Methyl Chloride Via Oxyhydrochlorination of Methane

Quarterly Technical Progress Report No.12
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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 in six different technical areas during this quarter. These key highlights are:

- 1) Mixed LnCl_3 solutions were successfully tested as substitutes for LaCl_3 in preparing OHC catalysts. This will dramatically lower the price of the catalyst.
- 2) Six catalyst samples were received from UCI. Each was made via either incipient wetness or compounded extrudate techniques. Four of the catalysts have been screened. All seem adequate.
- 3) Contact has opened with Calsicat as an alternate catalyst supplier to UCI. It should be valuable to draw from their catalyst expertise.
- 4) It has been decided to tie into the plant's natural gas source. Methods of cleaning up this stream are being investigated.
- 5) PDU construction completion is expected the first week in November. Pressure testing and punchout fix-up work remain to be completed.
- 6) Three new engineers were hired to work on the PDU. Half of the temporary operating procedures (TOP's) have been written. SOP completion date is targeted for the beginning of November.

Technical Results

Task 1.0 Catalyst Definition and Separation Unit Operation Development.

Catalyst Definition

Naasz and Jarvis traveled to Erie, Pennsylvania, to visit the Calsicat facilities. Their facilities and personnel were very impressive. It is obvious that they have catalyst expertise, and unlike UCI who is held back by secrecy agreements close to our technology, Calsicat is free to lend us help in technical problem areas. Calsicat produces alumina balls with a variety of pore size distributions. This should prove useful in tuning our system to do what we want. They also suggested that we send them some catalysts to test by DSC to determine whether or not we have a liquid phase catalyst at our reaction temperatures.

Six catalysts were prepared by UCI this quarter for screening in our lab reactor. The properties of each catalyst are shown in Table 1.

Table 1. Physical Properties of UCI Prepared Catalysts.

Catalyst	2395	2411	2520	2524	2525	2526
Size	1/16"	1/16"	1/16"	1/32"	1/16"	1/32"
Calcine Temp.			390F	390F	950F	950F
%Cu	2.4	2.3	2.7	2.7	2.7	2.7
%La	16.4	15.1	16.3	16.3	16.3	16.3
%Li	0.82	1.09	1.1	1.1	1.1	1.1
Surface Area m ² /g	192	197	173	173	204	208
Pore Volume cc/g	0.34	0.40	0.25	0.25	0.40	0.45
Density lbs/CF	52.4	50.6	48.4	48.2	40.0	42.6
Crush (DWL) lbs.	28.4	26.2	21.4	20.2	16.7	13.2

Catalysts 2395 and 2411 were prepared via incipient wetness technique. 2520-2526 were compounded extrudates.

Twelve catalyst samples were mailed to Micromeritics for pore size distribution and metal surface area measurements. These studies are an attempt to learn how adding various promoters to a catalyst affects its physical properties.

Two solutions of mixed lanthanide chlorides were received from Molycorp, Inc., this quarter. Their metals content is shown in Table 2.

Table 2. Metal Compositions of Mixed Lanthanide Chloride Solutions.

	5240	5241
%La	58	66
%Ce	15	0.9
%Pr	7	8.9
%Nd	20	24

Solution 5241 was used in the preparation of catalyst 554A; 5240 was used to make catalyst 554B.

Screening experiments were run this quarter to answer two questions: 1) Will the mixed LnCl_3 prepared catalysts have sufficient activity? and 2) Which of the UCI prepared catalysts yields the best results?

Data Set 1 is actual data gathered during the screening of catalyst 554B, prepared with mixed LnCl_3 solution 5240. Page 1 of Data Set 1 shows the summary of the run. Al7CO , Al7CO_2 , Al7M1 , Al7M2 , and Q7CH4C represent the most important fields: selectivity to CO , CO_2 , MeCl , and CH_2Cl_2 and conversion of methane. Data Set 1 shows that catalyst 554B is not sufficiently active enough between the temperatures of 280 and 290C, only reaching 6% methane conversion.

Data Set 2 shows catalyst 554B being pushed harder between the temperatures of 290 and 305C. At 300C, a fair result of 11% conversion/81% MeCl selectivity is obtained. Above that

temperature, oxygenation reactions take over. Page 6 of Data Set 2 clearly demonstrates the oxygenation reactions with a steadily climbing top reactor temperature upon setting the oven control at 305C.

Data Set 3 is the screening of catalyst 554A, formed using mixed LnCl_3 solution 5241. This run began very similar to the run shown in Data Set 2. However, upon reaching 300C, 11% conversion and 85% selectivity was reached. This is slightly better than 554B performed. At that point methane feeds were doubled followed by doubling the oxygen flows. In this process, the reaction essentially got diluted along with shortening the gas reactant residence time in the catalyst bed. This combination cooled the reaction off, and when temperatures were raised to 305, less than expected catalyst activity was observed.

Overall the mixed LnCl_3 solutions seem to work adequately in the preparation of OHC catalysts. However, solution 5241 with slightly more La seemed to yield higher selectivities for the same methane conversion. Because these solutions seem to work, catalyst cost should come down dramatically due to the difference in cost between LaCl_3 and mixed LnCl_3 .

Data Set 4 shows the screening of catalyst 2411 prepared via incipient wetness by UCI. This catalyst performed adequately yielding 10% conversion/82% selectivity at 295C. Boosting the temperature to 300C initiated burning.

Data Set 5 represents the first of the compounded extrudate catalysts, 2525. This catalyst reached 8% conversion/85% selectivity at 310C and was not pushed beyond that in this run. One reason for the inactivity of this catalyst was its particulate size. It was run as received from UCI, as a longer extrudate, instead of being ground and sieved to typical sizes of 12/25 mesh. Page 4 of this data set shows the effects of a GC glitch when the M2 (CH_2Cl_2) peak wasn't picked up and therefore registered as 0% for three data points.

Data Set 6 used a ground version of catalyst 2525, but also was allowed to pretreat under flowing N_2 overnight as opposed to the normal 1-2 hours. This catalyst, as expected, was more active. It produced oxygenates at 305C. However, 9% conversion and only 80% selectivity were reached at 300C.

Data Set 7 shows the final run of catalyst 2525. Here it was ground and pretreated for a normal time. 11% conversion/78% selectivity were reached at 305C before burning began at 310C.

Data Set 8 shows the screening of the other 1/16" compounded extrudate, catalyst 2520. A fair 10% conversion/83% selectivity was reached at 300C before oxygenation began at 305C. Pages 4 and 5 of Data Set 8 clearly show the effect of oxygenation taking over a reaction. Page 4 shows the selectivity to CO_x make a huge step change. Page 5 shows temperatures quickly climbing out of control clearly demonstrating the necessity of good heat transfer in the OHC reactor.

