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THE TEXAS COMPANY

REFINING DEPARTMENT
TECHNICAL & RESEARCH DIVISION



REPORT ON
RUNS 46, 47 AND 48
MONTEBELLO REACTOR NO. 3

PERSONAL AND
CONFIDENTIAL

Laboratory MONTEBELLO
Report No. TDC-802-33-P
Date AUGUST 17, 1950

BRIEF OF PARTIAL REPORT

Laboratory Montebello
Date Approved August 17, 1950
Work Completed June 20, 1949

Experiment No. TDC-802
Partial Report No. 33
Subject: Hydrocarbon
Synthesis

Subject: Runs 46, 47, and 48 - Montebello Reactor No. 3.

Object: To obtain yield data from the operation of Montebello Reactor No. 3 under conditions comparable to those planned for the Carthage Hydrocol synthesis unit at Brownsville, Texas.

History: Previous work with the Montebello Reactor No. 3 was done at 300 psig pressure using catalyst derived from mill scale.

Experimental Results: Changes in the generator and synthesis system were made to allow synthesis operation at 400 psig in order to conform with Brownsville design conditions. The work reported herein was conducted with promoted Brownsville magnetite catalyst at 650°F., 400 psig, and 1:1 recycle ratio. A combined-feed inlet linear velocity of one-foot-per-second was maintained in the reactor.

Conclusions:

1. When the Montebello Reactor No. 3 was operated with a 10 to 12-foot bed of magnetite catalyst under flow conditions comparable to Brownsville design, the yield of C₃ and heavier hydrocarbons was only about 75 per cent of that expected at Brownsville which will operate at a bed height of approximately 20 feet.
2. The C₃₊ yield increased with bed height.
3. It was not possible to operate the Montebello Reactor satisfactorily with extremely finely-ground magnetite catalyst (98.8 per cent through 325-mesh).

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HYDROCARBON SYNTHESIS

PARTIAL REPORT NO. 33

Montebello Laboratory
Work Completed June 20, 1949

Experiment No. TDC-802
Report Approved August 17, 1950

RUNS 46, 47, AND 48
MONTEBELLO REACTOR NO. 3

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HYDROCARBON SYNTHESIS

PARTIAL REPORT NO. 33

Montebello Laboratory

Work Completed June 20, 1949

Experiment No. TDC-802

Report Approved August 17, 1950

RUNS 46, 47, AND 48
MONTEBELLO REACTOR NO. 3

I. INTRODUCTION

A. Object

The object of the work described in this report was to obtain yield data from the operation of Montebello Reactor No. 3 under conditions comparable to those planned for the Carthage Hydrocol synthesis unit at Brownsville, Texas.

B. History

Previous synthesis runs on the Montebello Reactor No. 3 had been made at 300 psi pressure with catalyst derived from mill scale. Since the composition of this material was subject to variation from one mill to another and from time to time at the same mill, it was decided to consider magnetite as a catalyst source. Magnetite is an iron ore found in relatively large homogeneous deposits in this country, thus assuring a possible source of catalyst of constant quality.

At the conclusion of Run 45 the necessary changes in equipment were made to allow for synthesis operation at 400 psig in order to conform with the operating conditions planned for Brownsville.

C. Scope

This report discusses the operating and analytical data obtained from the 400 psig operation of the Montebello Reactor No. 3 using Alan Wood magnetite catalyst promoted with 0.6 parts

by weight of K₂O per 100 parts of iron. The approximate synthesis operating conditions were: 16,000 SCFH fresh feed, 1:1 recycle ratio, 1-foot per-second superficial gas-velocity in the reactor, at 400 psig and 650°F. catalyst bed temperature.

The work was conducted during the period March 20, 1949 through June 20, 1949.

II. EXPERIMENTAL WORK

A. Equipment and Method of Operation

1. Synthesis Gas Generation

The synthesis gas mixture of carbon monoxide and hydrogen was the product of the uncatalyzed reaction between natural gas and oxygen at 425 psig and at temperatures in the 2300°F. range. The natural gas contained approximately 85 per cent methane, 2.0 per cent CO₂, 9.0 per cent ethane, 3.5 per cent propane, and small amounts of butane and nitrogen. The generator product gas was composed of hydrogen and carbon monoxide in the ratio of 1.5-1.7:1 and normally contained less than 2.5 per cent unconverted methane, 3 per cent carbon dioxide, and less than one per cent nitrogen.

During Run 48 before the synthesis gas entered the reactor, it was scrubbed and cooled by passing through a water-wash tower. This tower contained an 18" by 25' bed of one-inch, carbon raschig rings kept moist by a cold water spray. The temperature of the effluent gas was approximately 70°F., and the water content corresponded to saturation at 70°F. instead of saturation at 140-150°F. as had existed before the scrubbing tower was used.

The generator system has been described in detail in previous reports¹ and since it serves only as a utility unit for the reactor, no further details are included in the present report.²

2. Catalyst Pretreatment and Reduction

The base material for the catalyst was Alan Wood run-of-the-mine magnetite concentrate, on which a sieve analysis showed the following results:

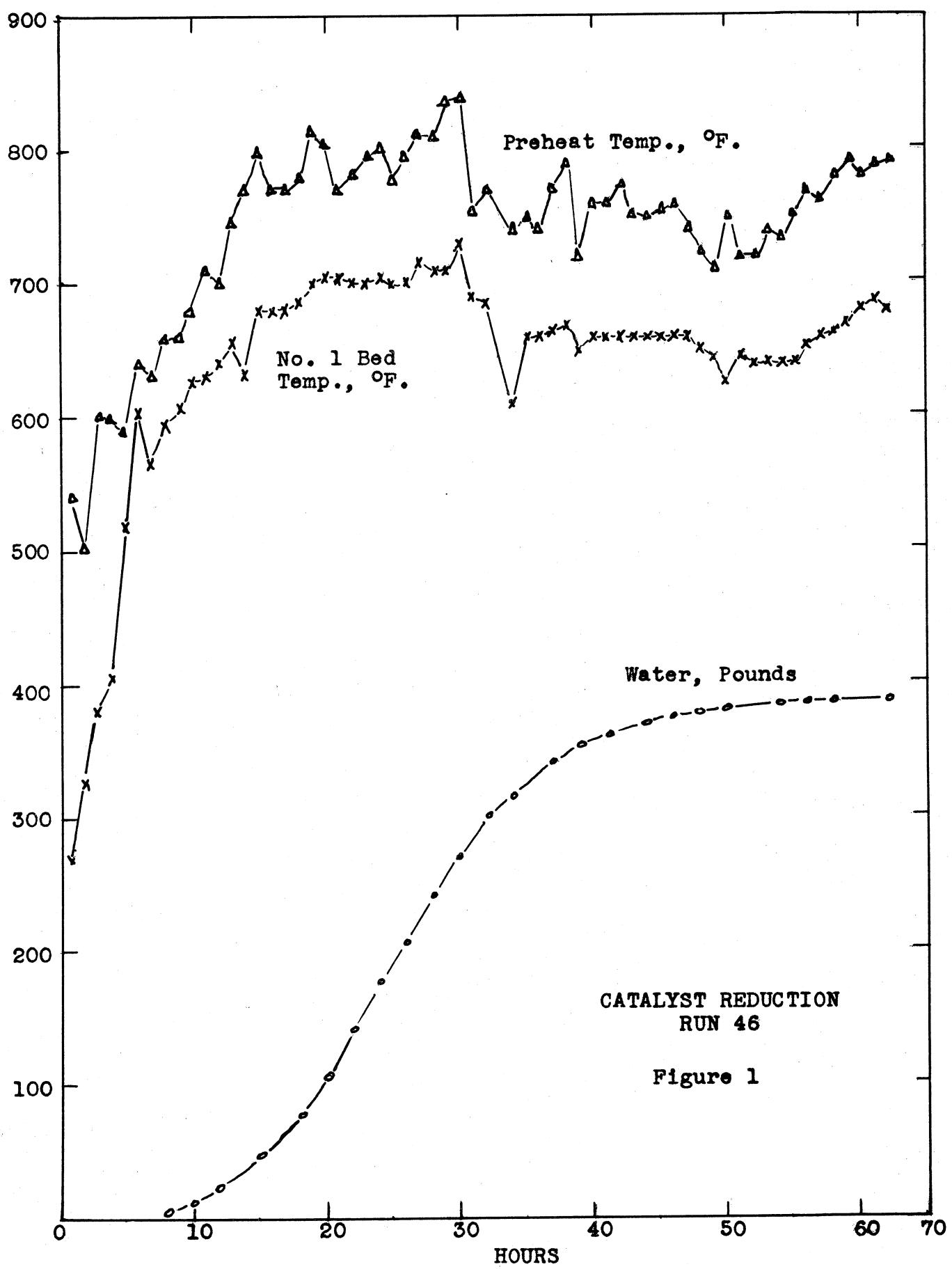
A.S.T.M. NO.	WEIGHT PER CENT
On 40	26.3
100	46.0
140	8.3
200	7.3
230	2.6
325	0.8
Thru 325	8.7

