	6	88	6	0	0	1	88	12	42	315
440676	1	3	4	94	2	0	0	1	85	13	43	315
445836	1	4	6	90	5	0	0	1	98	11	38	315
451997	1	4	5	91	4	0	0	1	90	12	39	315
456149	1	4	5	91	4	0	0	1	92	13	44	315
461311	2	7	9	82	9	0	0	1	102	14	46	315
466469	2	6	8	85	7	0	0	1	102	12	41	315
471630	2	6	7	85	7	0	0	1	107	13	44	316
476788	1	4	5	89	6	0	0	1	103	13	44	315
487111	1	5	7	87	6	0	0	1	99	12	42	315
492277	1	6	7	86	7	0	0	1	90	13	45	315

AVERAGES	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	MBC6	Q6CH4C	Q6HCLC	TQI612
AVG	7	12	19	74	7	0	0	88	19	55	315
STD	6	8	13	16	3	0	0	19	7	15	

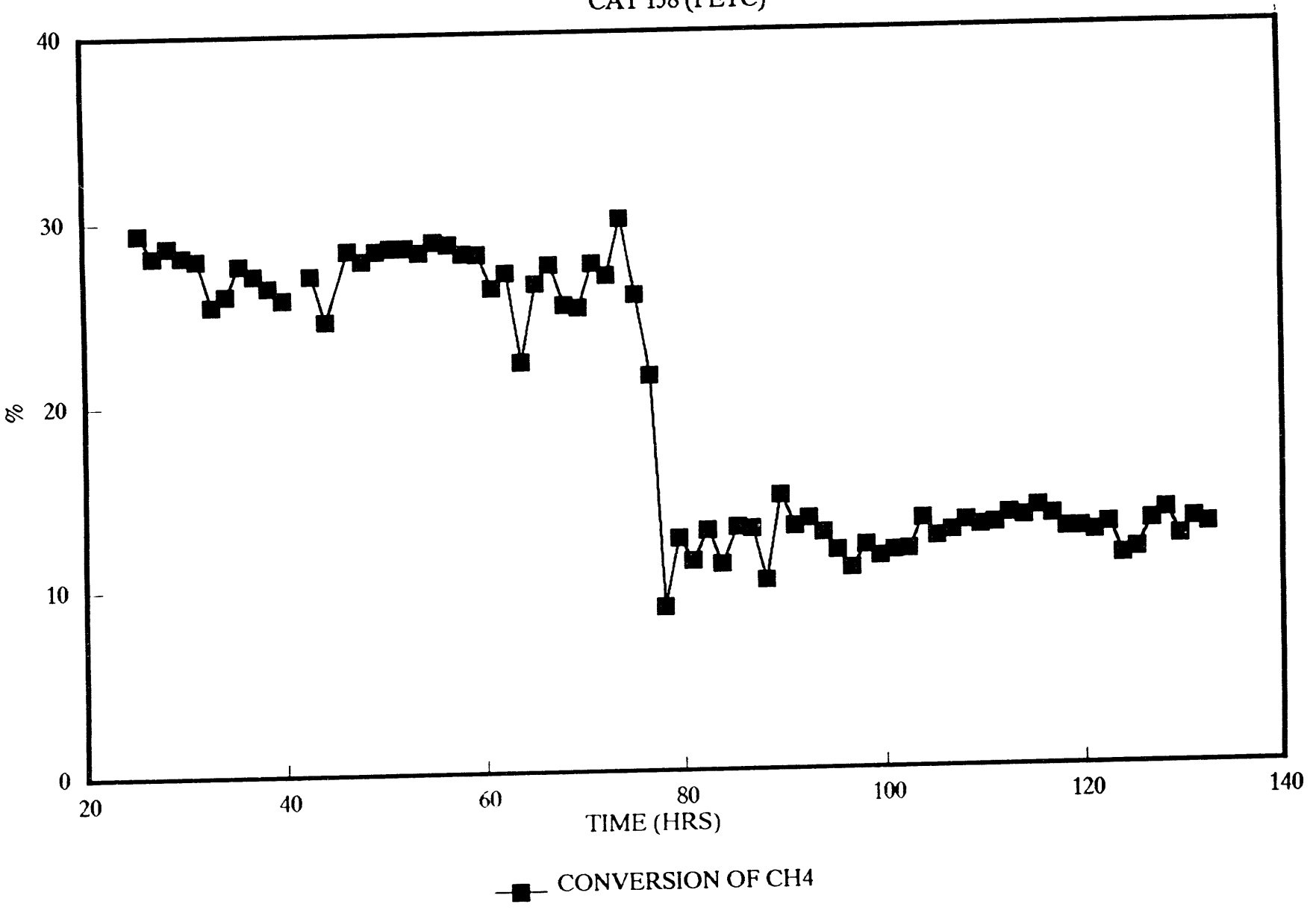
RUN 10346065

CAT 158



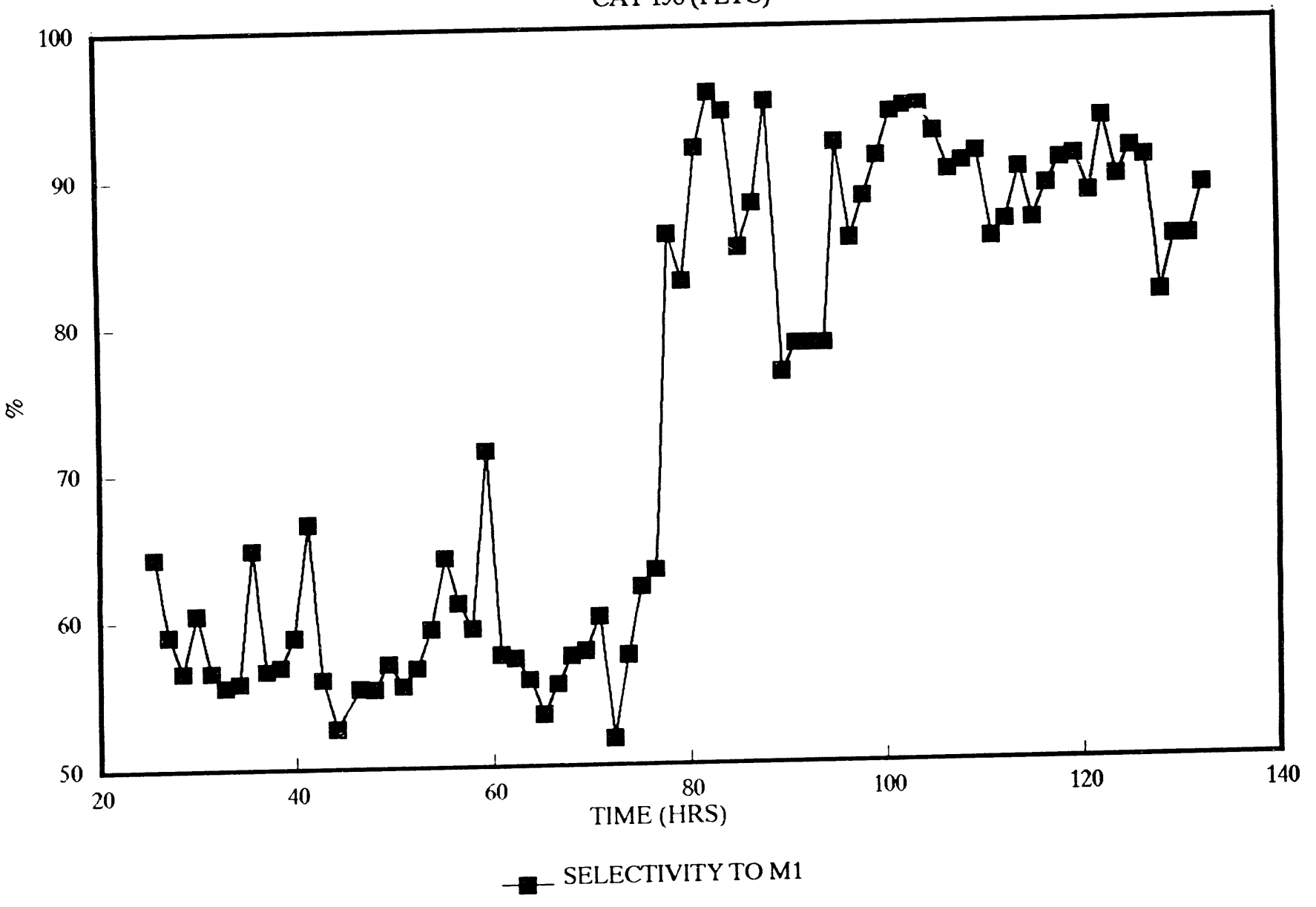
RUN 10346065

CAT 158 (PETC)