Data Set 9 reports the screening results of catalyst 2526, a 1/32" compounded extrudate calcined at 950C. This catalyst's activity is similar to the others with 12% conversion and 78% selectivity at 300C. Burning progressed at 305C.

Data Set 10 shows an attempt at screening catalyst 2524, the 1/32" compounded extrudate calcined at 390F. However, one of the GC columns was faulty ruining the data. Please disregard these reported results.

A summary of the screening to date of the UCI catalysts is shown in Table 3.

Table 3. Activity and Selectivity of Catalysts Prepared by UCI.

Catalyst	Temp (C)	CH ₄ Conv	CH ₃ Cl	CH ₂ Cl ₂	CO	CO ₂	CO _x
2411	285	7	88	10	0	2	2
	290	6	87	10	0	3	3
	295	10	82	13	0	4	4
	300	12	49	7	10	35	44
2525	290	5	92	6	0	1	1
	295	5	91	7	0	2	2
	300	8	86	10	0	3	3
	305	11	78	15	0	7	7
	310	18	52	10	11	27	38
2520	295	7	89	9	0	2	2
	300	10	83	13	0	4	4
	305	18	50	11	17	22	39
2526	295	9	85	12	0	4	4
	300	12	78	15	0	6	6
	305	18	47	12	19	22	41

Overall it appears that although the temperatures at which the catalysts start burning may differ by 5C, all the catalysts seem to have close to the same conversions/selectivities before oxygenation begins. The reason for the lack of diversity in catalyst performance is probably that the lab catalyst screening reactor cannot fully take advantage of the benefits of each catalyst. This is so for two reasons. First, the reactions are mass transfer limited. Sufficient gas velocities are not generated in the lab to eliminate this. Second, there is a huge lack of heat transfer in the lab reactor. Both of these problems should be eliminated in the PDU allowing full evaluation of the oxyhydrochlorination catalysts.

Task 2.0 PDU Design Engineering

ENGINEERING

Engineering activities this quarter were essentially complete with additional activities involving only construction support by the different disciplines. At the end of July engineering was 113% versus plan. However, this number continued to gradually increase throughout the quarter due to the extended construction schedule.

PROCESS ENGINEERING

This quarter three Dow Corning personnel visited our FTIR process analyzer vendor in Irvine, California, for a training seminar. The operation and maintenance of the FTIR hardware and software were explained. It was recommended that some labeling of lines and valves be made to aid in understanding and troubleshooting the analyzer. It was also decided that a mixed gas standard will be analyzed to confirm the analytical model's calculations. Because the mathematical model is based on the analysis of individual gas components, this "test" with a mixed gas standard should verify the model. These tests were made this quarter by the vendor. Dow Corning provided the vendor with a mixed gas standard for the tests. Preliminary results given over the phone look as if the vendor needed to do more calibration and modeling work. A written report is being awaited. The vendor was informed that ethyl and propyl chloride may be in the analyzed stream. This will most likely affect the MeCl modeling. At his time, it is difficult for Dow Corning to predict what amounts of these chemicals will be seen because we have never seen these in the laboratory, and our methane source has been close to pure methane (very little ethane or propane). The vendor will give us options to either look at this now or after we have a few PDU samples under our belt.

Issues continued around the methane feed supply. At the beginning of the quarter there appeared to be two options: 1) find a compressor to boost the local utilities source (mercaptan free) from 450 PSIG to 2500 PSIG to load a methane tube trailer, or 2) tie into the plants header (mercaptans included). Two compressor suppliers were contacted about skid mounted units. One estimated \$150M; the other estimated \$45-100M. Both vendors had very long lead times. After receiving this information, we concluded that the compressor option was not viable. We continued to work on the other option of tying into the plant's natural gas source and removing the sulfur containing compounds (because they are suspected catalyst poisons) and C4+ hydrocarbons (because they will throw off our analyzer's accuracy). Four companies were contacted about adsorbents. Three have responded back with two strong possibilities. We are continuing to define the scope of this option.

The issue of whether baffle plates were needed for the mini-plant phase separators was looked into with more detail this quarter. A phase separator design spreadsheet was used to show that due to the low flowrates, residence times, and nature of the liquids being separated, baffle plates are not necessary. Dip-tubes to introduce the liquid at the centers of the separators were added to the design. Eliminating the baffle plates saved the project \$25M.

Task 3.0 PDU Construction and Procurement

CONSTRUCTION

Construction completion is expected the first week in November. At the end of the quarter, pressure testing and punchout fix-up work were the main activities remaining to be completed. At the beginning of the quarter the piping was 40% complete overall, the electrical work was close to being finished, and the instrumentation work was underway. Total mechanical construction hours were at 61% of the target amount while actual costs were at only 56% of the target. Unfortunately, though, work continued to be slowed due primarily to delayed instrument deliveries and also, to a smaller extent, due to changes (made earlier) being constructed.

Mechanical construction this quarter included process pipe installation, vent pipe installation (this was an "adder" to the original mechanical package which was left out to speed-up the issuing of the package), instrument setting, instrument hook-up, scope changes, and pipe flushing.

Instrumentation was > 98% complete by the end of the quarter, and the total invoiced cost for electrical and instrumentation work was still less than the target amount.

BUDGET

The cost forecast for the project at the end of the quarter was \$2.78 MM which exceeded the authorized 10% overage on a CAR. This new forecast put us @ 111% of the capital authorization request (CAR). Several items contributed to the cost increase since the last quarter with one of the main ones being an underestimate of insulation costs with the bid coming in at six times higher than what we had in the budget. However, we were able to bring the initial bid down approximately \$15,000 by working with the contractor. This was done by using Fiberglass instead of calcium silicate (saving on both material and labor), using temporary insulation where practical, and "stove-piping" the insulation for short runs of pipe with several flanges. One of the main reasons for the high cost was due to the high amount of labor required to insulate the lined pipe which had several flange connections. Other items contributing to the overall project spending increase included the following: additional engineering support due to construction schedule stretch, money to cover punchout and SAT review fix-up item, field change work, completion of instrumentation ordering, increases in mechanical costs due to schedule stretch, shop support for equipment, and instrument checkout money not included in the last quarter's forecast. Note that this quarter's forecast does not include any money for changes during startup and has only \$25M allocated for the methane feed system (the scope for which, had not yet been fully defined).