This material was used as received for Runs 46 and 48, but for Run 47 it was ground by Twining Laboratories of Fresno, California, so that 98.8 per cent passed through a No. 325 ASTM sieve. For all three runs the magnetite was impregnated with K₂CO₃ to give 0.6 part of K₂O per 100 parts of Fe. The impregnation was carried out in the normal manner as described in previous reports.³ The original charges of catalyst to the reactor amounted to approximately 1800 pounds of unreduced magnetite which was reduced in situ by circulating hot hydrogen through the catalyst bed at approximately 1 foot-per-second velocity, 640-710°F. bed temperature, and 200 psig pressure. During reduction the steam cooling tubes were dry. The operating procedure was almost identical to that used when reducing catalyst in the special reducer.

¹Partial Report Nos. 5, 10, and 13, Experiment No. TDC-802.

²Data on synthesis gas generations appear in the Appendix.

³Partial Report Nos. 31 and 32, Experiment No. TDC-802.



All make-up catalyst used during the runs was prepared in the usual manner in the reducer which has been described in detail in previous reports.

To illustrate a typical reduction in the reactor, a graphical presentation of the data from Run 46 is shown in Figure 1, facing. Over a period of 62 hours, a total of 388 pounds of water was obtained from an initial charge of 1800 pounds of magnetite. The maximum water rate was 16.7 pounds per hour.

When the reduction in the reactor was complete, the circulation of hot hydrogen was continued while water was put into the cooling tubes and the pressure in the steam system was raised to about 500 psig. Synthesis gas was then introduced after which the pressure in the entire reactor system was raised to 400 psig within three hours.

3. Synthesis System

a. Description of Synthesis Reactor

The reactor used in Run 46 was the same 19 ft. by 12-inch vessel that was used in Runs 44 and 45², except that suitable changes in materials and fittings were made to allow for safe and trouble-free 400 psig operation.³

For Runs 47 and 48, a catalyst return line was installed between the bottom of the first cyclone separator and the lower part of the reactor. This line was made of 2-inch pipe and entered the reactor at a point 2 feet above the bottom steam header. The only obstruction in the line was a 2-inch cock which remained in an open position during normal operation, the theory being that the head of catalyst in the cyclone and return line would be

¹Partial Report Nos. 31 and 32, Experiment No. TDC-802.
²Partial Report No. 32, Experiment No. TDC-802.
³A more complete discussion of equipment may be found on pp. 63 through 71, Appendix.

greater than in the reactor and would create a constant return of catalyst fines to the bottom of the reactor. A pressure connection was installed below the cock in the return line so that in case of a minor obstruction in the line, the cock could be closed and recycle-gas pressure or nitrogen-cylinder pressure could be utilized to clear the line.

All of the other operations remained the same as in Runs 44 and 45.

b. Methods of Sampling and Analysis

Gas samples were taken every four hours in dry aluminum bombs, but normally only every other sample was analyzed and a 24-hour average made of these three analyses.

The liquid product samples were drawn directly from the product separator into glass bottles at 12-hour intervals.

The catalyst samples were obtained through a one-inch line located two feet from the bottom of the catalyst bed. The sample was blown directly into 5-gallon buckets containing about two pounds of "dry ice" and was immediately transferred to glass jars containing small pieces of "dry ice". Since the magnetite was not very pyrophoric except when freshly reduced, it was not deemed necessary to use sealed bombs to obtain the samples.

All gas analyses, including those for carbon dioxide, were made with a Consolidated Engineering Corporation mass spectrometer. Orsat analyses using the explosion technique were made periodically of the synthesis gas from the generator but these were only for control purposes.

Except as stated otherwise below, the tests made on

catalyst and product were by methods found in either The Texas Company Standard Methods of Test Book or Special Methods of Test Book. The specific surface of the catalyst was determined by ammonia adsorption. This method was devised and calibrated using F.C.C.U. cracking catalyst and does not give absolute values for specific surface of iron catalyst. It may, however, give an indication of the change in specific surface of iron catalysts.

The specific gravity of the catalyst was determined by the displacement of carbon tetrachloride in a picnometer.

The water-soluble chemicals content of the water was determined by salting out with potassium carbonate at 40-50°F.¹. These chemicals were predominantly alcohols since the test does not indicate the light organic acids content.

c. Methods of Calculation

The data used in this report were obtained by forcing the weight balances on the assumption that any losses were in wet gas flow measurements. Overall weight balances varied between 90 and 99 per cent. The yields of separated oil and water were based on actually measured quantities. The term "C₃ plus" has been used in this report as in the past to denote all hydrocarbons having three or more carbon atoms to the molecule, plus the water-soluble chemicals as determined by the salting out test mentioned above.

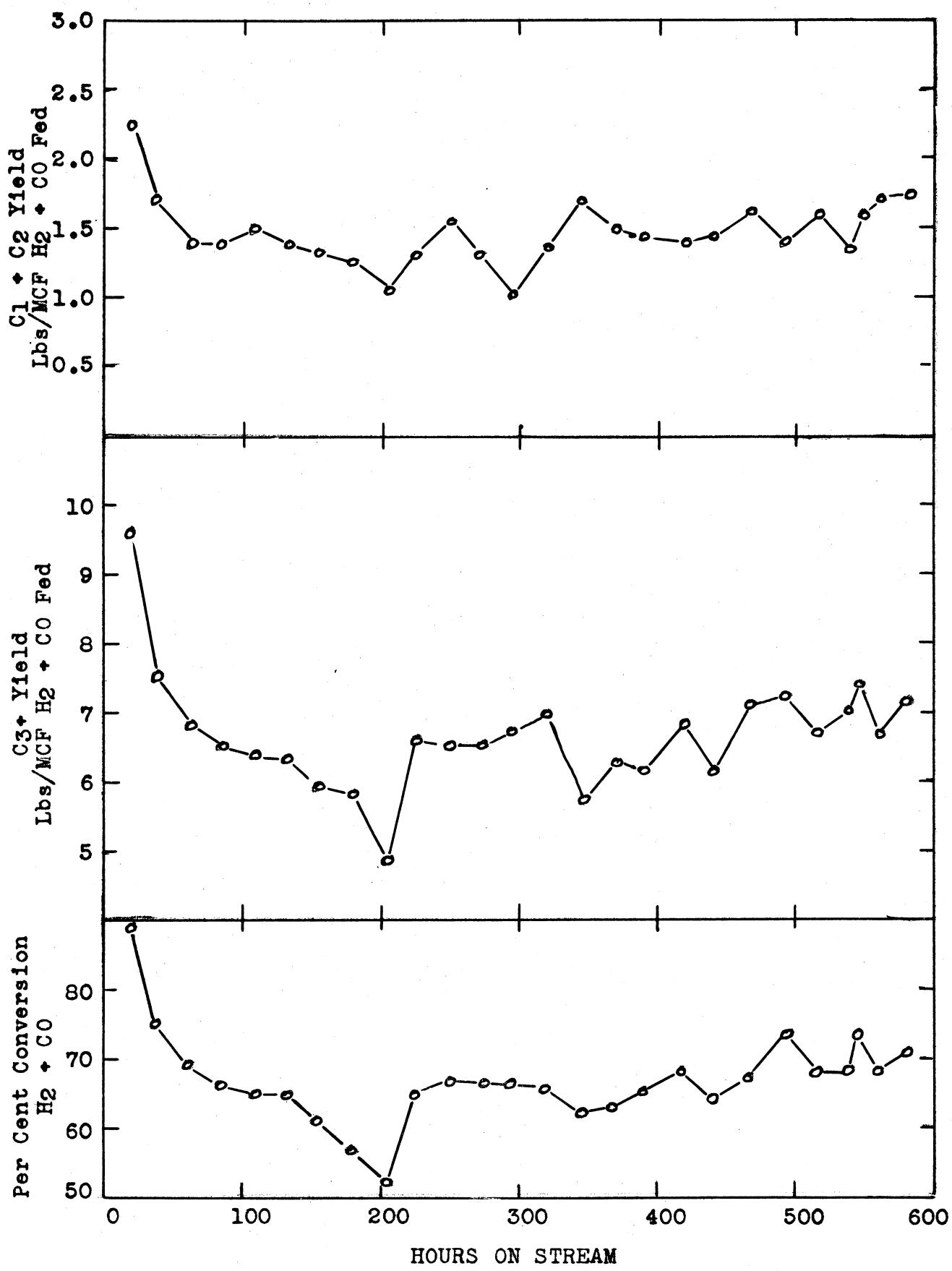
B. Experimental Results

1. Run 46

Except that the initial charge of catalyst was reduced in the reactor, the operating technique was the same as in Run 45.²

¹This method is not in The Texas Company Standard Method of Test Book or Special Method of Test Book, but is discussed fully in Partial Report No. TDC-101-33.