RUN 10346065

CAT 158 (PETC)



00003294 OPERATOR NAME: B. CRUM DATE: 19-MAR-93
00003294 LOG BOOK #: 10346 PAGE #: 150
00003294 RUN #: 10346067 CATALYST #: 163c
00003294 CATALYST NAME: PURCHASED Cu CATALYST
00003294 COMMENTS: START AT LOW TEMP 10 DEG C INCREMENTS
00003294 Rx PLUGGED AT END OF RUN
00003294
00003294 MASS OF CATALYST (g): 6.45
00003294 REACTOR INSIDE DIAM (CM): .6
00003294 CATALYST BED HEIGHT (CM): 25.4
00003308 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00003308 ==========
00003308 INITIAL FINAL ABSOLUTE
00003308 TEMP TEMP RAMP RATE
00003308 (DEG C) (DEG C) (DEG C / MIN)
00003308 ==========
00003308 BOTTOM: 250 260 2 FLUID VELOCITY 9.0 CM/SEC
00003308 MIDDLE: 250 260 2 RUN TIME 160 HRS
00003308 TOP : 250 260 2
00003308
00003308 (INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)
00003308
00003308 CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8
00003308 HCl FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0

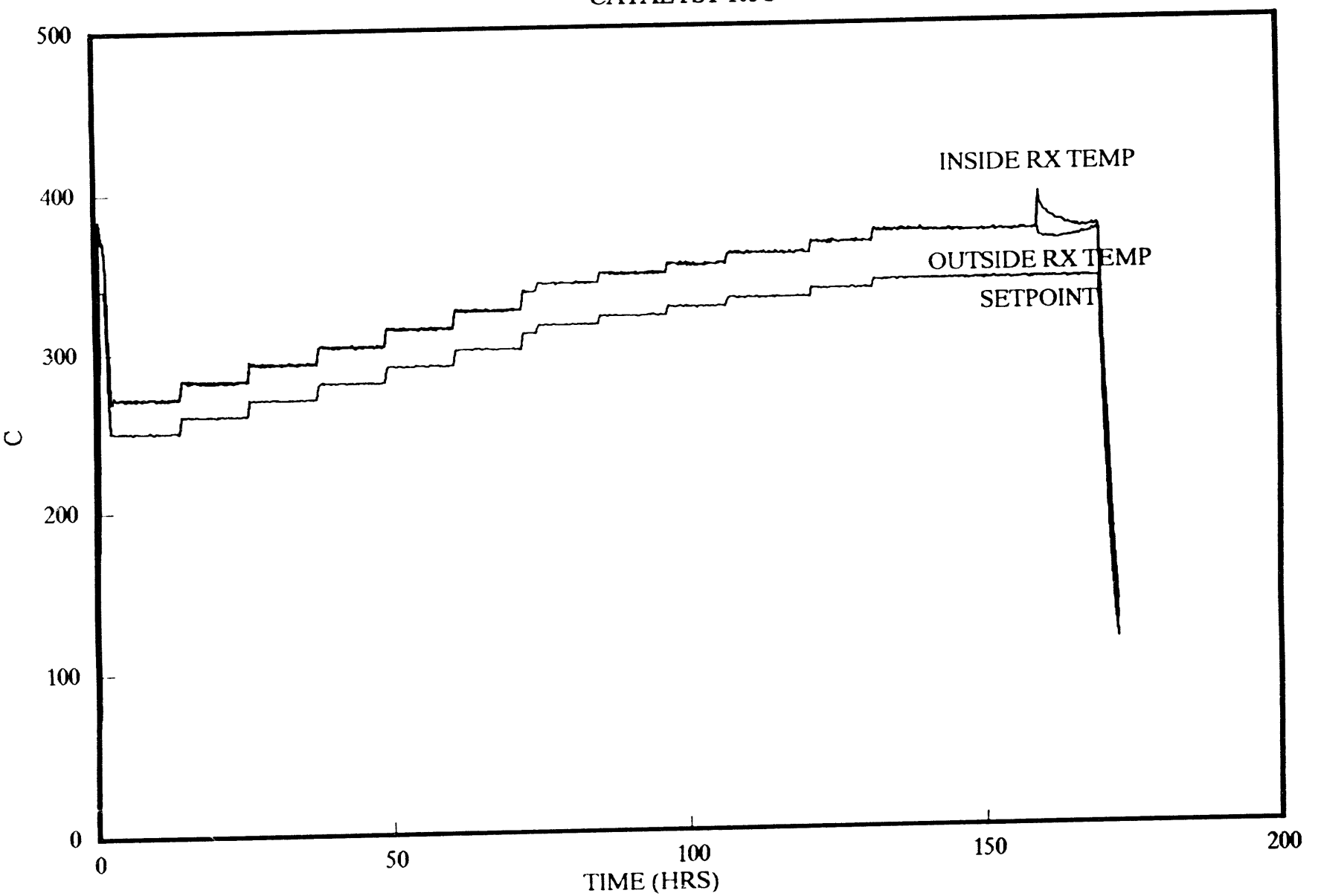
Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612
15266	0	0	0	0	0	0	0	1	200	0	0	250
20428	0	0	0	0	0	0	0	1	200	0	0	250
25570	0	0	0	0	0	0	0	1	200	0	0	250
30664	0	0	0	0	0	0	0	1	200	0	0	250
35840	0	0	0	0	0	0	0	1	102	0	0	250
40942	0	0	0	0	0	0	0	1	200	0	0	250
46021	0	0	0	0	0	0	0	1	200	0	0	250
51167	0	0	0	0	0	0	0	2	102	0	0	253
57043	0	0	0	0	0	0	0	2	102	0	0	260
62101	0	0	0	0	0	0	0	2	200	0	0	260
67232	0	0	0	0	0	0	0	2	102	0	0	260
72388	0	0	0	0	0	0	0	2	102	0	0	260
77507	0	0	0	0	0	0	0	2	102	0	0	260
82607	0	0	0	0	0	0	0	2	102	0	0	260
87693	0	0	0	0	0	0	0	2	102	0	0	259
92805	0	0	0	0	0	0	0	3	102	0	0	263
98652	0	0	0	0	0	0	0	3	102	0	0	270
103788	0	0	0	0	0	0	0	3	102	0	0	270
108889	0	0	0	0	0	0	0	3	102	0	0	271
114012	0	0	0	0	0	0	0	3	102	0	0	270
119102	0	0	0	0	0	0	0	3	200	0	0	270
124159	0	0	0	0	0	0	0	3	200	0	0	270
129271	0	0	0	0	0	0	0	3	199	0	0	270
134379	0	0	0	0	0	0	0	4	199	0	0	273
140224	0	0	0	0	0	0	0	4	200	0	0	280
145293	0	0	0	0	0	0	0	4	200	0	0	280
150401	0	0	0	0	0	0	0	4	200	0	0	280
155508	0	0	0	0	0	0	0	4	102	0	0	280
160598	0	0	0	0	0	0	0	4	198	0	0	281
165641	0	0	0	0	0	0	0	4	199	0	0	280
170740	0	0	0	0	0	0	0	4	196	0	0	280
175786	0	0	0	0	0	0	0	5	188	0	0	283
181599	0	0	0	0	0	0	0	5	198	0	0	290
186706	0	0	0	0	0	0	0	5	165	0	0	290
191807	0	0	0	100	0	0	0	5	102	0	0	290
196905	0	0	0	100	0	0	0	5	102	0	0	290
202000	0	0	0		0	0	0	5	197	0	0	290
207099	0	0	0		0	0	0	5	199	0	0	290
212142	0	0	0		0	0	0	5	199	0	0	290
217239	0	0	0		0	0	0	6	198	0	0	293
223065	0	0	0	100	0	0	0	6	102	0	0	300
228168	0	0	0	100	0	0	0	6	102	0	0	301
233266	0	0	0	100	0	0	0	6	102	0	0	300
238367	0	0	0	100	0	0	0	6	102	0	0	300
243466	0	0	0		0	0	0	6	197	0	0	300
248560	0	0	0		0	0	0	6	199	0	0	300
253685	0	0	0		0	0	0	6	102	0	0	300
258772	0	0	0	100	0	0	0	7	199	0	0	303
264585	0	0	0	100	0	0	0	7	101	0	0	310
269706	0	0	0	100	0	0	0	1	100	0	0	315
274848	0	0	0	100	0	0	0	1	102	0	0	315
279938	0	0	0	100	0	0	0	1	101	0	0	315
285045	0	0	0	100	0	0	0	1	108	0	0	315
290153	0	0	0	100	0	0	0	1	198	0	0	315
295273	0	0	0	100	0	0	0	1	101	0	0	315
300424	0	0	0	100	0	0	0	1	96	0	0	315