A summary of the main reasons for the forecasted overrun are:

- \$125 M for two non-process related adders (KY sales tax not included in the original estimate and wrong charge out rate used for part of engineering estimate)
- \$132 M in process scope changes (5% of CAR, not too bad for most projects)
- \$? M Extended construction due to late equipment & instrument deliveries

\$174 M under-estimate of mechanical work
+ \$ 60 M under-estimate of insulation work
\$491 M = 20% of CAR

To sum it up, the project has been hit hard by under-estimating during the budgeting phase (some of which was due to the "pilot plant" scale of the project) and has had some unfortunate adders. There have been scope changes but these changes were made to make the unit operational as defined in the PDP scope. They were not a result of development work continuing during design. The majority of the changes were the normal types of changes that occur during detailed design (e.g. add a drain valve, etc.), some changes were SAT requirements and the rest were oversights in the original scope. All of these changes were made before construction, thus helping to reduced their cost impact.

Let's face it, when you have 5% adders from hard hits, 5% adders to fix the scope, and 10% adders due to under-estimating, there's only so much a project can take. However, thanks to the diligent efforts of the project team, the costs have been contained to only 11% over the CAR.

SCHEDULE

Construction completion was delayed this quarter due primarily to delays in instrument deliveries. Note that these delays were in addition to the delays already experienced during the last two quarters in equipment deliveries. To a smaller extent, changes being processed through the construction also served to delay construction completion.

Task 4.0 PDU Start-up

STARTUP

Several job candidates were interviewed for PDU engineer positions during July. By the end of August, three engineers had been hired and started work. Training for the new engineers involved normal work process orientation and safety orientation. We worked to bring them up to speed on the technology by giving lab tours, several OHC technical documents to read, and also giving a process overview class. By the end of the quarter, all of the new engineers had completed the HAZ-MAT technician training. This made the whole team (including the coordinator) qualified to respond to hazardous material incidents.

Other training this quarter included sending two team members to Midland, Michigan, to attend a CAMILE data acquisition and control system training course. Also, representatives from a couple of other vendors gave the team short overview seminars on field instrumentation.

OUTSTANDING work was done by members of the startup team in completing pipe flushing this quarter. Completing this work prior to pressure testing saved the project at least two weeks on the schedule. Also, writing the TOP's for this work paid dividends by minimizing the amount of field time required to complete this work and also by helping the work to go smoothly and safely. This effort demonstrated that PROPER PLANNING IS THE KEY TO A SMOOTH STARTUP.

Temporary operating procedure (TOP) writing continued and about half of them were completed by the end of the quarter. The TOP's were written to map out the operational steps required to startup each system and develop efficient systematic tests to verify the proper sizing and operation of the equipment and instruments. Determining this early on will help to avoid operational problems and also avoid delays during the startup. Other reasons for writing the TOP's included: 1) determining commissioning activities required, 2) facilitating work execution by planning activities (once they were identified) and preparing written procedures (which were organized into "work packets" according to the tasks involved for each TOP), 3) to identify potential problem areas, 4) familiarize the engineers with the process design and the intricacies of the unit's operation, and 5) to anticipate potential safety concerns (before they are discovered while doing the work).

Standard operating procedure writing continued throughout the quarter. The SOP writer collaborated with the software programmer to insure consistency between the SOP and the software. Several technical operating issues were discovered and addressed during the course of the writing. At the end of the quarter, the target for completing the SOP was the beginning of November.

Programming of our CAMILE data acquisition and control system was >90% completed by the end of the quarter. This work included proofreading sequences, writing shutdown and emergency stop sequences, modifying other sequences, and writing Q&A pages. Our programmer worked with the SOP writer to insure consistency between the code and the SOP.

We met with analytical personnel this quarter to discuss sampling, analysis methods, and resources.

The process was punched-out this quarter with participation by all of the startup engineers. These checks included verifying that the PDU was built in accordance with the P&ID's and also involved checking operability and safety. This activity helped familiarized the team with the PDU layout. It was very impressive the way the team pulled together and finished this work in half the time we initially estimated for the effort.

Also, representatives from Engineering, SMI, and Construction S&I (scheduling and inspection) participated in a walk-through punchout of the unit. The usual amount of punchout items were found. However, most of them were small. They were reviewed by the project manager and those approved were submitted to the contractors for correction.

SAFETY

There were no safety incidents for the project this quarter.

A safety audit team (SAT) walk-through audit of the PDU was held this quarter. No major items were found. Items that were identified were submitted to the contractors for correction.

At the end of the quarter, we were targeting to begin commissioning work the first week in November. Punchout items were to be finished up during the next month and insulation work was to start the second week in October and was expected to last until the end of the month. Instrument checkouts were also be done during October.

Data Appendices

Data Appendix A- Catalyst Synthesis and Composition Information

Data Appendix B- Experimental Data Sets

Data Appendix A

Catalyst Synthesis and Composition Information

CATALYST 554A

SUPPORT	Alumina CS331-1, United Catalyst, Lot #3208-S
SOURCE	$\text{Cu}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ - lab book 11291 page 67.
LOADING	2.48% Cu, 4.72% La, 0.745% Li, 1.37% Nd, 0.418% Pr.
IMPREGNATION METHOD	Copper species and LiCl dissolved in water before being mixed with mixed LnCl_3 . Solution then added to dry alumina for 16 hours impregnation. Catalyst was dried under flowing N_2 .
PRETREATMENT	Alumina dried at 325°C under vacuum for 16 hours.
COLOR	Yellow-brown.

CATALYST 554B

SUPPORT	Alumina CS331-1, United Catalyst, Lot #3208-S
SOURCE	$\text{Cu}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ - lab book 11291 page 67.
LOADING	2.41% Cu, 3.19% La, 0.781% Li, 0.232% Nd, 0.076% Pr, 0.1% Ce.
IMPREGNATION METHOD	Copper species and LiCl dissolved in water before being mixed with mixed LnCl_3 . Solution then added to dry alumina for 16 hours impregnation. Catalyst was dried under flowing N_2 .
PRETREATMENT	Alumina dried at 325°C under vacuum for 16 hours.
COLOR	Yellow-brown.