²Partial Report No. 32, Experiment No. TDC-802.



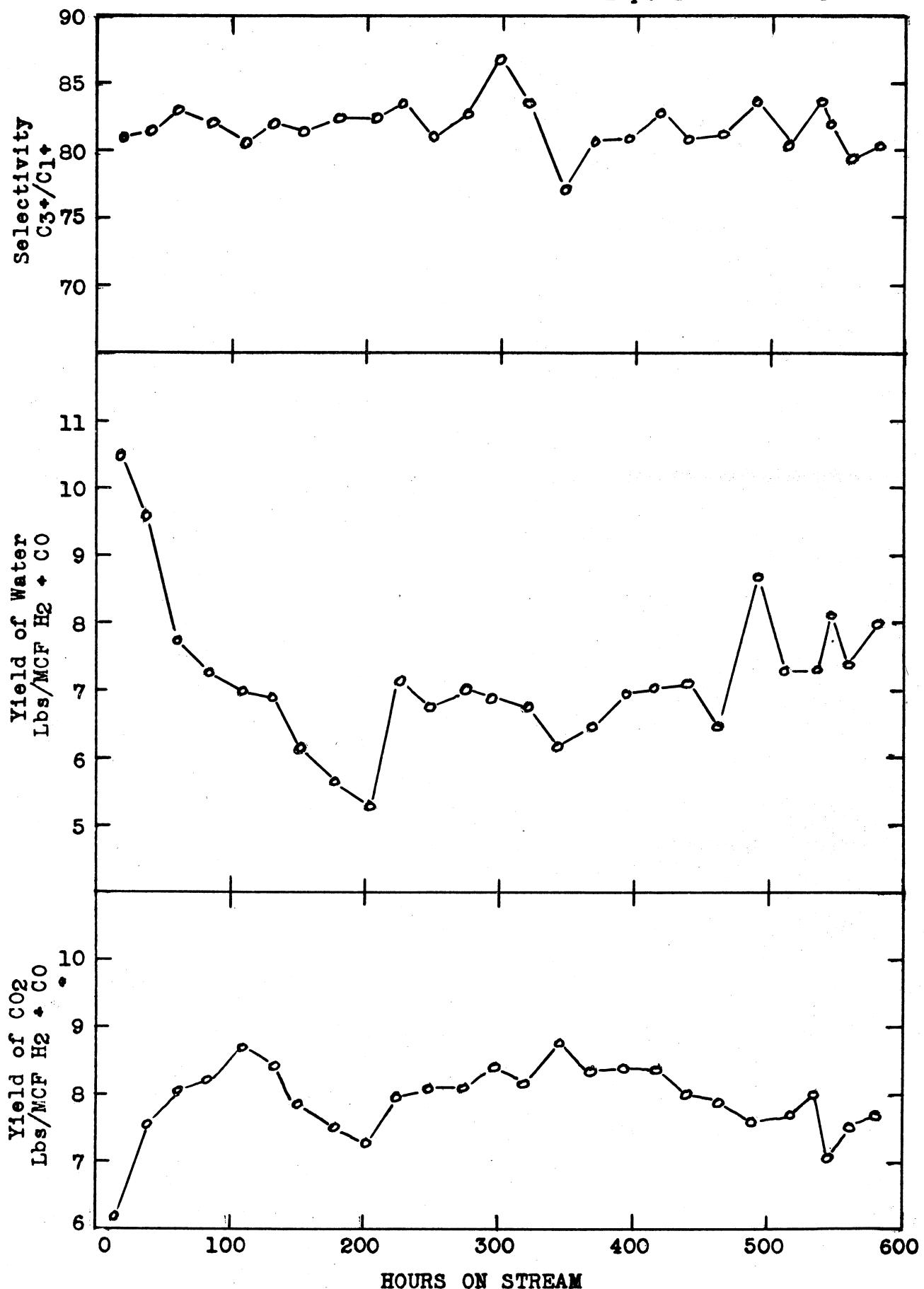
CONVERSION AND HYDROCARBON YIELDS
RUN 46

Figure 2

For the first 19 hours of operation, the fresh feed rate was only 10,254 SCFH, because of the limitation of the orifice in the meter run. After the orifice plate had been changed, the fresh feed rate was raised to 16,000 to 17,000 SCFH for the remainder of the run. There was no addition of catalyst during the first 206 hours of operation, during which time the conversion of $H_2 + CO$ declined from an initial 88.8 per cent to 51.7 per cent. The yield of C_3^+ followed a similar pattern, going from 9.6 lbs/MCF $H_2 + CO$ to 4.9 lbs/MCF.

The decision was then made to load fresh catalyst in an effort to increase the conversion rate. Addition of 257 pounds of reduced catalyst brought the conversion of $H_2 + CO$ up to 65 per cent and increased the C_3^+ yield to 6.5 lbs/MCF. A 50 pound-per-day addition rate for the next 164 hours maintained the conversion and C_3^+ yield almost at these levels. Beginning with Period 46-Q (390 hours) the addition rate was raised to about 160 pounds a day average and was held there until the end of the run. This caused the C_3^+ yield and conversion to increase slowly to 7.0 lbs/MCF and 70 per cent respectively.

The conversion of $H_2 + CO$ and the yields of hydrocarbons are shown chronologically in Figure 2, facing. The selectivity and yields of carbon dioxide and water are shown in Figure 3, following. Usually the CO_2 yield varied inversely with the water yield except during a short general decline in all yields just prior to the time when the addition of catalyst was initiated. The water yield was consistently of the same magnitude as the C_3^+ yield. The selectivity (yield of C_3^+ /yield of C_1^+) did not vary much and usually was between 80 to 85 per cent.



SELECTIVITY AND YIELDS OF CARBON DIOXIDE AND WATER

Figure 3

A bad leak in the high pressure steam system and mechanical failure of the recycle compressor terminated Run 46 after 580 hours on stream.