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
305593	0	0	0	100	0	0	0	2	83	0	3	318	
310999	0	0	0	100	0	0	0	2	101	0	2	320	
316125	0	0	0	100	0	0	0	2	101	0	0	320	
321228	0	0	0	100	0	0	0	2	102	0	0	320	
326326	0	0	0	100	0	0	0	2	102	0	0	320	
331444	2	0	2	98	0	0	0	2	84	2	5	320	
336585	7	0	7	93	0	0	0	2	93	3	10	320	
341720	0	0	0	100	0	0	0	2	100	2	6	320	
346865	0	0	0	100	0	0	0	3	101	2	7	322	
352203	6	0	6	89	5	0	0	3	96	3	8	325	
357363	1	0	1	99	0	0	0	3	72	3	11	325	
362523	2	0	2	98	0	0	0	3	88	2	7	325	
367682	8	0	8	92	0	0	0	3	100	3	9	325	
372842	7	0	7	93	0	0	0	3	101	3	9	325	
378004	7	0	7	93	0	0	0	3	100	3	10	325	
383162	4	0	4	96	0	0	0	4	98	2	7	325	
388743	6	3	9	85	6	0	0	4	99	6	19	330	
393903	6	2	9	86	6	0	0	4	101	5	16	330	
399065	6	2	9	85	6	0	0	4	100	6	20	330	
404161	0	2	2	94	4	0	0	4	192	0	0	330	
409323	6	3	9	85	6	0	0	4	99	6	20	330	
414483	5	2	7	88	5	0	0	4	99	7	22	330	
419625	0	3	3	90	7	0	0	4	157	2	6	330	
440649	5	2	6	89	5	0	0	1	84	10	34	335	
445812	4	1	5	91	4	0	0	1	89	9	30	336	
450964	4	1	5	91	4	0	0	1	83	11	35	335	
456123	4	2	5	90	4	0	0	1	88	9	30	335	
461282	3	2	5	90	5	0	0	1	87	8	25	336	
466444	2	1	3	94	3	0	0	1	79	8	26	335	
471602	7	3	10	82	8	0	0	2	94	8	27	336	
477184	7	4	11	78	11	0	0	2	117	12	41	340	
482343	5	4	10	78	12	0	0	2	83	14	48	340	
487509	6	4	10	79	11	0	0	2	87	13	45	340	
492671	6	4	10	78	12	0	0	2	85	13	46	340	
497834	6	4	10	78	12	0	0	2	85	15	53	340	
502991	1	1	3	94	3	0	0	2	70	16	54	340	
508151	6	4	10	79	11	0	0	1	94	14	48	340	
513312	6	4	10	78	12	0	0	1	83	14	50	340	
518470	3	2	5	89	6	0	0	1	76	14	49	340	
523631	6	4	10	79	11	0	0	1	84	11	37	339	
528784	4	3	6	87	7	0	0	1	78	14	48	340	
533951	6	3	10	79	11	0	0	1	86	12	42	340	
539112	6	4	10	79	11	0	0	1	86	12	41	340	
544272	6	4	10	79	11	0	0	1	86	13	45	340	
549423	6	4	10	80	10	0	0	1	84	11	39	340	
554590	1	1	2	98	0	0	0	1	62	13	43	341	
559742	7	4	11	77	12	0	0	1	82	15	50	341	
564904	6	4	10	78	11	0	0	1	83	14	46	340	
570040	1	1	2	98	0	0	0	1	67	14	45	340	
575170	32	4	36	53	11	0	0	1	137	17	43	340	
580332	17	28	46	45	9	0	0	1	52	27	59	340	
585490	16	28	45	44	11	0	0	1	68	27	61	341	
590651	13	21	34	57	9	0	0	1	41	29	73	340	
595813	17	26	43	47	11	0	0	1	58	28	65	340	
600970	18	25	43	46	11	0	0	1	50	26	59	340	
606129	12	15	27	65	8	0	0	1	81	27	73	340	
611292	10	14	23	69	8	0	0	1		25	0		

AVG & STD	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
AVG 250	0	0	0	0	0	0	0	1	186	0	0	250	
	0	0	0	0	0	0	0	0	34	0	0		
AVG 260	0	0	0	0	0	0	0	2	114	0	0	260	
	0	0	0	0	0	0	0	0	32	0	0		
AVG 270	0	0	0	0	0	0	0	3	151	0	0	270	
	0	0	0	0	0	0	0	0	49	0	0		
AVG 280	0	0	0	0	0	0	0	4	185	0	0	280	
	0	0	0	0	0	0	0	0	32	0	0		
AVG 290	0	0	0	0	0	0	0	5	195	0	0	290	
	0	0	0	0	0	0	0	1	4	0	0		
AVG 300	0	0	0	100	0	0	0	6	138	0	0	300	
	0	0	0	0	0	0	0	0	47	0	0		
AVG 315	0	0	0	100	0	0	0	1	111	0	0	315	
	0	0	0	0	0	0	0	0	33	0	1		
AVG 320	1	0	1	99	0	0	0	2	98	1	4	320	
	2	0	2	4	2	0	0	0	11	0	2		
AVG 325	5	0	6	93	1	0	0	3	94	3	10	325	
	3	1	3	4	2	0	0	0	9	1	4		
AVG 330	5	2	7	88	5	0	0	4	115	5	16	330	
	2	0	3	3	1	0	0	0	34	2	8		
AVG 335	4	2	6	89	5	0	0	1	87	9	30	335	
	1	1	2	4	2	0	0	0	5	1	4		
AVG 340	9	8	17	74	9	0	0	1	79	17	48	340	
	7	9	14	15	3	0	0	0	19	6	13		