Data Appendix B
Experimental Data Sets

HOOD #7 RAMPING EXPERIMENT DEFINITION

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OPERATOR NAME: B. CRUM DATE: 10-AUG-94
 LOG BOOK #: 11202 PAGE #: 148
 RUN #: 11202059 CATALYST #: 5548
 CATALYST NAME: _____
 COMMENTS: _____

MASS OF CATALYST (g): 4.51
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

OHC/JSS

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TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
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BOTTOM: 280	280	1
MIDDLE: 280	280	1
TOP : 280	280	1

(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): 29.8 AUX FLOW RATE (CC/MIN): 0

Time	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712
30434	0	0	0	94	6	0	0	0	1	72	4	15	20
35595	0	0	0	92	8	0	0	0	1	71	5	17	18
40767	0	0	0	93	7	0	0	0	1	69	3	10	17
45930	0	0	0	95	5	0	0	0	2	70	4	15	18
51795	0	0	0	94	6	0	0	0	2	68	4	16	20
56954	0	0	0	94	6	0	0	0	2	67	5	18	22
62108	0	0	0	94	6	0	0	0	2	67	3	9	20
67230	0	0	0	94	6	0	0	0	2	68	4	13	18
72388	0	0	0	94	6	0	0	0	3	67	5	18	21
78268	0	1	1	92	7	0	0	0	3	66	6	23	25
83407	0	1	1	92	7	0	0	0	3	66	7	23	23
88529													
93699	0	1	1	93	6	0	0	0	3	68	6	22	17
98835	0	1	1	93	6	0	0	0	4	68	6	23	17
AVERAGES AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712	
AVG 280	0	0	0	93	7	0	0	0	1	70	4	14	18
STD	0	0	0	1	1	0	0	0	0	1	1	3	1
AVG 285	0	0	0	94	6	0	0	0	2	68	4	15	20
STD	0	0	0	0	0	0	0	0	0	0	1	3	2
AVG 290	0	1	1	92	7	0	0	0	3	67	6	23	20
STD	0	0	0	0	0	0	0	0	0	1	0	0	3

RUN 11202059

CAT 554B

RUN 11202059

CAT 554B

RUN 11202059

CAT 554B

RUN 11202059

CAT 554B

HOOD #7 RAMPING EXPERIMENT DEFINITION

OPERATOR NAME: B. CRUM DATE: 22-AUG-94
 LOG BOOK #: 11202 PAGE #: 150
 RUN #: 11202060 CATALYST #: 554B
 CATALYST NAME:
 COMMENTS: SCREENING RUN

MASS OF CATALYST (g): 4.33
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

OHC/JSS

TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

INITIAL FINAL ABSOLUTE
 TEMP TEMP RAMP RATE
 (DEG C) (DEG C) (DEG C / MIN)

BOTTOM: 290 290 1
 MIDDLE: 290 290 1
 TOP : 290 290 1

(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 TO MAINTAIN FINAL TEMPERATURES (HOURS): 6														
Time	A17CO	A17CO2	A17COX	A17M1	A17M2	A17M3	A17M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQ712	
14396	0	4	4	96	0	0	0	0	1	72	6	20	46	291
19543	0	1	1	91	8	0	0	0	1	60	7	25	42	290
24717	0	2	2	89	9	0	0	0	1	63	7	26	39	290
29850	0	1	1	92	7	0	0	0	1	59	6	21	40	290
35026	0	1	1	92	7	0	0	0	1	58	6	20	42	290
40196	0	1	1	92	7	0	0	0	2	59	5	19	42	291
46064	0	2	2	87	10	0	0	0	2	59	7	24	48	295
51224	0	2	2	87	11	0	0	0	2	59	7	27	49	295
56386	0	2	2	87	10	0	0	0	2	60	8	29	47	295
61546	0	2	2	88	10	0	0	0	2	59	8	30	49	295
66717	0	2	2	88	10	0	0	0	2	60	8	29	49	295
71850	0	2	2	90	8	0	0	0	3	63	8	29	47	296
77686	0	4	4	82	14	0	0	0	3	67	9	34	51	300
82846	0	4	4	81	15	0	0	0	3	61	11	40	55	300
88006	0	4	4	81	15	0	0	0	3	61	12	43	52	300
93152	0	4	4	81	15	0	0	0	3	61	12	46	52	300
102162	8	4	13	73	15	0	0	0	1	68	16	57	100	305
107334	7	19	26	58	16	0	0	0	1	60	18	55	100	305
112504	6	19	25	59	16	0	0	0	1	61	18	56	100	305
117654	5	20	24	59	16	0	0	0	1	59	15	46	100	306
122805	4	20	24	60	16	0	0	0	1	59	17	51	100	305
127973	5	19	24	60	16	0	0	0	1	60	18	56	100	305
133124	4	22	26	59	16	0	0	0	1	59	18	54	100	305
138284	3	22	25	60	16	0	0	0	1	59	18	53	100	305
143456	2	21	23	61	16	0	0	0	2	59	17	54	100	307
AVERAGES A17CO	A17CO2	A17COX	A17M1	A17M2	A17M3	A17M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQ712		
AVG 290	0	2	2	92	6	0	0	0	1	62	6	22	42	290
STD	0	1	1	2	3	0	0	0	0	5	1	3	2	0
AVG 295	0	2	2	88	10	0	0	0	2	60	8	28	48	295
STD	0	0	0	1	1	0	0	0	0	1	0	2	1	1
AVG 300	0	4	4	81	15	0	0	0	3	62	11	41	52	300
STD	0	0	0	1	1	0	0	0	0	3	1	4	1	0
AVG 305	5	19	23	61	16	0	0	0	1	60	17	54	100	305
STD	2	5	4	4	0	0	0	0	0	3	1	3	0	0

RUN 11202060

CAT 554B

RUN 11202060
CAT 554B

Data Set 2 Page 3

RUN 11202060

CAT 554B

RUN 11202060
CAT 554B

HOOD #7 RAMPING EXPERIMENT DEFINITION

OPERATOR NAME: B. CRUM DATE: 24-AUG-94
 LOG BOOK #: 12068 PAGE #: 8
 RUN #: 1206801 CATALYST #: 554A
 CATALYST NAME:
 COMMENTS: SCREENING RUN

MASS OF CATALYST (g): 4.67
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

OHC/JSS

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TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
BOTTOM: 290	290	1
MIDDLE: 290	290	1
TOP : 290	290	1

(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): 29.8 AUX FLOW RATE (CC/MIN): 0

TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 8

Time	A17CO	A17CO2	A17COX	A17M1	A17M2	A17M3	A17M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQ1712	COMMENT
13924	0	1	1	99	0	0	0	0	1	74	7	22	19	290
19085	0	2	2	90	9	0	0	0	1	72	0	0	9	290
24281	0	1	1	91	7	0	0	0	1	71	7	25	15	289
29406	0	1	1	94	5	0	0	0	1	67	7	23	18	290
34581	0	1	1	92	7	0	0	0	1	70	8	24	17	290
39751	0	0	0	95	5	0	0	0	2	68	7	23	17	291
45831	0	1	1	89	9	0	0	0	2	68	8	29	29	295
50780	0	2	2	88	10	0	0	0	2	69	8	23	21	295
55941	0	2	2	88	10	0	0	0	2	70	8	31	23	295
61101	0	2	2	90	9	0	0	0	2	68	8	29	23	295
68281	0	2	2	89	9	0	0	0	2	93	5	19	18	295
71421	0	2	2	90	9	0	0	0	3	68	7	27	22	296
78985	0	3	3	85	12	0	0	0	3	70	11	40	30	300
82148	0	3	3	84	13	0	0	0	3	69	11	40	28	300
87305	0	2	2	85	13	0	0	0	3	67	11	40	28	300
92481	0	2	2	85	13	0	0	0	3	80	5	18	19	300 DOUBLED CH4 FEEDS
99079	0	1	1	93	5	0	0	0	1	83	5	35	18	300
104240	0	0	0	96	4	0	0	0	1	82	5	35	17	300
109401	0	0	0	96	4	0	0	0	1	82	2	11	14	300
114545	0	0	0	96	4	0	0	0	1	81	3	20	16	300
119698	0	0	0	96	4	0	0	0	1	81	5	36	19	300
124805	0	0	0	96	4	0	0	0	2	70	6	42	60	300 DOUBLED O2 FEEDS
129979	0	2	2	93	5	0	0	0	2	74	6	40	15	300
135141	0	2	2	93	5	0	0	0	2	74	7	48	16	300
140300	0	2	2	92	6	0	0	0	2	75	8	44	16	300
145459	0	2	2	92	6	0	0	0	2	74	6	42	17	300
150619	0	2	2	93	5	0	0	0	2	73	6	45	16	300
155767	0	2	2	92	6	0	0	0	1	75	6	45	16	300
161787	0	4	4	87	9	0	0	0	1	78	7	51	28	305

AVERAGES	A17CO	A17CO2	A17COX	A17M1	A17M2	A17M3	A17M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQ1712	
AVG 290	0	1	1	93	6	0	0	0	1	70	8	20	18	290
STD	0	1	1	4	3	0	0	0	1	6	2	11	9	
AVG 295	0	2	2	89	9	0	0	0	2	73	7	26	23	295
STD	0	0	0	1	1	0	0	0	0	9	1	4	3	
AVG 300	0	3	3	85	13	0	0	0	3	69	11	40	29	300
STD	0	0	0	0	0	0	0	0	0	1	0	0	1	
AVG HI CH4	0	1	1	93	6	0	0	0	1	81	4	26	17	300
STD	0	1	1	4	3	0	0	0	1	1	1	10	2	
AVG HI O2	0	2	2	93	5	0	0	0	2	74	6	43	22	300
STD	0	1	1	1	0	0	0	0	0	1	0	2	15	
AVG 305	0	4	4	87	9	0	0	0	1	78	7	51	28	305
STD	0	0	0	0	0	0	0	0	0	0	0	0	0	

RUN 1206601
CAT 554A

RUN 1206601

CAT 554A

RUN 1206601

CAT 554A

RUN 1206601

CAT 554A

HOOD #7 RAMPING EXPERIMENT DEFINITION

=====

OPERATOR NAME: JARVIS DATE: 27-JUL-94
 LOG BOOK #: 11202 PAGE #: 143
 RUN #: 11202056 CATALYST #: 2411
 CATALYST NAME: UCI INCIPIENT WETNESS
 COMMENTS: SCREENING RXN

MASS OF CATALYST (g): 4.32
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

OHC/JSS

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TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL FINAL ABSOLUTE
 TEMP TEMP RAMP RATE
 (DEG C) (DEG C) (DEG C / MIN)

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BOTTOM: 280 285 1
 MIDDLE: 280 285 1
 TOP : 280 285 1

(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): 29.8 ALX FLOW RATE (CC/MIN): 0

TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 6														
Time	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712	
15953	0	2	2	88	9	0	0	0	1	69	8	28	24	285
21123	0	2	2	88	10	0	0	0	1	68	7	27	23	285
26273	0	2	2	88	10	0	0	0	1	68	6	22	21	285
31443	0	2	2	88	10	0	0	0	1	68	6	20	20	285
36577	0	2	2	88	10	0	0	0	2	67	6	23	21	286
42412	0	3	3	86	11	0	0	0	2	67	8	28	26	290
47571	0	3	3	86	11	0	0	0	2	67	8	31	26	290
52744	0	3	3	87	11	0	0	0	2	67	7	25	26	290
57895	0	2	2	89	9	0	0	0	2	76	1	3	21	290
63062	0	3	3	87	11	0	0	0	3	68	8	31	26	291
68950	1	4	5	82	13	0	0	0	3	66	10	39	36	295
74110	2	5	6	79	14	0	0	0	3	65	11	42	37	296
79262	2	4	6	81	13	0	0	0	3	64	11	40	34	295
84398	0	4	4	83	13	0	0	0	3	87	8	30	-3	295
89558	0	3	3	87	11	0	0	0	4	79	9	34	30	297
95402	17	4	21	67	12	0	0	0	4	96	20	62	100	300
100568	16	25	41	49	10	0	0	0	4	83	18	41	100	300
105730	16	26	41	48	11	0	0	0	4	107	19	250	100	300
110884	0	52	52	48	0	0	0	0	4	77	3	46	18	300
116043	0	67	67	33	0	0	0	0	0	94	0	1	15	300
AVERAGES AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712		
AVG 285	0	2	2	88	10	0	0	0	1	68	7	24	22	285
STD	0	0	0	0	0	0	0	0	0	1	1	3	2	
AVG 290	0	3	3	87	10	0	0	0	2	69	6	24	25	290
STD	0	0	0	1	1	0	0	0	0	4	3	11	2	
AVG 295	1	4	5	82	13	0	0	0	3	72	10	37	27	295
STD	1	1	1	2	1	0	0	0	0	9	1	4	15	
AVG 300	10	35	44	49	7	0	0	0	3	91	12	80	66	300
STD	8	22	15	11	5	0	0	0	2	10	9	87	41	

RUN 11202056
CAT 2411

RUN 11202056

CAT 2411

RUN 11202056

CAT 2411

Data Set 4 Page 4

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HOOD #7 RAMPING EXPERIMENT DEFINITION