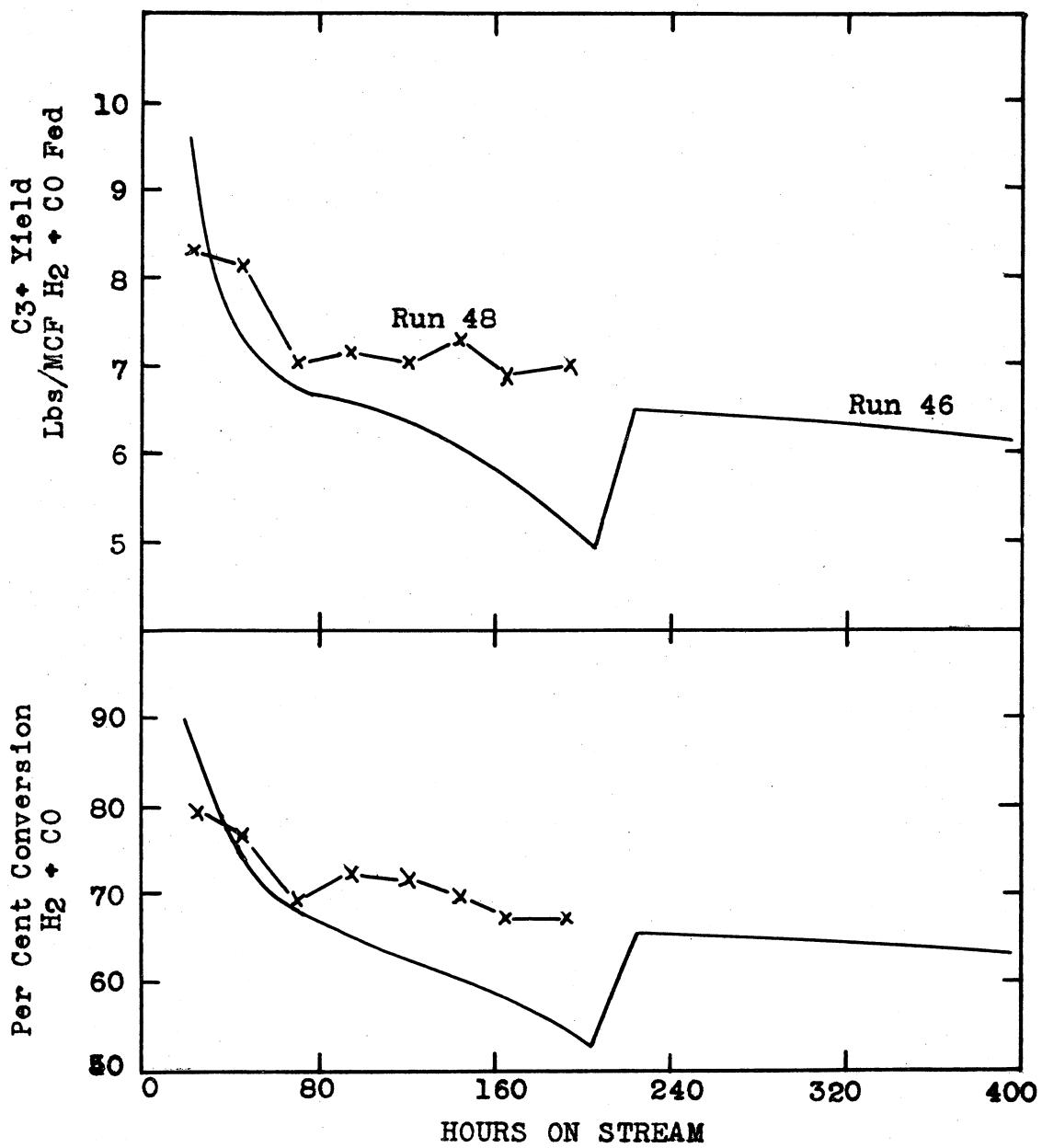
2. Run 47

Run 47 was an attempt to operate the Montebello Reactor with finely ground magnetite to determine whether a catalyst of smaller particle size would effect better conversion. It was intended that the magnetite be ground so that it would be predominantly in the 100-325 mesh size range, but the type of grinding facilities available resulted in a grind of 98.8 per cent through a 325-mesh sieve. The run lasted only 14 hectic hours and was shut down because of plugs in the cyclones, catalyst loader, and product condenser. It was impossible to control the bed temperatures and operation, and no significant data were obtained.

3. Run 48

It was suspected that there might have been a trace amount of some unidentified catalyst poison in the fresh feed because Runs 42, 45, and 46 all showed declines in yield down to similar levels even though different catalysts, flow conditions, and reactors were involved. For this reason a water-wash scrubbing tower was installed to determine whether or not the suspected poison could be scrubbed by this means. The Brownsville system similarly includes a water scrubbing of the generator product gas.

A catalyst return line from the first cyclone was installed with the idea that this might make possible operation with a higher bed height. Previously the highest bed height which could be maintained was of the order of 11 to 12 feet in the 19-foot reactor indicating that a disengaging space of at least 7 feet



CONVERSION AND HYDROCARBON YIELDS
RUN 48

Figure 4

above the dense phase level was necessary.

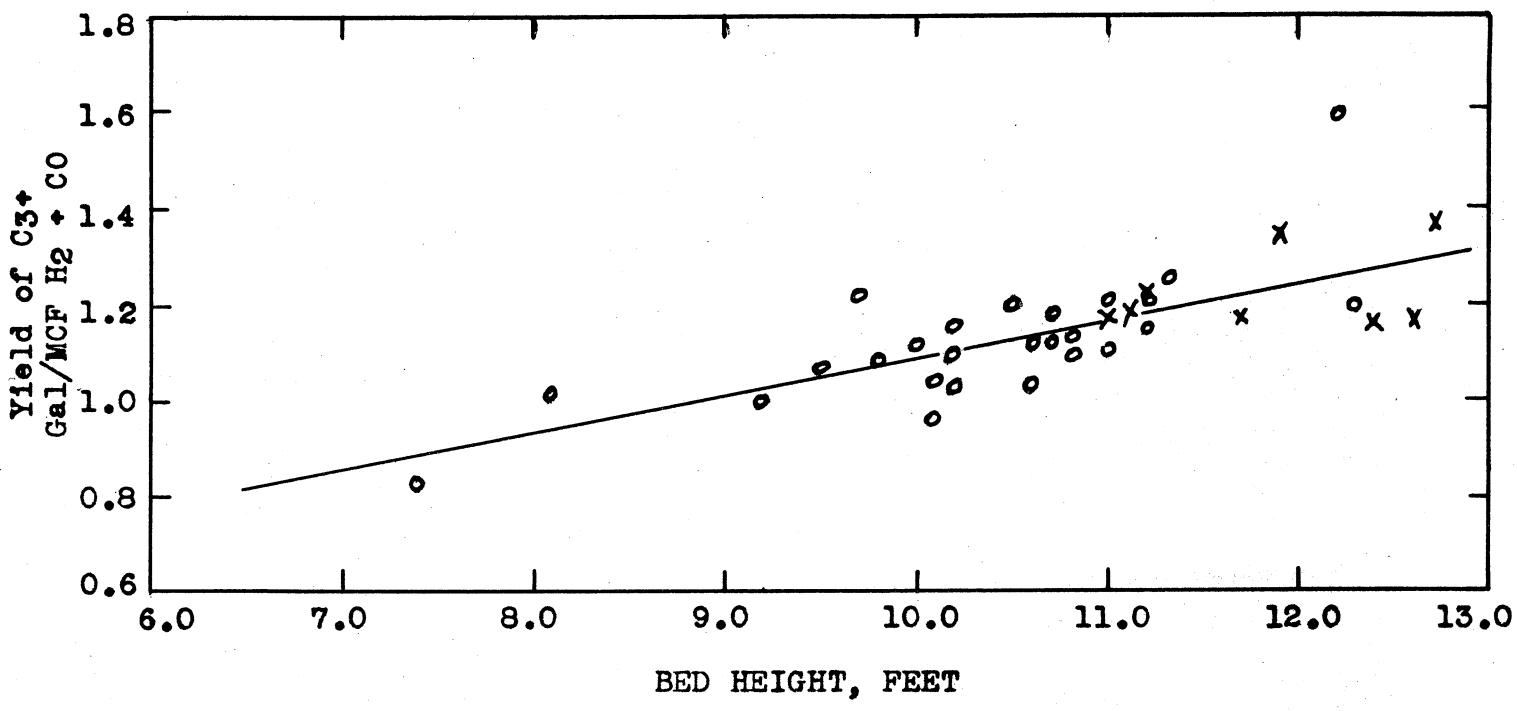
Despite these changes, Run 48 appeared to be only a confirmation of Run 46. The flow rates were approximately the same, but the catalyst make-up was started sooner. After 70 hours, freshly reduced catalyst was loaded at an average rate of 58 lbs/day for the remaining 120 hours. The catalyst return system operated for only the first 58 hours at most and may have become plugged sooner than was realized.

Another leak in the high pressure steam system caused the shut-down of the reactor after 190 hours. The run was not continued after the repairs were made since it was apparently only duplicating Run No. 46.