RUN 10346067

CATALYST 163C



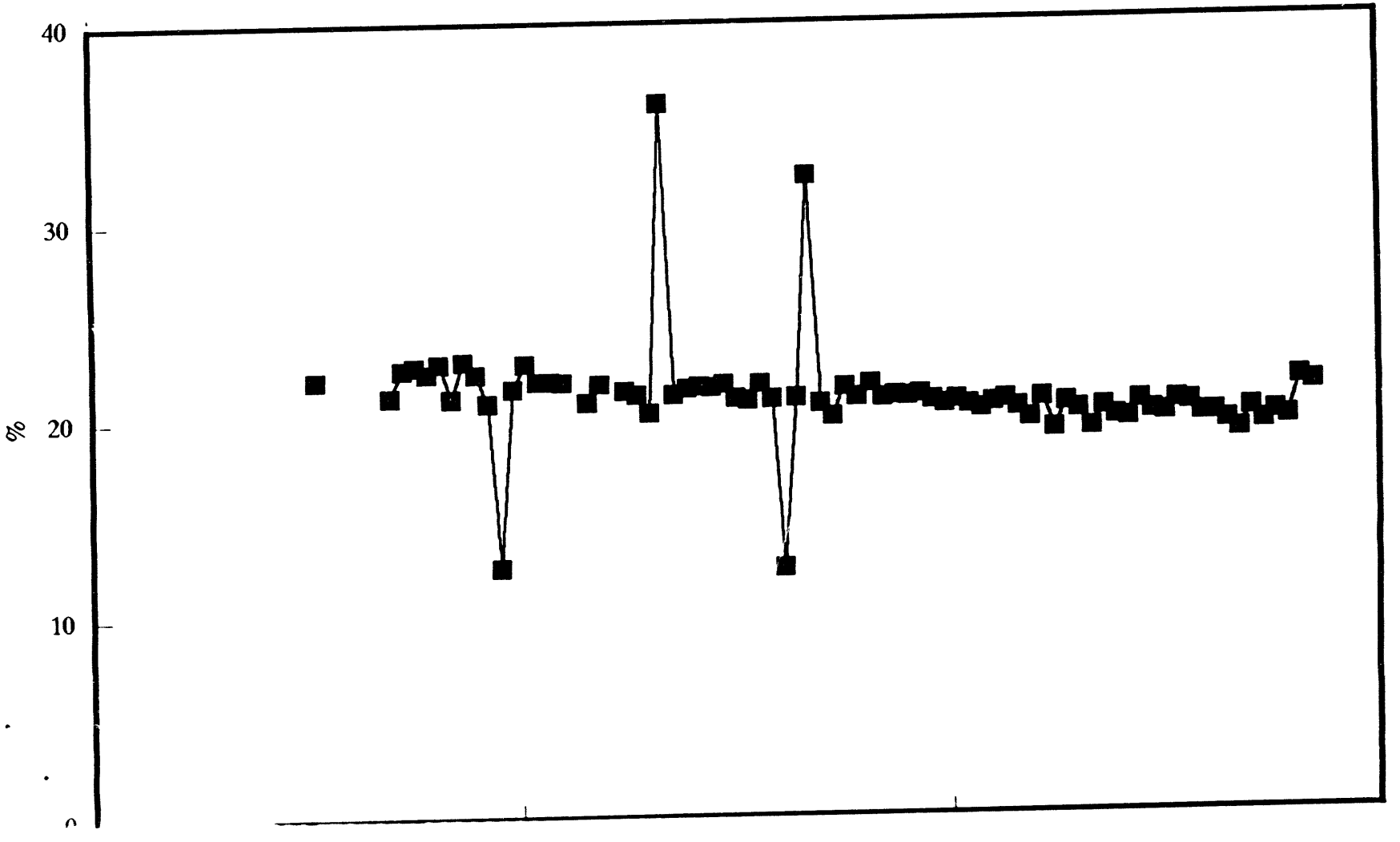
00010468 HOOD #6 RAMPING EXPERIMENT DEFINITION
00010468 ==========
00010468
00010468 OPERATOR NAME B CRUM DATE 27-JAN-93
00010468 LOG BOOK # 10346 PAGE # 136
00010468 RUN # 10346061 CATALYST # 535
00010468 CATALYST NAME _____
00010468 COMMENTS TC IN BED
00010468
00010468
00010468 MASS OF CATALYST (g) 3.75
00010468 REACTOR INSIDE DIAM (CM) 6
00010468 CATALYST BED HEIGHT (CM) 25.4
00010262 TEMPERATURE RAMPING EXPERIMENT FOR HOOD #6
00010262 ==========
00010262 INITIAL FINAL ABSOLUTE
00010262 TEMP TEMP RAMP RATE
00010262 (DEG C) (DEG C) (DEG C / MIN)
00010262 ==========
00010262 BOTTOM 340 340 2 SPACE VELOCITY 9.0 CM/SEC
00010262 MIDDLE 340 340 2 RUN TIME 140 HRS
00010262 TOP 340 340 2
00010262
00010262 (INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)
00010262
00010262 CH4 FLOW RATE (CC/MIN) 100 O2 FLOW RATE (CC/MIN) 22.6
00010262 HCl FLOW RATE (CC/MIN) 29.6 AUX FLOW RATE (CC/MIN) 0

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
15605	0	3	3	79	18	0	0	1				0	340
88093	0	6	6	72	19	3	0	1				0	340
93276	0	7	7	70	21	3	0	1	82	22		90	340
98380	0	6	6	71	20	3	0	1				0	340
119482	0	6	6	71	20	3	0	1				0	340
124706	0	6	6	70	21	3	0	1	94	21		87	340
129878	1	6	6	71	20	3	0	1	68	23		91	340
135057	1	6	7	71	19	3	0	1	73	23		91	340
140234	1	6	6	71	20	3	0	1	68	22		91	340
145361	1	5	6	72	19	3	0	1	72	23		92	340
150477	0	5	5	72	20	3	0	1	94	21		86	340
155646	1	5	6	72	19	3	0	1	74	23		92	340
160836	1	5	6	72	19	3	0	1	71	22		91	340
165976	0	5	5	75	18	2	0	1		21		394	340
171168	0	5	5	75	18	2	0	1		12		398	340
176366	1	6	7	72	19	3	0	1	70	22		87	340
181555	1	5	6	72	19	3	0	1	72	23		90	340
186741	1	5	6	73	19	2	0	1	72	22		87	340
191900	1	5	6	72	19	3	0	1	70	22		87	341
197077	1	5	6	73	18	2	0	1	71	22		86	340
202246	0	7	8	70	17	6	0	1				334	341
207364	0	7	7	67	19	7	0	1	75	21		87	339
212556	1	5	6	72	19	3	0	1	67	22		87	340
217692	2	5	7	71	19	3	0	1	74			304	340
222854	1	2	3	92	6	0	0	1	98	21		99	340
228023	1	5	6	72	19	3	0	1	68	21		84	340
233174	1	5	6	73	19	2	0	1	82	20		80	340
238318	0	5	5	73	19	3	0	1		36		209	340
243486	1	2	2	94	3	0	0	1	102	21		83	340
248653	1	5	6	72	19	3	0	1	93	21		120	340
253808	1	5	6	71	20	3	0	1	93	22		122	340
258965	1	5	6	73	18	2	0	1	96	22		119	340
264134	1	5	6	73	19	2	0	1	93	22		120	340
269285	1	5	6	72	19	3	0	1	90	21		116	340
274445	1	5	6	74	20	0	0	1	94	21		107	340
279606	2	5	6	74	20	0	0	1	90	22		104	340
284767	1	5	6	73	20	0	0	1	101	21		108	340
289919	0	5	5	71	21	3	0	1	143	12		72	340
295093	2	5	6	74	20	0	0	1	90	21		102	340
300257	0	5	5	75	20	0	0	1		32		175	339
305406	2	5	6	75	19	0	0	1	92	21		105	340
310566						0	0	1	109	20		96	340
315777	1	4	5	79	17	0	0	1	94	21		114	340
320953	2	5	6	74	20	0	0	1	93	21		101	340
326106	2	4	6	75	19	0	0	1	92	22		111	340
331260	2	4	6	75	20	0	0	1	95	21		110	340
336418	2	4	6	74	19	0	0	1	91	21		102	340
341594	2	4	6	74	20	0	0	1	92	21		101	340
346746	2	4	6	77	17	0	0	1	94	21		107	340
351907						0	0	1	95	21		105	340
357066	2	4	6	75	19	0	0	1	99	21		106	340
362226	2	4	6	75	19	0	0	1	95	21		106	340
367387	2	4	6	75	19	0	0	1	94	21		105	340
372547	2	4	6	77	18	0	0	1	103	20		104	340
377706	2	4	6	76	18	0	0	1	94	21		105	340
382866	2	4	6	76	18	0	0	1	100	21		105	340
388026	2	4	6	76	18	0	0	1	94	20		103	340
393186	2	4	6	75	19	0	0	1	102	20		95	340
398345	2	4	6	75	19	0	0	1	91	21		99	340
403506	2	4	6	74	20	0	0	1	103	19		100	340
408674	2	4	7	73	20	0	0	1	98	21		104	340
413826	2	4	6	76	18	0	0	1	102	20		103	340
418986	2	4	6	78	16	0	0	1	105	19		97	340
424147	2	4	6	75	19	0	0	1	97	20		103	340
429301	0	4	4	77	19	0	0	1	105	20		111	340
434466	2	4	5	76	16	2	0	1	90	20		76	340
439625	2	3	4	84	11	0	0	1	90	21		74	340
444785	2	4	6	72	19	2	0	1	70	20		80	340
449946	2	4	6	75	17	2	0	1	79	20		78	340
455106	2	0	2	77	18	2	0	1	74	21		84	340
460265	2	3	6	75	17	2	0	1	76	21		81	340
465426	2	4	6	74	18	2	0	1	83	20		79	340
470584	2	4	6	73	18	2	0	1	75	20		79	340
475745	2	3	4	84	11	0	0	1	91	20		71	340
480907	2	3	5	82	13	0	0	1	105	19		70	340
486067	2	4	6	73	18	2	0	1	72	20		79	340
491227	2	4	6	74	18	2	0	1	87	20		77	340
496386	2	3	5	78	15	2	0	1	81	20		76	340
501547	3	3	6	74	18	2	0	1	88	20		77	340
506706	2	4	6	75	17	2	0	1	68	22		84	340
511866	3	4	6	72	19	2	0	1	75	21		86	341

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TQI612	
AVG	1	4	6	75	18	1	0	1	88	21	105		340
STD	1	1	1	4	3	1	0	0	14	3	65		