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OHC/JSS

OPERATOR NAME: B. CRUM DATE: 31-AUG-94
 LOG BOOK #: 12066 PAGE #: 10
 RUN #: 1206602 CATALYST #: UNITED CAT#2525
 CATALYST NAME: Cu/Li/La ON EXTRUDATES
 COMMENTS: SCREENING RUN

MASS OF CATALYST (g): 3.13
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

OHC/JSS

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TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
BOTTOM: 290	290	1
MIDDLE: 290	290	1
TOP : 290	290	1

(INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)

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

TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 8

Time	A17C0	A17C02	A17COX	A17M1	A17M2	A17M3	A17M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQ1712
16118	0	0	0	91	9	0	0	0	1	75	4	15	9
21225	0	0	0	91	9	0	0	0	1	74	4	13	7
26378	0	0	0	90	10	0	0	0	1	74		2	3
31484	0	0	0	100	0	0	0	0	1	73	4	15	8
36658	0	0	0	100	0	0	0	0	1	72	4	13	9
41817	0	0	0	100	0	0	0	0	2	72			6
47676	0	0	0	91	9	0	0	0	2	71	5	17	12
52786	0	0	0	92	8	0	0	0	2	70	4	18	11
57960	0	0	0	92	8	0	0	0	2	70	4	15	13
63118	0	0	0	91	9	0	0	0	2	69	4	14	13
68286	0	0	0	90	10	0	0	0	2	84	3	10	12
73424	0	0	0	95	5	0	0	0	3	69	4	13	12
79237	0	2	2	92	8	0	0	0	3	69	5	19	16
84357	0	2	2	92	8	0	0	0	3	68	5	17	15
89506	0	2	2	93	6	0	0	0	3	70	3	11	11
94665	0	2	2	92	8	0	0	0	3	80	4	14	12
99826	0	2	2	93	6	0	0	0	3	70	5	18	11
105000	0	2	2	93	6	0	0	0	4	69	4	15	13
110666	0	2	2	91	7	0	0	0	4	67	6	21	17
116018	0	2	2	92	6	0	0	0	4	66			12
121138	0	2	2	92	6	0	0	0	4	65	6	22	19
126283	0	2	2	91	7	0	0	0	4	67	6	22	19
131458	0	2	2	92	6	0	0	0	4	66	6	22	19
136606	0	2	2	91	7	0	0	0	5	66	6	22	19
142424	0	4	4	85	11	0	0	0	5	66	8	29	27
147599	0	4	4	86	10	0	0	0	5	64	8	29	28
152759	0	4	4	85	11	0	0	0	5	65	8	28	28
157897	0	4	4	85	11	0	0	0	5	70	6	23	25
163004	0	4	4	85	11	0	0	0	5	0	8		
94665	0	2	2	92	8	0	0	0	3	80	4	14	12
99826	0	2	2	93	6	0	0	0	3	70	5	18	11
105000	0	2	2	93	6	0	0	0	4	69	4	15	13
110666	0	2	2	91	7	0	0	0	4	67	6	21	17
116018	0	2	2	92	6	0	0	0	4	66			12
121138	0	2	2	92	6	0	0	0	4	65	6	22	19
126283	0	2	2	91	7	0	0	0	4	67	6	22	19
131458	0	2	2	92	6	0	0	0	4	66	6	22	19
136606	0	2	2	91	7	0	0	0	5	66	6	22	19
142424	0	4	4	85	11	0	0	0	5	66	8	29	27
147599	0	4	4	86	10	0	0	0	5	64	8	29	28
152759	0	4	4	85	11	0	0	0	5	65	8	28	28
157897	0	4	4	85	11	0	0	0	5	70	6	23	25
163004	0	4	4	85	11	0	0	0	5				
AVERAGES	A17C0	A17C02	A17COX	A17M1	A17M2	A17M3	A17M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQ1712
AVG 290	0	0	0	95	5	0	0	0	1	73	4	12	7
STD	0	0	0	5	5	0	0	0	0	1	0	5	2
AVG 295	0	0	0	92	8	0	0	0	2	72	4	14	12
STD	0	0	0	2	2	0	0	0	0	5	1	2	1
AVG 300	0	2	2	92	6	0	0	0	3	71	4	16	13
STD	0	0	0	0	0	0	0	0	0	4	1	3	2
AVG 305	0	2	2	91	6	0	0	0	4	66	6	22	17
STD	0	0	0	0	0	0	0	0	0	1	0	1	3
AVG 310	0	4	4	85	11	0	0	0	5	53	8	27	27
STD	0	0	0	0	0	0	0	0	0	27	1	3	1
AVG 2 300	0	2	2	93	6	0	0	0	3	73	4	16	12
STD	0	0	0	0	0	0	0	0	0	5	0	2	1
AVG 2 305	0	2	2	91	6	0	0	0	4	66	6	22	17
STD	0	0	0	0	0	0	0	0	0	1	0	1	3
AVG 2 310	0	4	4	85	11	0	0	0	5	66	8	27	27
STD	0	0	0	0	0	0	0	0	0	2	1	3	1

RUN 1206602

CAT PP2525 (NOT CRUSHED)

RUN 1206602

CAT PP2525 (NOT CRUSHED)

RUN 1206602
CAT PP2525 (NOT CRUSHED)

RUN 1206602

CAT PP2525 (NOT CRUSHED)

HOOD #7 RAMPING EXPERIMENT DEFINITION

=====

OPERATOR NAME: B. CRUM DATE: 07-SEP-94
 LOG BOOK #: 12066 PAGE #: 12
 RUN #: 1206603 CATALYST #: UNITED CAT#2525
 CATALYST NAME: Cu/Li/La ON EXTRUDATES
 COMMENTS: SCREENING RUN

MASS OF CATALYST (g): 3.79
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

OHC/JSS

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TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

=====

INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
BOTTOM: 290	290	1
MIDDLE: 290	290	1
TOP : 290	290	1

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(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