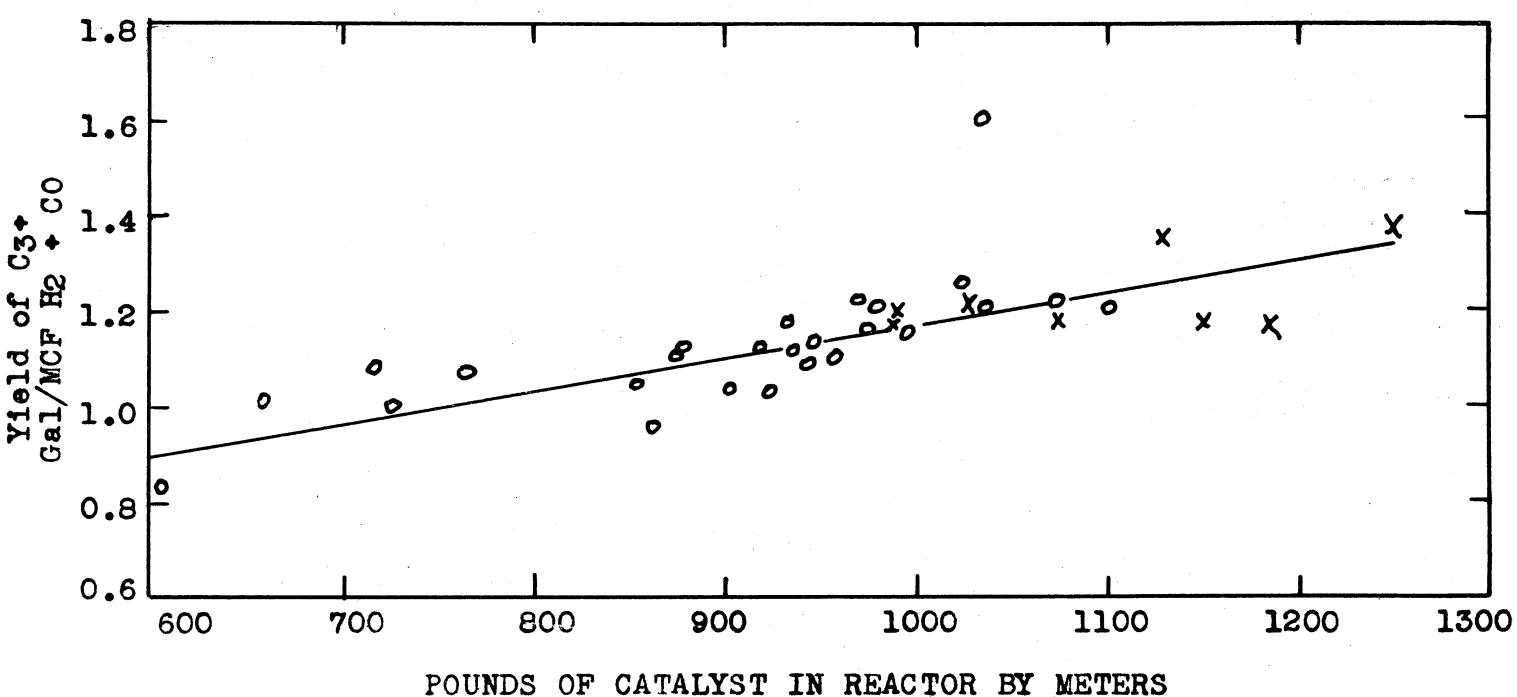
The conversion and C₃* yield data for Run 48 are shown in Figure 4, facing. The corresponding data from Run 46 are also shown for comparison. It may be recalled that during the first portion of Run 46 no catalyst was added to the reactor whereas in Run 48 an addition rate of 58 lbs/day was used. Examination of the curves for conversion and C₃* production shows that the data from Run 48 fall along a line that would probably represent data obtained from Run 46 had the bed level been maintained by catalyst addition from the start. It can be seen that extrapolation of the Run 48 curves would make them coincide with the Run 46 curves for the periods during which catalyst was added.

4. Effect of Bed Height and Catalyst Inventory on Yield of C₃*

The yield of C₃* has been plotted against catalyst bed height and weight of catalyst in the reactor as shown in Figure 5, following. There was an increase in C₃* yield with both bed

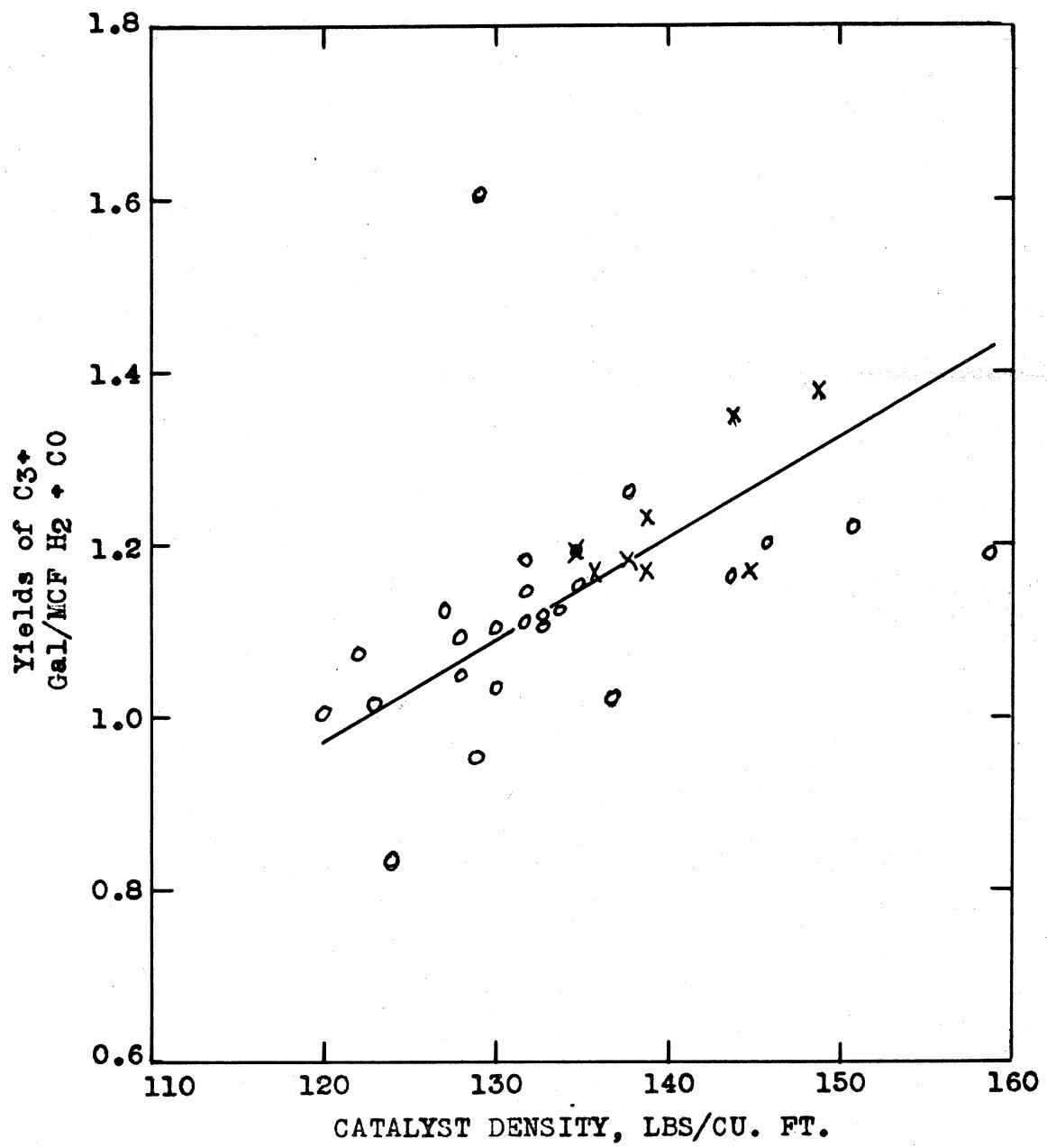


O Run 46
X Run 48



EFFECT OF CATALYST BED HEIGHT
AND INVENTORY ON YIELD OF C₃₊

Figure 5



VARIATION OF CATALYST DENSITY WITH
YIELD OF C₃+

Figure 6

height and catalyst inventory. This was to be expected because the bed height was dependent on catalyst inventory, but it was observed that the bed height affected the yield more than did the inventory. The first supposition was that the real factor was only the bed height but this was made doubtful when the yield of C₃₊ was plotted against catalyst density as shown in Figure 6, facing. These data indicate that an increase in catalyst density of 10 lbs/cu. ft. was accompanied by about the same increase of C₃₊ yield as when the bed height was raised a foot. It is possible that the variation of the catalyst density was a resultant factor rather than a causative one with the C₃₊ yield.

5. Comparison of Yields on Straight-Run and Polymer Bases

The ultimate yield of marketable product has been calculated on the assumption that in a commercial plant the propylene (4.32 pounds per gallon) will be polymerized to a product of 6.25 pounds per gallon with 90 per cent recovery. It is likewise expected to polymerize the butylenes (5.00 pounds per gallon) to a product of 6.10 pounds per gallon with 95 per cent recovery. The propane has not been included in the calculation of the ultimate yield. Water soluble chemicals have been considered in both cases as marketable product.