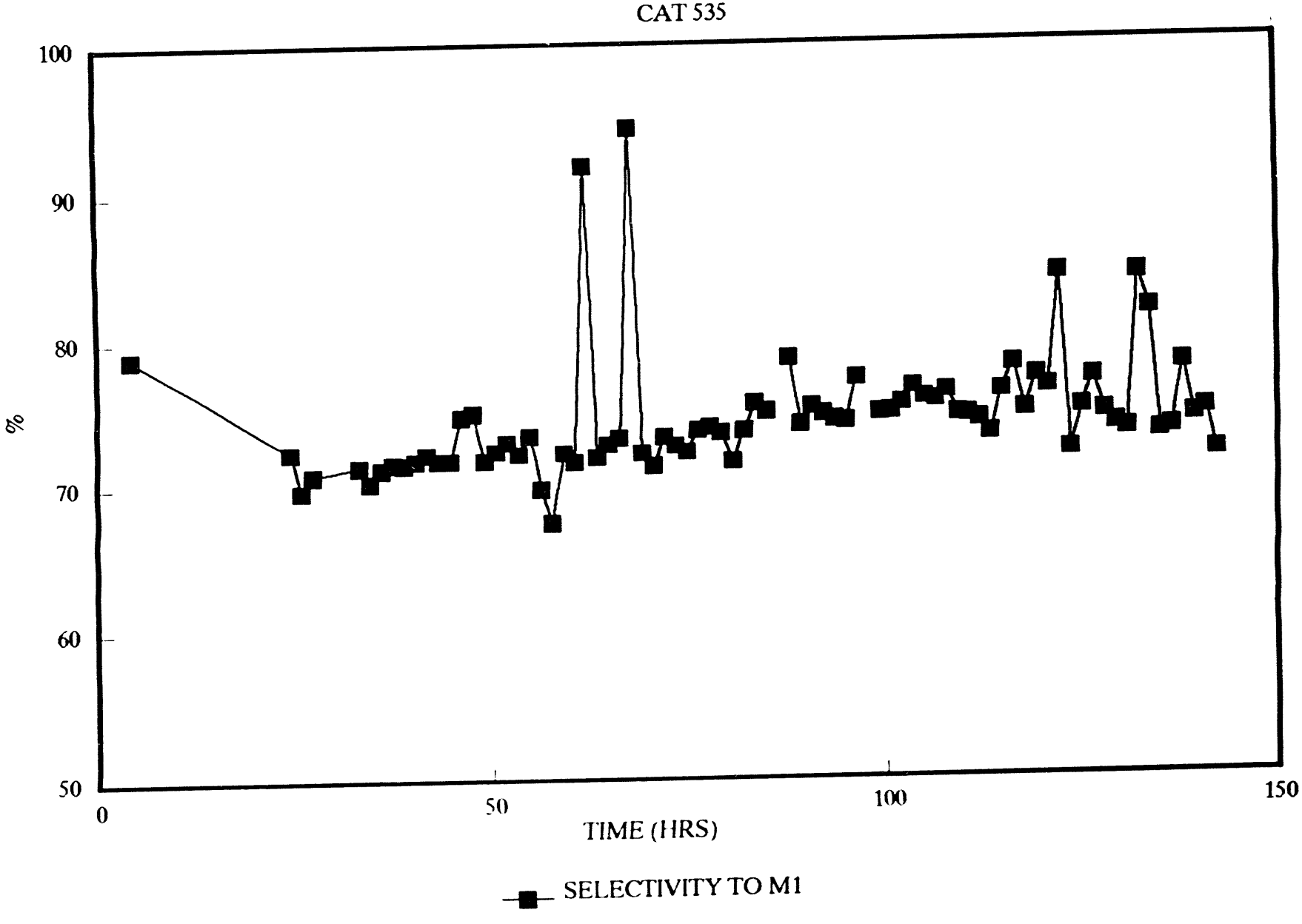
RUN 10346061

CAT 535



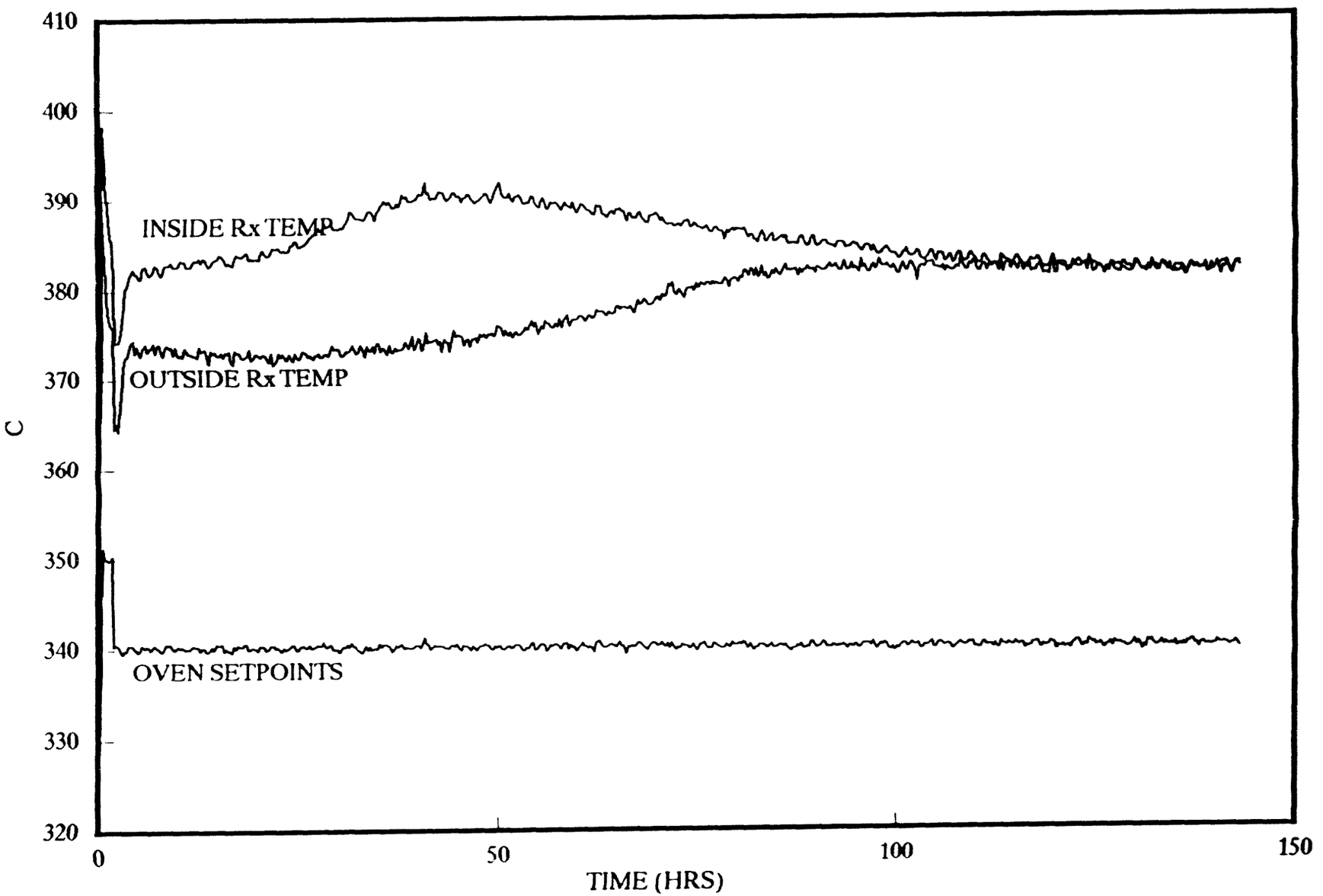
RUN 10346061

CAT 535



RUN 10346061

CATALYST 535



OPERATOR NAME BRUCE CRUM
LOGBOOK # 10348 PAGE 140
RUN # 10348083 CATALYST # 836
CATALYST NAME

COMMENTS 8 WEEK RUN TEMPERATURE RAISED NEAR END
TEMPERATURE PROFILE AND HEADER DATA LOST DUE TO
CAMILE GLITCH CAMILE SHUT DOWN ON CALC ERROR AT BEGINNING OF RUN--RESTARTED NEXT DAY