TIMETO MAINTAIN FINAL TEMPERATURES (HOURS): 8

Time	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712	
65885	0	0	0	0	0	0	0	0	1	77	7	0	33	290
71045	0	2	2	89	8	0	0	0	1	63	7	25	24	290
76206	0	2	2	88	9	0	0	0	1	68	6	21	20	290
81381	0	2	2	89	9	0	0	0	1	69	6	24	18	290
86526	0	2	2	88	10	0	0	0	1	69	3	13	15	290
95779	0	3	3	84	12	0	0	0	2	68	8	29	24	295
100941	0	4	4	84	12	0	0	0	2	68	7	27	23	295
106101	0	3	3	86	11	0	0	0	2	66	8	30	23	295
111261	0	3	3	86	11	0	0	0	2	65	7	27	26	295
116421	0	3	3	86	10	0	0	0	2	65	7	24	25	295
121589	0	3	3	86	11	0	0	0	3	65	7	27	27	297
127446	0	6	6	81	13	0	0	0	3	63	10	36	38	300
132620	0	6	6	80	14	0	0	0	3	62	10	38	38	300
137767	0	6	6	79	15	0	0	0	3	63	10	37	37	300
142939	0	6	6	79	15	0	0	0	3	64	8	30	34	300
148100	0	7	7	79	15	0	0	0	3	75	6	24	30	300
153244	0	5	5	82	12	0	0	0	4	64	10	38	38	301
159089	11	16	27	57	16	0	0	0	4	61	18	55	100	305
AVERAGES AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712		
AVG 290	0	2	2	89	9	0	0	1	67	6	20	19	290	
STD	0	0	0	1	1	0	0	0	2	1	5	3		
AVG 295	0	3	3	86	11	0	0	2	66	7	27	24	295	
STD	0	0	0	1	1	0	0	0	1	0	2	2		
AVG 300	0	6	6	80	14	0	0	3	65	9	34	36	300	
STD	0	0	0	1	1	0	0	0	4	1	5	3		
305	11	16	27	57	16	0	0	4	61	18	55	100	305	

1 PT ONLY

BED WAS PRETREATED OVERNIGHT. CAMILE SHUT DOWN AND ENDED RUN

RUN 1206603

CAT PP 2525 CRUSHED

—■— CONVERSION OF CH₄

RUN 1206603

CAT PP 2525 CRUSHED

RUN 1206603
CAT PP 2525 CRUSHED

RUN 1206603
CAT PP2525 (CRUSHED)

HOOD #7 RAMPING EXPERIMENT DEFINITION

=====

OPERATOR NAME: B. CRUM DATE: 19-SEP-94
 LOG BOOK #: 12066 PAGE #: 14
 RUN #: 1206604 CATALYST #: pp2525
 CATALYST NAME: GROUND & SIEVED PP2525
 COMMENTS: NORMAL PRETREATMENT

MASS OF CATALYST (g): 3.69
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

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TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL FINAL ABSOLUTE
 TEMP TEMP RAMP RATE
 (DEG C) (DEG C) (DEG C / MIN)

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BOTTOM: 295 300 1

MIDDLE: 295 300 1

TOP : 296 300 1

(INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)

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

TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 8

Time	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712
16787													290
21937	0	2	2	92	7	0	0	0	1	69	7	24	14
27096	0	2	2	92	6	0	0	0	1	68	6	19	13
32269	0	1	1	93	6	0	0	0	1	68	6	20	14
37417	0	2	2	93	6	0	0	0	1	67	2	5	16
42588	0	2	2	92	6	0	0	0	2	66	4	15	22
48455	0	2	2	91	7	0	0	0	2	65	7	24	22
53627	0	2	2	92	6	0	0	0	2	65	6	22	22
58788	0	2	2	91	7	0	0	0	2	64	5	17	19
63938	0	2	2	91	7	0	0	0	2	64	6	21	19
69097	0	2	2	91	6	0	0	0	2	64	2	7	16
74257	0	2	2	92	6	0	0	0	3	64	7	24	23
80137	0	4	4	87	10	0	0	0	3	65	8	30	28
85310	0	4	4	86	10	0	0	0	3	65	7	26	28
90458	0	3	3	86	10	0	0	0	3	67	8	31	25
95629	0	3	3	86	11	0	0	0	3	67	8	30	23
100777	0	3	3	86	11	0	0	0	3	68	8	29	22
105938	0	3	3	87	11	0	0	0	4	70	8	30	20
111827	0	6	6	78	16	0	0	0	4	67	8	29	35
116989	0	6	6	78	15	0	0	0	4	64	13	47	39
122148	0	7	7	78	15	0	0	0	4	61	12	44	42
127297	0	7	7	78	15	0	0	0	4	61	12	42	47
132474	0	8	8	76	16	0	0	0	4	63	12	43	43
137619	0	8	8	77	15	0	0	0	5	61	12	43	46
143508	11	25	36	54	11	0	0	0	5	59	19	48	100
148666	12	28	40	50	10	0	0	0	5	61	18	44	100
153827	11	27	38	52	10	0	0	0	5	61	18	43	100
158988	11	27	38	52	10	0	0	0	5	62	18	43	100
164154	11	27	38	53	10	0	0	0	5	62	18	43	100
169307	11	28	39	52	10	0	0	0	0	63	18	44	100
AVERAGES AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7		MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712
AVG 290	0	1	1	92	6	0	0	0	1	68	5	17	14
STD	0	0	0	1	0	0	0	0	0	1	2	7	1
AVG 295	0	2	2	91	7	0	0	0	2	64	5	18	20
STD	0	0	0	1	0	0	0	0	0	1	2	6	2
AVG 300	0	3	3	86	10	0	0	0	3	67	8	29	24
STD	0	0	0	0	0	0	0	0	0	2	0	1	3
AVG 305	0	7	7	78	15	0	0	0	4	63	11	42	42
STD	0	1	1	1	0	0	0	0	0	2	2	6	4
AVG 310	11	27	38	52	10	0	0	0	4	61	18	44	100
STD	0	1	2	1	0	0	0	0	0	1	0	2	0

RUN 1206604

CAT PP2525

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RUN 1206604
CAT PP2525

RUN 1206604
CAT PP2525

RUN 1206604

CAT PP2525

HOOD #7 RAMPING EXPERIMENT DEFINITION

=====

OPERATOR NAME: B. CRUM DATE: 26-SEP-94

LOG BOOK #: 12066 PAGE #: 16

RUN #: 1206605 CATALYST #: pp2520

CATALYST NAME: GROUND & SIEVED PP2520

COMMENTS: NORMAL PRETREATMENT

MASS OF CATALYST (g): 3.79

REACTOR INSIDE DIAM (CM): 0.45

CATALYST BED HEIGHT (CM): 30.5

===== TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7 =====

INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
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BOTTOM: 295	295	1
MIDDLE: 295	295	1
TOP : 295	295	1

(INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)