The yields on both straight-run and polymer bases are compared in Table I, page 17. The data have been averaged for those periods during which the catalyst make-up rates were similar. The yield on the polymer basis varied between 87.4 and 89.7 per cent of the straight-run yield of C₃₊, this percentage being higher when the yields in general were higher.

COMPARISON OF YIELDS ON STRAIGHT-RUN AND POLYMER BASES

TABLE I

Run No.	Catalyst Make-up Rate lbs./day	C ₃₊ Yield Straight-Run gal./MCF H ₂ +CO	Ultimate Yield Polymer basis gal./MCF H ₂ +CO	Polymer/ Straight-Run Per Cent
46A-I	0	1.125	0.983	87.4
46J-P	50	1.090	0.953	87.4
46Q-Y	160	1.142	1.018	89.1
48A-H	58	1.232	1.105	89.7

6. Product Quality

Distillations of the recovered oil indicated that it was usually 70 per cent in the gasoline boiling range and 15 per cent in the gas-oil range with 15 per cent residue. The acid content of both water-soluble and oil-soluble product was high as was reflected by neutralization numbers normally in the range of 40 to 50. The saponification numbers of the oil were only about 4 to 5 points higher than the neutralization numbers. Bromine numbers in the range of 80 to 90 gave evidence that the recovered oil was highly unsaturated.

The water-soluble chemicals, as determined by salting out with K₂CO₃, almost always constituted 10 per cent of the total water product.

7. Comparison of Yields of Montebello Reactor with Brownsville Design

Brownsville Case VI design is based on a C₃₊ yield of 1.6 gals/MCF H₂ + CO. With comparable flow conditions, the yield of C₃₊ from the Montebello Reactor was about 1.2 gals/MCF H₂ + CO with a 10 to 12-foot bed height. This was only 75 per cent of Brownsville design. The Brownsville reactor is considered capable of operating with a catalyst bed height of about 20 feet, and this higher bed height may make it possible to obtain a better yield of C₃₊ than 1.2 gals/MCF H₂ + CO.

8. Properties of Used Catalyst

Analytical facilities at Montebello are not adequate for making extensive tests on the synthesis catalyst. Routine tests are made to obtain particle-size distribution, bulk density, specific gravity, and ammonia adsorption number.

Spot samples of catalyst from Run 46 were sent to Beacon Laboratory for more complete analyses, such as distribution of iron compounds by x-ray diffraction, specific surface by nitrogen adsorption, and elemental analysis. A summary of the analyses of the catalyst is shown in Table II, following.

The distribution of the iron was consistently about 30 per cent carbide, 60 per cent oxide, and 10 per cent or less metallic iron. It is interesting to note that a sample of magnetite catalyst used at Beacon under Montebello conditions showed an iron distribution of 60 per cent carbide, no oxide, and 40 per cent metallic iron.

Carbon deposition on the Alan Wood magnetite has not presented any problem when used in the Montebello Reactor. As shown in Table II, the maximum total carbon content of the used catalyst was less than 10 per cent by weight.

The impregnation of the raw catalyst was made to give 0.6 parts K₂O per 100 parts by weight of Fe and chemical analysis showed that the reduced catalyst contained 0.66 parts K₂O. The K₂O content dropped abruptly, however, after synthesis gas had been introduced, and remained at about 0.3 parts per 100 of Fe for the remainder of the run. It is hard to believe that the K₂O was stripped off mechanically with the catalyst fines after
Run 28-SF-11026 reported in Partial Report TDC-101-56.

TABLE II
ANALYSES OF CATALYST

RUN NO.	X-Ray Analyses Weight Per Cent			Specific Surface by N ₂ -M ² /g.	NH ₃ Adsorption No.	Chemical Analyses Weight Per Cent				K _{2O} /100 Fe
	Fe ₂ O ₃ g	Fe ₃ O _x	Fe			K _{2O}	Fe	C	H	
46 Reduced			100 ¹	3.7		0.56	84.7			0.66
46-A	30	60	10	1	1.6	0.25	66.9	3.6	0.20	0.37
46-C					6.8			4.7	0.31	
46-E					8.0			8.63	0.45	
46-G					6.7			8.63	0.38	
46-I	30	65	5	1	5.4	0.12	65.6	9.7	0.63	0.18
46-K					6.4			6.65	0.37	
46-M					8.4			7.87	0.32	
46-N	30	60	10	1	9.4	0.20	68.9	6.45	0.22	0.29
46-P	40	55	5	2.7	9.4	0.17	63.7	7.7	0.36	0.26
46-T	30	60	10	1		0.23	71.3	6.18	0.26	0.32
46-Y	30	65	5	1	8.6	0.24	68.1	7.38	0.25	0.35

¹Chemical Analysis showed 73.5% metallic iron

synthesis gas was introduced when it was not removed by the same process when the catalyst was being reduced. A sizable proportion of the catalyst fines were removed during reduction but this did not affect the K₂O content. This indicates that the K₂O is removed by some mechanism related to the synthesis reaction; perhaps by formation of potassium iron acetate.

III. CONCLUSIONS

1. When the Montebello Reactor No. 3 was operated with a 10 to 12-foot bed of magnetite catalyst under flow conditions comparable to Brownsville design, the yield of C₃ and heavier hydrocarbons was only about 75 per cent of that expected at Brownsville which will operate at a bed height of approximately 20 feet.
2. The C₃₊ yield increased with bed height.
3. It was not possible to operate the Montebello Reactor satisfactorily with extremely finely-ground magnetite catalyst (98.8 per cent through 325-mesh).

IV. RECOMMENDATIONS

There are no recommendations to be made at this time.

V. FUTURE WORK

It is planned to investigate further the effect of bed depth on yields of salable products. For this work the height of the reactor has been extended approximately 10 feet. Work is also planned with an intermediate grind of catalyst.

REPORT PREPARED BY W.L. Hater

APPROVED BY Dr. BoisEastman/RAB

WLS:HV

WEK-LCKJr-CEL-WJC-dBE
WMS-RFB-KGM-JMB

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WEK-LCKJr-CEL-WJC-dBE

WMS-RFB-KGM-JMB

VI. APPENDIX

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A. SUMMARIES OF RUNS 46 AND 48