MASS OF CATALYST 3.50
REACTOR INSIDE DIAM(CM) 6
CATALYST BED HT (C M) 26 4
TEMPERATURE PROBE INSIDE BED

SPACE VELOCITY 9 0 CM/SEC
RUN TIME 350 HRS

CH4 FLOW 100
O2 FLOW 22 6
HCL FLOW 29 6

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	IDs	MBC6	Q6CH4C	Q6HCLC	TQI612	
11238	3	0	3	83	14	0	0	1	88	17	65	340	
16416	3	3	5	78	15	2	0	1	87	19	71	340	
21660	2	3	6	76	16	2	0	1	94	18	71	340	
26721	2	4	6	75	17	2	0	1	94	19	75	340	
31879	1	5	6	73	18	3	0	1	89	21	81	340	
37038	1	6	7	73	18	2	0	1	83	21	81	340	
42183	0	7	7	72	18	3	0	1	89	21	83	340	
47364	0	7	7	71	19	3	0	1	82	22	87	340	
52614	0	7	7	71	19	3	0	1	80	22	85	340	
57673	0	7	7	72	18	3	0	1	83	22	86	340	
62833	0	7	7	71	19	3	0	1	84	22	87	340	
67991	0	7	7	71	19	2	0	1	86	21	84	340	
73153	0	7	7	71	19	3	0	1	138	15	60	340	
78313	0	7	7	72	19	3	0	1	83	22	85	340	
83473	0	7	7	71	20	2	0	1	78	22	87	340	
88633	0	7	7	70	20	3	0	1	72	23	91	340	
93783	0	5	5	78	15	2	0	1	118	19	74	340	
98963	0	6	6	71	19	3	0	1	85	21	83	340	
104112	0	5	5	72	20	3	0	1	115	19	78	340	
109282	1	6	7	71	20	3	0	1	73	22	89	340	
114440	1	6	7	72	19	3	0	1	88	22	87	340	
119601	0	6	6	72	19	3	0	1	72	23	91	340	
124762	0	6	6	71	20	3	0	1	71	22	88	340	
129918	0	6	6	72	19	3	0	1	79	22	90	340	
135082	0	6	6	72	19	3	0	1	75	22	89	340	
140238	1	4	5	83	12	0	0	1	111	20	73	340	
145401	0	5	5	74	18	2	0	1	75	22	88	340	
150562	0	5	5	79	15	2	0	1	84	22	84	340	
155720	0	6	6	72	19	3	0	1	74	22	90	340	
160882	0	6	6	72	20	3	0	1	72	22	89	340	
166033	0	8	8	66	26	0	0	1	146	17	69	339	
171192	0	5	5	72	20	3	0	1	78	21	86	340	
176362	0	5	5	72	20	3	0	1	73	22	89	340	
181521	0	5	5	77	16	2	0	1	81	22	87	340	
186681	0	5	5	73	19	3	0	1	73	22	88	340	
191841	0	5	5	72	20	3	0	1	72	22	88	340	
197000	0	5	5	74	19	2	0	1	78	22	86	340	
202161	0	5	5	73	20	3	0	1	81	22	89	340	
207320	0	5	5	73	19	3	0	1	73	21	87	340	
212480	0	5	5	74	19	3	0	1	74	22	89	340	
217643	0	3	3	89	9	0	0	1	88	22	79	340	
222802	0	5	5	73	20	3	0	1	77	21	87	340	
227961	0	5	5	73	19	3	0	1	83	21	87	340	
233112	0	5	5	74	19	3	0	1	79	21	86	340	
238272	0	3	3	83	13	1	0	1	86	22	82	340	
243431	0	5	5	74	19	2	0	1	72	22	88	340	
248802	2	5	6	73	18	2	0	1	85	21	83	341	
253753	2	4	6	75	19	0	0	1	75	22	82	340	
258920	2	5	6	75	19	0	0	1	72	22	83	340	
345447	2	4	6	73	19	2	0	1	78	20	81	340	
350608	2	4	6	73	19	2	0	1	71	21	82	340	
355760	2	4	6	73	18	2	0	1	73	21	84	340	
360912	2	4	6	73	18	2	0	1	74	20	79	340	
366140	1	4	5	77	14	3	0	1	80	21	83	340	
371301	2	4	6	74	18	2	0	1	71	20	79	340	
376462	2	4	6	75	18	2	0	1	77	20	79	340	
381611	2	4	6	74	18	2	0	1	72	20	81	340	
386771	2	4	6	74	18	2	0	1	84	19	78	340	
391932	2	4	6	75	17	2	0	1	72	20	79	340	
397090	2	3	6	75	17	2	0	1	95	19	73	340	
402268	3	3	6	76	17	2	0	1	97	14	52	340	
407420	2	3	6	75	17	2	0	1	76	20	77	341	
412579	2	3	6	74	18	2	0	1	75	19	75	340	
417741	2	3	5	79	14	2	0	1	79	20	77	340	
422900	3	3	6	74	18	2	0	1	74	19	78	340	
428060	1	1	2	86	10	0	0	1	82	18	86	340	
433221	2	3	6	77	16	2	0	1	78	19	73	341	
438380	2	3	6	75	17	2	0	1	77	20	78	340	
443540	2	3	5	82	13	0	0	1	96	18	84	340	
448701	3	3	6	77	16	2	0	1	75	19	73	340	
453860	3	3	6	77	16	2	0	1	83	19	73	340	
459021	3	3	6	76	16	2	0	1	114	16	61	340	
464180	3	3	6	76	16	2	0	1	122	14	55	340	
469340	3	3	6	76	16	2	0	1	115	15	57	340	
474501	3	3	6	76	16	2	0	1	89	18	70	340	
479661	3	3	6	77	16	2	0	1	86	18	67	340	
484819	3	3	6	76	16	2	0	1	76	18	71	340	
489981	3	3	6	76	15	2	0	1	82	18	70	340	
495142	2	3	5	83	12	0	0	1	96	18	66	340	
500306	4	3	6	76	14	2	0	1	128	18	69	340	
505460	3	3	6	76	16	2	0	1	85	19	72	340	
510620	3	3	6	75	17	2	0	1	86	20	75	340	
515779	3	3	6	77	16	2	0	1	80	20	76	340	
520936	3	3	6	75	17	2	0	1	77	20	77	340	
526099	3	3	5	76	16	2	0	1	78	20	74	340	
531259	3	3	6	76	14	1	0	1	112	16	66	340	
536420	3	3	6	76	16	2	0	1	81	20	76	340	
541580	3	3	5	77	15	2	0	1	82	19	74	340	
546739	3	3	6	77	16	2	0	1	86	18	73	340	
551900	3	3	6	77	15	2	0	1	81	19	72	340	
557060	3	3	6	77	15	2	0	1	78	19	72	340	
562220	3	3	6	77	16	2	0	1	79	18	70	340	
567381	3	3	5	77	16	2	0	1	75	19	74	340	
572540	3	3	6	77	16	2	0	1	83	18	71	340	
577699	3	3	6	77	15	2	0	1	107	16	62	340	
582859	3	3	6	78	15	2	0	1	78	19	74	340	
588027	3	3	6	78	15	2	0	1	88	18	68	340	
593179	4	3	6	77	15	1	0	1	127	14	55	340	
598333	3	2	6	78	15	1	0	1	86	17	65	340	

Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TOI612	
603602	3	3	6	77	16	2	0	1	80	19	72	340	
608660	1	1	2	91	8	0	0	1	109	17	60	340	
613621	3	3	6	78	15	2	0	1	78	19	71	340	
618661	1	1	2	86	12	0	0	1	81	18	68	340	
624140	3	3	6	79	14	1	0	1	84	18	67	340	
629299	3	3	6	77	16	1	0	1	77	19	70	340	
634458	3	2	6	78	15	2	0	1	91	17	66	340	
639619	4	3	6	77	15	2	0	1	109	15	58	340	
644782	3	3	6	77	15	1	0	1	83	18	67	341	
649933	0	2	2	86	12	0	0	1	165	11	42	340	
655100	3	2	6	80	14	0	0	1	81	18	68	340	
660259	3	3	6	77	15	2	0	1	78	19	70	340	
665419	3	2	5	79	14	1	0	1	84	17	63	340	
670580	3	2	5	82	13	0	0	1	83	18	65	340	
675740	4	3	6	77	16	1	0	1	92	17	63	340	
680899	3	2	6	80	15	0	0	1	80	19	71	340	
686060	3	2	6	81	14	0	0	1	86	18	64	340	
691220	3	2	6	81	14	0	0	1	79	18	66	340	
696379	3	2	5	82	12	0	0	1	84	18	64	340	
701538	3	2	6	79	14	1	0	1	89	17	66	340	
706700	3	2	6	80	14	0	0	1	88	17	62	340	
711862	4	2	6	79	15	0	0	1	85	17	63	340	
717019	3	2	5	85	10	0	0	1	133	14	49	340	
722180	3	2	6	82	13	0	0	1	84	18	63	340	
727341	4	2	6	80	14	0	0	1	89	18	64	340	
732502	3	2	6	81	14	0	0	1	80	18	65	340	
737674	3	2	5	83	12	0	0	1	92	17	60	340	
742820	4	2	5	81	13	0	0	1	93	17	62	341	
747979	4	2	6	82	12	0	0	1	115	14	53	341	
753140	3	2	6	82	13	0	0	1	77	18	66	340	
758292	2	2	4	88	8	0	0	1	85	17	58	340	
763458	3	2	5	80	16	0	0	1	92	17	64	340	
768618	4	2	6	79	14	0	0	1	85	17	63	340	
773780	4	2	6	82	12	0	0	1	130	13	45	340	
778938	4	2	6	83	12	0	0	1	92	17	59	340	
784098	3	2	5	84	11	0	0	1	78	17	61	340	
789261	4	2	6	79	15	0	0	1	78	18	64	340	
794420	3	2	5	84	11	0	0	1	78	18	63	340	
799580	3	2	5	85	10	0	0	1	92	16	57	341	
804741	4	2	6	81	13	0	0	1	78	18	65	340	
809899	4	2	6	79	14	0	0	1	80	18	64	340	
815060	4	2	6	82	13	0	0	1	106	16	58	340	
820220	2	2	4	88	8	0	0	1	80	18	65	340	
825380	3	2	5	83	12	0	0	1	86	17	61	340	
830541	5	2	7	78	15	0	0	1	120	13	49	340	
835699	4	2	7	78	15	0	0	1	78	17	62	340	
840859	3	2	5	83	12	0	0	1	80	17	62	340	
846020	4	2	6	82	12	0	0	1	88	17	62	340	
851180	4	2	6	82	13	0	0	1	77	17	63	340	
856339	3	2	5	84	11	0	0	1	79	18	63	340	
861499	3	2	5	83	12	0	0	1	84	17	60	340	
866661	4	2	6	82	13	0	0	1	82	17	60	340	
871819	4	2	6	80	14	0	0	1	78	17	62	340	
876979	4	2	6	83	11	0	0	1	118	15	52	340	
882141	4	2	6	79	14	0	0	1	90	16	58	340	
887300	4	2	6	83	12	0	0	1	96	16	58	340	
892458	4	2	6	79	14	0	0	1	88	17	61	340	
897620	4	2	6	82	12	0	0	1	88	16	58	340	
902782	4	2	6	80	13	0	0	1	94	16	57	340	
907939	3	2	5	84	11	0	0	1	86	16	58	340	
913099	4	2	6	81	13	0	0	1	98	15	55	340	
918260	4	2	7	80	14	0	0	1	103	15	53	340	
923420	4	2	6	83	11	0	0	1	118	12	44	340	
928580	4	2	6	81	13	0	0	1	84	16	58	340	
933739	4	2	6	82	12	0	0	1	99	15	54	340	
938899	3	2	5	86	9	0	0	1	109	14	49	340	
944059	4	2	6	83	11	0	0	1	89	15	53	340	
949221	3	2	5	83	11	0	0	1	84	16	56	340	
954421	4	2	6	81	13	0	0	1	95	15	53	340	
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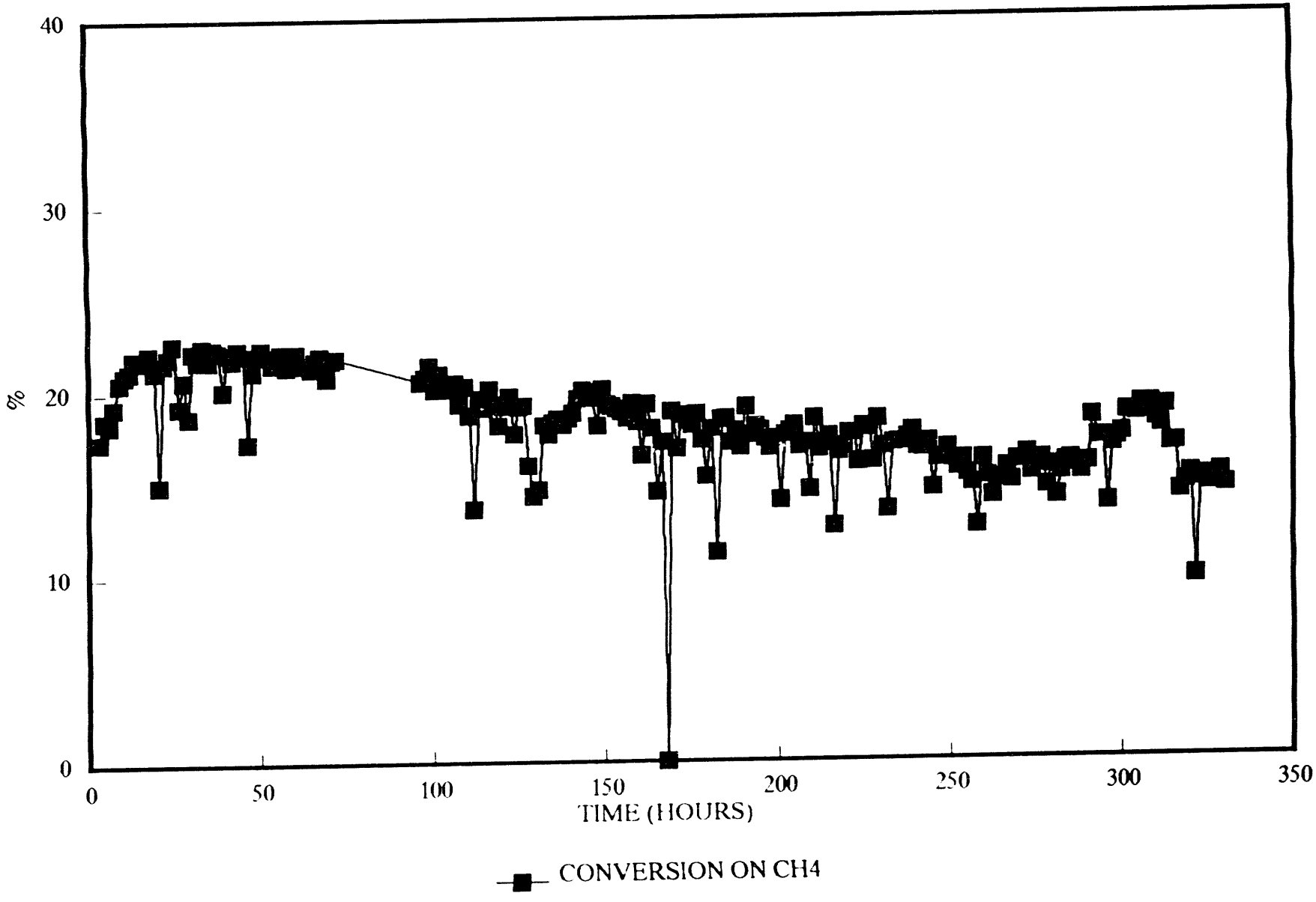
969741	3	2	5	85	0	0	0	1	80	16	51	340	
974900	4	2	6	94	0	0	0	1	82	16	52	340	
980061	5	3	8	92	0	0	0	1	88	15	47	340	
985220	5	3	8	92	0	0	0	1	88	16	49	340	
990379	4	2	6	94	0	0	0	1	79	16	51	341	
995538	7	3	9	91	0	0	0	1	124	16	44	340	
1000699	4	2	6	94	0	0	0	1	90	16	50	340	
1005863	5	2	7	93	0	0	0	1	109	14	43	341	
1011018	4	2	6	94	0	0	0	1	79	15	48	340	
1016178	4	2	6	94	0	0	0	1	84	16	50	340	
1021341	5	3	8	92	0	0	0	1	90	16	49	340	
1026499	5	2	7	79	14	0	0	1	92	16	56	340	
1031660	4	2	6	80	13	0	0	1	80	15	55	340	
1036819	4	2	7	80	13	0	0	1	80	16	57	340	
1044321	4	2	6	81	13	0	0	1	79	16	57	345	
1048480	5	3	8	75	16	1	0	1	84	17	66	345	
1054640	4	2	7	79	13	1	0	1	80	17	63	345	
1059799	4	2	6	85	9	0	0	1	123	14	48	345	
1064960	4	2	6	82	12	0	0	1	79	17	60	345	
1070119	5	3	8	75	16	2	0	1	77	17	65	345	
1075279	4	2	6	82	12	0	0	1	78	17	63	345	
1080455	4	2	6	81	13	0	0	1	75	19	67	345	
1086662	0	3	3	84	13	0	0	1	79			345	
1090759	5	3	7	78	15	0	0	1	93	16	66	345	
1095920	4	2	6	83	11	0	0	1	82	19	67	345	
1101082	4	2	6	83	11	0	0	1	82	19	66	346	
1106240	4	2	6	83	12	0	0	1	72	19	68	345	
1111399	5	3	8	77	15	0	0	1	94	18	66	345	
1116559	4	2	6	83	11	0	0	1	80	18	63	345	
1121721	4	2	7	81	12	0	0	1	103	19	66	345	
1126880	4	2	6	82	12	0	0	1	74	17	60	345	
1132041	3	2	5	86	9	0	0	1	81	17	60	345	
1137199	5	2	7	80	13	0	0	1	102	14	50	345	
1142362	5	2	7	81	13	0	0	1	96	15	53	345	
1147520	5	3	8	79	14	0	0	1	86	16	64	345	
1152678	7	3	9	78	14	0	0	1	133	10	34	345	
1157842	5	2	7	80	13	0	0	1	84	16	52	345	
1163006	4	2	6	84	10	0	0	1	88	15	52	345	
1168159	4	2	6	83	11	0	0	1	95	15	52	345	
1173319	3	2	5	87	8	0	0	1	86	16	51	345	
1178479	2	1	3	92	6	0	0	1	71	15	53	344	
1183640	6	2	8	79	13	0	0	1	99	14	52	345	
1188802	3	2	5	87	8	0	0	1	78	15	53	345	
Time	AI6CO	AI6CO2	AI6COX	AI6M1	AI6M2	AI6M3	AI6M4	ID6	MBC6	Q6CH4C	Q6HCLC	TOI612	
AVG 340	2	3	6	79	14	1	0	1	88	18	69	340	
STD 340	2	2	1	6	5	1	0	0	15	2	13		
AVG 345	4	2	6	82	12	0	0	1	87	16	59	345	
STD 345	1	0	1	4	2	0	0	0	14	2	8		