CH4 FLOW RATE (CC/MIN): 100 O2 FLOW RATE (CC/MIN): 22.8

HCI FLOW RATE (CC/MIN): 29.6 AUX FLOW RATE (CC/MIN): 0

TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 8

Time	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712
14754	0	0	0	0	0	100	0	0	1	96	5	36	19
19924	0	2	2	89	9	0	0	0	1	70	7	24	21
25072	0	2	2	89	9	0	0	0	1	69	7	24	21
30232	0	2	2	88	10	0	0	0	1	71	7	26	20
35402	0	2	2	90	8	0	0	0	2	70	6	21	18
41273	0	4	4	83	13	0	0	0	2	70	9	32	27
46433	0	4	4	84	12	0	0	0	2	67	9	35	31
51604	0	4	4	83	12	0	0	0	2	67	10	37	30
56763	0	4	4	83	13	0	0	0	2	67	10	37	31
61912	0	4	4	84	12	0	0	0	2	67	9	34	37
67072	0	5	5	82	13	0	0	0	3	66	10	39	33
72984	18	10	28	58	14	0	0	0	3	61	17	52	100
78129	17	26	43	47	9	0	0	0	3	58	18	39	100
83290	17	25	42	48	10	0	0	0	3	60	18	40	100
88448	17	26	43	48	9	0	0	0	3	58	18	39	100
AVERAGES AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712	
AVG 295	0	2	2	89	9	0	0	0	1	70	7	24	20
STD	0	0	0	1	1	0	0	0	0	1	0	2	1
AVG 300	0	4	4	83	13	0	0	0	2	67	10	36	32
STD	0	0	0	1	1	0	0	0	0	1	1	2	3
AVG 305	17	22	39	50	11	0	0	0	3	59	18	42	100
STD	0	7	6	4	2	0	0	0	0	1	0	5	0

RUN 1206605
CAT PP2520

Data Set 8 Page 2

RUN 1206605

CAT PP2520

Data Set 8 Page 3

RUN 1206605

CAT PP2520

Data Set 8 Page 4

RUN 1206605

CAT PP2520

HOOD #7 RAMPING EXPERIMENT DEFINITION

=====

OPERATOR NAME: B. CRUM DATE: 27-SEP-94
 LOG BOOK #: 12066 PAGE #: 18
 RUN #: 1206606 CATALYST #: pp2526
 CATALYST NAME: GROUND & SIEVED PP2526
 COMMENTS: NORMAL PRETREATMENT

MASS OF CATALYST (g): 3.74
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
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BOTTOM: 295	295	1
MIDDLE: 295	295	1
TOP : 295	295	1

(INITIAL TEMPERATURE CAN BE GREATER THAN FINAL TEMPERATURE)

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

TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 8

Time	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712	
14284	0	4	4	87	10	0	0	0	1	77	11	38	31	295
19430	0	4	4	84	13	0	0	0	1	67	11	40	31	295
24605	0	4	4	84	12	0	0	0	1	67	9	34	29	295
29765	0	3	3	85	12	0	0	0	1	68	9	34	28	295
34926	0	3	3	85	11	0	0	0	1	67	7	25	25	296
40072	0	3	3	85	11	0	0	0	2	67	9	32	27	297
45905	0	6	6	79	15	0	0	0	2	65	13	48	42	301
51049	0	6	6	79	15	0	0	0	2	64	13	47	43	300
56225	0	7	7	77	16	0	0	0	2	66	12	46	41	300
61384	0	7	7	76	17	0	0	0	2	66	13	49	43	300
66546	0	6	6	79	15	0	0	0	2	64	13	48	42	300
71690	0	6	6	79	15	0	0	0	3	70	6	23	28	301
77524	17	20	37	47	16	0	0	0	3	54	18	49	100	305
82695	20	23	43	47	10	0	0	0	3	60	19	41	100	305
87843	20	23	43	47	10	0	0	0	3	60	19	42	100	305
AVERAGES AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7	MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712		
AVG 295	0	4	4	85	12	0	0	0	1	69	9	34	28	295
STD	0	0	0	1	1	0	0	0	0	4	1	5	2	
AVG 300	0	6	6	78	15	0	0	0	2	66	12	44	40	300
STD	0	0	0	1	1	0	0	0	0	2	2	9	5	
AVG 305	19	22	41	47	12	0	0	0	3	58	18	44	100	305
STD	1	2	3	0	3	0	0	0	0	3	0	4	0	

RUN 1206606
CAT PP2526

RUN 1206606

CAT PP2526

RUN 1206606
CAT PP2526

RUN 1206606

CAT PP2526

HOOD #7 RAMPING EXPERIMENT DEFINITION

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OPERATOR NAME: B. CRUM DATE: 29-SEP-94
 LOG BOOK #: 12066 PAGE #: 20
 RUN #: 1206607 CATALYST #: pp2524
 CATALYST NAME: GROUND & SIEVED PP2524
 COMMENTS: NORMAL PRETREATMENT

MASS OF CATALYST (g): 4.40
 REACTOR INSIDE DIAM (CM): 0.45
 CATALYST BED HEIGHT (CM): 30.5

TEMPERATURE RAMPING EXPERIMENT FOR HOOD #7

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INITIAL TEMP (DEG C)	FINAL TEMP (DEG C)	ABSOLUTE RAMP RATE (DEG C / MIN)
BOTTOM: 295	300	1
MIDDLE: 295	300	1
TOP : 295	300	1

=====

(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	TIME TO MAINTAIN FINAL TEMPERATURES (HOURS): 8								MBC7	Q7CH4C	Q7HCLC	Q7O2C	TQI712	
	AI7CO	AI7CO2	AI7COX	AI7M1	AI7M2	AI7M3	AI7M4	ID7						
19690	0	32	32	62	6	0	0	0	1	77	17	42	57	295
24920	23	30	52	41	7	0	0	0	1	63	22	40	100	295
30142	21	28	49	44	7	0	0	0	1	63	22	43	100	295
35361	21	29	50	43	7	0	0	0	1	64	22	41	100	295
40590	0	36	36	54	10	0	0	0	1	70	22	55	100	295
45801	0	36	36	55	9	0	0	0	2	70	22	55	100	297
51743	0	35	35	56	9	0	0	0	2	70	23	58	100	300
56960	0	35	35	56	9	0	0	0	2	165	94	237	100	300
62169	0	35	35	56	9	0	0	0	2	165	94	231	100	300
67390	0	35	35	56	9	0	0	0	2	165	93	238	100	300
72622	0	35	35	56	9	0	0	0	2	165	94	236	100	301

*** DATA FROM THIS RUN SHOULD BE USED WITH CAUTION. THE COX NUMBERS ARE NOT CORRECT. MS COLUMN WILL BE REPLACED AFTER THIS RUN

RUN 1206607

CAT PP2524