SUMMARY OF SYNTHESIS RUN NO. 46

Period	A	B	C	D	E	F	G	H	I	J	K	L	M
Hours	0-19	19-38	38-62	62-84	84-108	108-132	132-156	156-180	180-204	204-225	225-249	249-273	273-297
Press., Psig	430	413	423	419	422	422	425	430	433	431	430	431	430
Temp. °F.	628	638	648	652	648	648	644	646	641	649	642	646	647
Flow Rates-SCFH													
Fresh Feed	10254	15937	15896	16135	16566	16380	16874	16638	16521	16861	16721	16969	17077
Recycle	16866	20022	20464	18894	18238	17986	18019	18505	18728	17847	16778	17730	17713
Wet Gas (Adj.)	2873	6066	7015	7680	8168	7937	8817	9308	9892	8330	7981	8098	8121
Catalyst Data (by Δp)													
Weight, lbs.	1034	1026	973	875	718	764	727	657	607	937	944	929	944
Vol.-Cu. Ft.	8.1	7.5	6.7	6.7	6.5	6.3	6.1	5.3	4.9	7.0	7.1	7.1	7.1
Depth.-Ft.	12.2	11.3	10.2	10.2	9.8	9.5	9.2	8.1	7.4	10.6	10.8	10.7	10.8
Feed Rates-H ₂ +CO													
SCFH	9860	15333	15384	15635	16048	15820	16216	15990	15700	16023	15885	16235	16300
SCFH/Sq.Ft.	14939	23232	23309	23689	24315	23997	24570	24227	23788	24277	24068	24598	24697
SCFH/CF Cat.	2217	2044	2296	2334	2469	2514	2658	3017	304	2289	2237	2287	2296
SCFH/# Cat.	9.54	14.94	15.81	17.87	19.59	20.73	22.31	24.34	25.86	17.10	16.83	17.48	17.27
Recycle Ratio	1.64	1.26	1.29	1.17	1.10	1.10	1.07	1.11	1.13	1.06	1.00	1.04	1.04
Inlet Vel.Ft/Sec.	0.82	1.08	1.09	1.05	1.05	1.03	1.05	1.06	1.06	1.04	1.01	1.04	1.05
Ratio of H ₂ /CO in													
Fresh Feed	1.61	1.57	1.63	1.58	1.65	1.62	1.68	1.69	1.73	1.63	1.64	1.67	1.68
Combined Feed	1.72	1.87	2.03	1.98	2.10	1.98	2.01	2.06	2.05	2.05	1.96	2.03	2.11
Wet Gas	1.87	2.33	2.64	2.66	2.95	2.57	2.55	2.60	2.49	2.84	2.55	2.69	2.96
Consumed	1.59	1.39	1.33	1.21	1.24	1.29	1.31	1.25	1.27	1.25	1.35	1.33	1.30
Yields/MCF of													
CO+H ₂ Fed	lbs.	gal.	lbs.	gal.	lbs.	gal.	lbs.	gal.	lbs.	gal.	lbs.	gal.	lbs.
C ₃	1.21	0.91	1.10	0.99	1.05	0.90	0.88	1.10	0.67	0.92	0.85	1.10	1.10
C ₄	0.97	0.98	0.79	0.80	0.80	0.83	0.77	0.79	0.61	0.86	0.85	0.87	0.81
C ₅	0.34	0.11	0.29	0.29	0.29	0.33	0.31	0.36	0.27	0.37	0.42	0.37	0.37
C ₆	0.06	0.09	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.11	0.10	0.10	0.08
C ₃ - C ₆	2.58	0.55	2.39	0.50	2.23	0.48	2.14	0.45	2.21	0.47	2.14	0.45	2.34
400 EP	3.89	0.62	2.75	0.11	2.36	0.38	2.43	0.39	2.26	0.36	2.32	0.37	1.69
C ₃ - 400 EP	6.47	1.17	5.14	0.94	4.59	0.86	4.57	0.84	4.47	0.83	4.46	0.82	4.05
400+	2.45	0.35	1.54	0.22	1.35	0.20	1.17	0.16	1.10	0.16	1.09	0.16	1.06
WS Chem	0.67	0.08	0.83	0.10	0.86	0.10	0.79	0.10	0.78	0.09	0.77	0.09	0.76
Total C ₃ +	9.59	1.60	7.51	1.26	6.80	1.16	6.53	1.10	6.35	1.08	6.32	1.07	5.91
C ₁	1.31	0.89	0.73	0.82	0.87	0.74	0.71	0.69	0.56	0.71	0.81	0.73	0.36
C ₂	0.92	0.80	0.64	0.59	0.61	0.63	0.62	0.53	0.49	0.60	0.73	0.60	0.65
C ₁ + C ₂	2.23	1.69	1.37	1.41	1.48	1.37	1.33	1.22	1.05	1.31	1.54	1.33	1.01
Total C ₁ +	11.82	9.20	8.17	7.94	7.83	7.69	7.24	7.01	5.96	7.91	8.01	7.84	7.68
CO ₂	6.19	7.48	7.97	8.23	8.70	8.35	7.76	7.54	7.25	7.90	8.09	8.05	8.38
Net Water	10.50	9.59	7.74	7.24	6.99	6.88	6.18	5.65	5.13	7.05	6.76	7.01	6.91
Shift (H ₂)(CO ₂)													
Ratio (H ₂ O)(CO)	5.54	4.43	6.02	5.91	6.51	5.75	5.45	6.20	5.65	5.37	5.32	5.36	6.35
Conv. Basis F.F.													
CO %	89.8	80.3	77.6	75.9	76.1	74.0	70.0	67.5	62.2	75.7	75.2	75.3	77.0
H ₂ %	88.2	70.8	63.6	59.4	57.3	58.8	54.5	49.9	45.6	57.7	61.6	60.2	59.4
H ₂ + CO %	88.8	74.5	68.9	65.8	64.4	64.6	60.3	56.5	51.7	64.5	66.7	65.8	66.0
Selectivity C ₃ +	% C ₁ +	81.1	81.6	83.2	82.2	81.1	82.2	81.6	82.4	83.4	80.8	83.0	86.8
Weight Bal. %		84.2	95.0	93.5	92.9	91.1	92.2	91.1	91.1	93.2	92.0	91.1	90.6

SUMMARY OF SYNTHESIS RUN NO. 46 (CONT'D)

Period	N	O	P	Q	R	S	T	U	V	W	X-1	X-2	Y
Hours	297-321	321-345	345-369	369-393	393-417	417-441	441-465	465-489	489-513	513-537	540-546	546-561	561-580
Pres., Psig	133	132	122	126	132	125	126	122	117	120	134	126	126
Temp., °F.	649	641	642	642	640	644	644	640	639	640	655	698	698
Flow Rates-SCFH													
Fresh Feed	16936	16993	16725	16614	16218	16519	16506	16364	16304	16395	16874	17250	17160
Recycle	17744	18219	17653	17027	16970	17656	16608	17088	17577	17414	25201	17280	17126
Wet Gas (Adj.)	8366	8916	8431	7990	7322	8108	7730	6589	7449	7447	6625	7727	7219
Catalyst Data (by Δp)													
Weight, lbs.	936	862	854	906	996	925	1074	1034	957	1101	970	880	981
Vol.-Cu. Ft.	7.1	6.7	6.7	7.0	7.4	6.7	7.4	8.1	7.3	6.9	6.4	6.6	7.3
Depth.-Ft.	10.7	10.1	10.1	10.6	11.2	10.2	11.2	12.3	11.0	10.5	9.7	10.0	11.0
Feed Rates-H ₂ +CO													
SCFH	15854	16247	16194	16050	15716	15837	15883	15725	15590	15737	16250	16726	16681
SCFH/Sq.Ft.	24021	24617	24536	24318	23812	23995	24065	23826	23621	23844	24621	25342	25274
SCFH/CF Cat.	2233	2425	2417	2293	2124	2364	2146	1941	2136	2281	2539	2534	2285
SCFH/# Cat.	16.94	18.85	18.96	17.72	15.78	17.12	14.79	15.21	16.29	14.29	16.75	19.01	17.00
Recycle Ratio	1.05	1.07	1.06	1.02	1.05	1.07	1.01	1.04	1.08	1.06	1.49	1.00	1.00
Inlet Vel.Ft/Sec.	1.04	1.06	1.04	1.01	1.00	1.03	1.00	1.01	1.02	1.02	1.27	1.04	1.03
Ratio of H ₂ /CO in Fresh Feed	1.69	1.65	1.66	1.67	1.68	1.70	1.71	1.68	1.70	1.66	1.72	1.71	1.66
Combined Feed	2.15	2.06	2.07	2.03	2.10	2.11	2.12	2.11	2.07	2.05	2.07	2.06	2.05
Wet Gas	3.08	2.80	2.80	2.69	2.92	2.96	2.97	3.04	2.74	2.80	2.51	2.74	2.89
Consumed	1.28	1.23	1.26	1.45	1.34	1.29	1.34	1.38	1.38	1.32	1.52	1.40	1.35
Yields/MCF of CO+H ₂ Fed	lbs.	gal.	lbs.										
C ₃	1.05	0.77	0.79	0.86	0.95	0.86	0.94	0.82	0.84	1.10	0.79	0.83	1.00
C ₄	0.84	0.66	0.69	0.74	0.85	0.71	0.89	0.82	0.74	0.77	0.88	0.79	0.77
C ₅	0.42	0.29	0.34	0.33	0.41	0.27	0.44	0.46	0.35	0.33	0.44	0.38	0.35
C ₆	0.09	0.05	0.09	0.07	0.09	0.03	0.09	0.10	0.09	0.09	0.13	0.07	0.08
C ₃ - C ₆	2.40	0.51	1.77	0.38	1.91	0.40	2.00	0.42	2.30	0.48	1.87	0.40	2.36
400 EP	2.58	0.41	2.21	0.35	2.46	0.39	2.47	0.39	2.72	0.43	2.39	0.38	2.75
C ₃ - 400 EP	4.98	0.92	3.98	0.73	4.37	0.79	4.47	0.81	5.02	0.91	4.26	0.78	5.11
400+	1.22	0.17	1.00	0.14	1.10	0.16	0.98	0.14	1.05	0.15	1.08	0.16	1.28
WS Chem	0.75	0.09	0.69	0.09	0.79	0.09	0.68	0.08	0.78	0.09	0.75	0.09	0.97
Total C ₃ +	6.95	1.18	5.67	0.96	6.26	1.04	6.13	1.03	6.85	1.15	6.09	1.03	7.11
C ₁	0.71	0.89	0.82	0.78	0.72	0.75	0.85	0.72	0.78	0.73	0.82	0.97	1.00
C ₂	0.65	0.80	0.68	0.67	0.68	0.70	0.77	0.66	0.82	0.63	0.77	0.75	0.73
C ₁ + C ₂	1.36	1.69	1.50	1.45	1.40	1.45	1.62	1.38	1.60	1.36	1.59	1.72	1.73
Total C ₁ +	8.31	7.36	7.76	7.58	8.25	7.54	8.73	8.60	8.24	8.39	8.95	8.39	8.89
CO ₂	8.10	8.74	8.33	8.38	8.32	7.97	7.90	7.59	7.67	8.03	6.99	7.47	7.69
Net Water	6.75	6.16	6.38	6.86	7.00	7.10	6.52	8.71	7.29	7.32	8.10	7.38	7.97
Shift (H ₂)(CO ₂)													
Ratio (H ₂ O)(CO)	6.23	6.29	6.27	5.67	6.40	5.72	6.40	5.20	5.35	5.63	6.21	5.02	5.09
Conv.Basis F.F.													
CO	77.1	73.2	73.6	74.7	78.2	75.5	77.4	81.9	76.6	77.6	79.5	76.8	80.3
H ₂	58.3	54.6	55.6	59.3	62.1	57.3	60.6	67.3	62.3	62.1	70.1	62.8	65.6
H ₂ + CO	65.3	61.6	62.4	65.1	68.1	64.0	66.8	72.8	67.6	67.9	73.6	67.9	71.1
Selectivity C ₃ +													
C ₁ +	83.6	77.0	80.7	80.9	83.0	80.8	81.4	84.0	80.6	83.8	82.2	79.5	80.5
Weight Bal. %	92.7	91.4	91.4	91.9	93.6	91.8	90.7	97.3	91.3	91.9	93.7	92.0	93.6