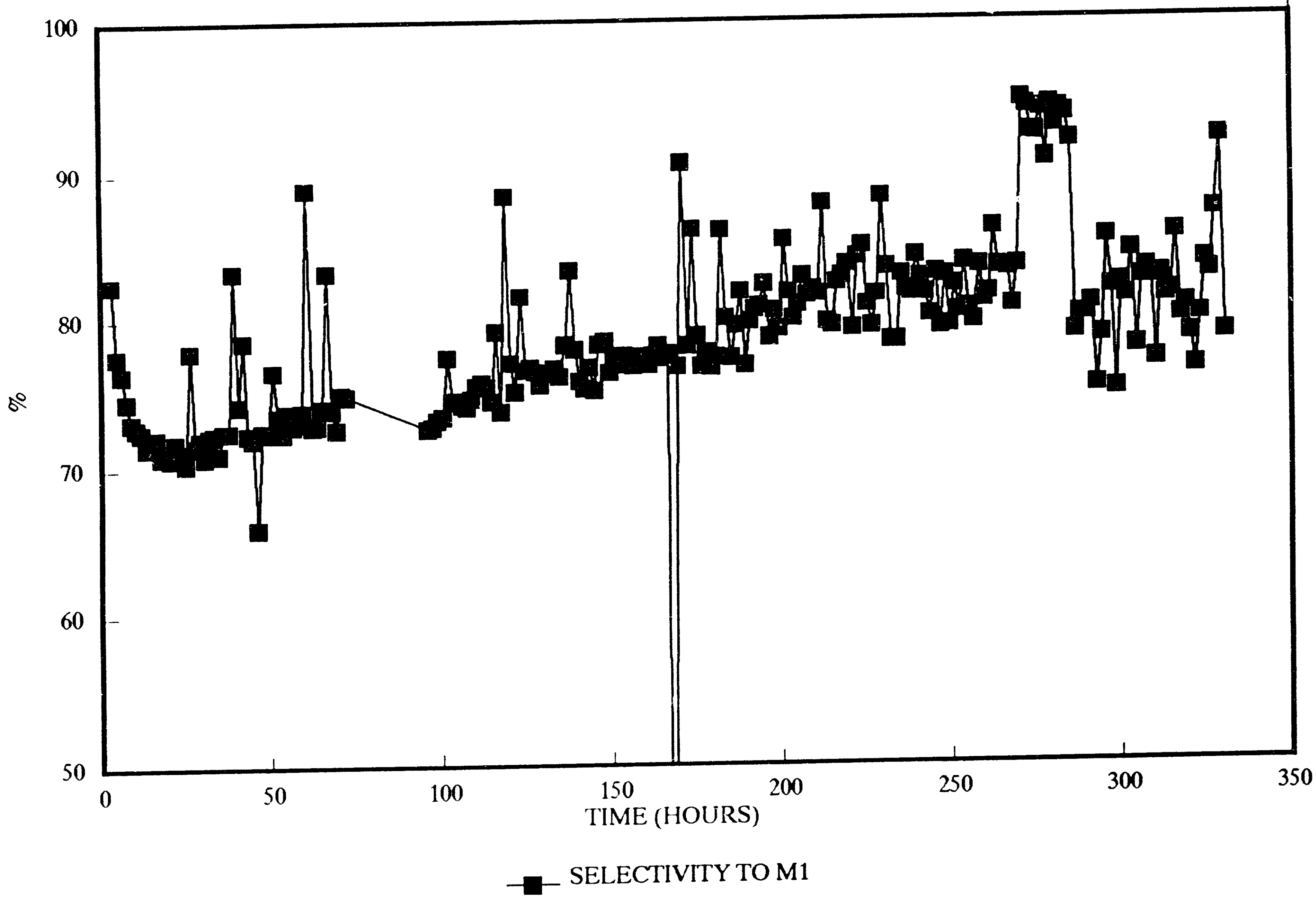
RUN 10346063

CAT 535



RUN 10346063

CAT 535



Data Appendix B

Catalyst Synthesis and Composition Information

CATALYST 511

SUPPORT	Silica CS-1040, PQ Corp. Lot #1229-2201
SOURCE	$CuCl_2.2H_2O$. 9947 lab-book page 34.
LOADING	0.992% Cu, 1.34% Cl.
IMPREGNATION METHOD	Very short impregnation period. While heating the solvent was evaporated using a nitrogen flow.
PRETREATMENT	Under vacuum for 3 hours at 140 °C, and R.T. overnight under static vacuum.
COLOR	Green.

CATALYST 516

SUPPORT	Silica (CS-1040)
SOURCE	CuCl. 9947 lab-book page 46.
LOADING	2.23% Cu, 1.29% Cl.
IMPREGNATION METHOD	The pale yellow acetonitrile solution of the pure salt was added to the support for impregnation overnight. Solvent removed while heating at 50 C for 1.5 hours under vacuum.
PRETREATMENT	Under full vacuum at 350 °C for 2 hours
COLOR	White

CATALYST 518

Silica (CS-1040)

"Cu_6Al" cluster. 9947 lab-book page 43 and 54.

1.86% Cu, 0.14% Al.

METHOD The acetonitrile solution of the cluster was left with the support overnight. The pale blue color of the solution was decanted and the catalyst was dried (see pretreatment).

Under full vacuum
A. 50-60 °C for 1 hour
B. 200 °C for 2 hours
C. 350 °C for 2 hours

Black

CATALYST 535

Silica CS-1040, PQ Corp. Lot #1229-2201

[$Cu(NCCH_3)4PF_6$. 9947 lab-book page 89.

1.94% Cu, 12.1% Cl, 1.16% Li,19.5% Li, and 1.02% P.

IETHOD The colorless acetonitrile solution of the salt was added to the support for impregnation over the weekend. The solvent was removed under vacuum. A solution in water was made from $LaCl_3$ and LiCl and was added to the catalyst preparation. The water was removed with a dry nitrogen purge.

Under vacuum for 30 minutes at 110 °C.

CATALYST 163C

(Purchased G-108 SUD-CHEMIE)

SUPPORT	Silica
SOURCE	Unknown
LOADING	Cu = 30%
IMPREGNATION METHOD	Unknown
PRETREATMENT	Under flowing dry nitrogen for 60 minutes at 350 °C.. Crushed and sieved between 18 an 35 mesh.

END

DATE
FILMED
4/26/94