SUMMARY OF SYNTHESIS RUN NO. 48

B. DETAILED DATA FROM RUNS 46 AND 48

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 A From Hr. 1800 to Hr. 0900 hrs. 0-19

FLOWS			RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS			
	SCFH	%	Generator Press.	430	A S T M		Hempel Dist.		In Reactor at Start of Period	1117	Particle Size				
Oxygen	2791		O ₂ Preheat, °F	422	Prod.	Naph			°F % A.P.I.	Fresh Catalyst Charged			Screen		Sedimentation
Nat. Gas	3411		Gas Preheat, °F	673	A.P.I.	56.3		to 400	64.3 56.3	Catalyst Recharged		Frac.	M	%	M
Total			Reactor Press.	384	I.B.P.	100		400-550	16.6 36.9	Total		On 40	420+	14.9	80+
Fresh Feed	10254		Steam Back Press.	673	5%			550+	19.1 16.8	Catalyst Taken Out	45	100	419-150	59.1	80-40
F. F. by C			Temperatures, °F		10%	134				In Reactor at End of Period	1022	150	149-105	11.7	40-20
Avg. F. F.			Heater Outlet	417	20	182					200	104-74	8.7	20-10	
Wet Gas	2039		Catalyst ±1	626	30	188					250	73-62	1.6	10-0	
Contraction			±2	628	40	216									
Recycle	16058		±3	639	50	240									
Bleed	808		±4	617	60	266									
			±5		70	296									
Total	16866		Average	628	80	330									
Total Feed	27120		Product Separator	53	90	366									
Recycle/F.F.	1.64				95	394									
Inlet Vel.	0.62				E.P.	408									
Steam Flow					Rec.	98									
					Res.	1.5									
					Loss.	0.5									

NATURAL GAS		PRODUCT INSPECTION					IN					OUT						
%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	m/hr	C	H	O	Mol %	m/hr	C	H	O
CO ₂	1.78	Neut. No.	56.6	47.6				O ₂	7.364 0.014				CO ₂	3.310	0.896	0.9	1.79	
CH ₄	84.51	Sap. No.	53.9	47.9				CO ₂	0.160	0.16	0.520		CO	36.773	9.951	10.0	9.95	
C ₂ H ₆	9.43	Hydrox. No.						CH ₄	7.806	7.8130.424			CH ₄	0.027	0.007	0.0	0.03	
C ₃ H ₈	3.41	Bromine No.	84.4					C ₂ H ₆	0.849	1.70	5.094		H ₂	59.377	16.067	32.13		
C ₄ H ₁₀	0.16	% Fe						C ₃ H ₈	0.307	0.92	2.456		N ₂	0.513	0.139			
N ₂	0.56	% Alc		6.0				C ₄ H ₁₀	0.014	0.06	0.140		H ₂ O				6.31 3.16	
O ₂	0.15	API	49.4	9.7				N ₂	0.050				Total		27.06	10.9	36.4714.90	
MM	18.953							Total	10.4459.11415.076	Balance					105.9	100.9398.89		

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION							
%	m/hr	#/hr	%	m/hr	#/hr	m/hr	#/hr	m/hr	#/hr	m/hr	%	m/hr	%	m/hr	a/hr	%	a/hr	#/hr	##/gal gal/hr	
CO	36.773	9.95	278.67	14.79	0.723	20.251	0.019	28.53	6.581	16.530	23.10	7.600	13.11	8.930			-8.930			
H ₂	59.377	16.06	32.38	27.63	1.350	2.721	1.902	3.85	12.296	28.360	39.63	14.198	24.49	14.162			-28.324			
CO ₂	3.310	0.90	39.43	53.14	1.620	71.302	2.283	100.46	14.748	15.644	21.86	17.031	29.58	1.387	1.387	15.53		2.774		
N ₂	0.513	0.14	3.89	0.75	0.036	1.010	0.051	1.42	0.332	0.471	0.56	0.383	0.66	0.088						
CH ₄	0.027	0.01	0.11	11.78	0.576	9.240	0.312	13.02	5.241	5.248	7.33	6.053	10.44	0.805	0.805	9.01	3.220			
C ₂ H ₄				2.63	0.129	3.620	0.182	5.10	1.171	1.171	1.64	1.353	2.33	0.182	0.364	4.08	0.728		57.8	
C ₂ H ₆				1.92	0.094	2.330	0.132	3.99	0.955	0.955	1.19	0.987	1.70	0.132	0.254	2.96	0.792			
C ₃ H ₈				3.41	0.170	7.150	0.240	10.07	1.551	1.551	2.17	1.791	3.09	0.240	0.720	8.06	1.440		10.07 4.32 2.33	
C ₃ H ₈				0.62	0.030	1.320	0.042	1.86	0.277	0.277	0.39	0.319	0.55	0.042	0.126	1.41	0.336		9.06 5.25 1.45 84.2	
C ₄ H ₈				1.96	0.095	5.330	0.134	7.51	0.870	0.870	1.22	1.004	1.73	0.134	0.536	6.00	1.072		1.86 4.24 0.44	
C ₄ H ₁₀				0.51	0.025	1.450	0.055	2.04	0.227	0.227	0.32	0.262	0.45	0.035	0.140	1.57	0.350		7.51 5.00 1.50	
C ₅ H ₁₀				0.59	0.029	2.030	0.041	2.88	0.264	0.264	0.37	0.305	0.53	0.041	0.205	2.30	0.410		7.13 6.10 1.17 79.3	
C ₆ H ₁₂				0.11	0.005	0.360	0.007	0.51	0.047	0.047	0.07	0.054	0.09	0.007	0.035	0.39	0.084		2.86 0.51 5.45 0.62	
OIL				0.10	0.005	0.420	0.007	0.59	0.042	0.042	0.06	0.049	0.08	0.007	0.042	0.47	0.084		0.59 5.5 0.11	
WATER												0.431	0.74		4.306	48.22	8.612		60.40 6.5129.28	
TOTAL	27.06	354.48		4.887	129.036.866	181.80	44.501	71.556				6.156	10.82			11.196	5.156	5.598		
H ₂ +CO	26.01					2.921						44.890	21.798					82.59	13.05	
H ₂ /CO	1.61					1.87						1.72	1.87				1.59			
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr	%	#/hr	%	EFFLUENT RATIOS	CONTRACTION: 74.55						
			H ₂ /CO	#/MCF	g/M3	Gal/hr	Gal/MCF	cc/M3						H ₂ /H ₂ O	2.306	CO Conversion:	89.76			
C ₁ +C ₂	16.05	22.00	2.231	37.73										C ₂ /C ₂ O	2.240	H ₂ Conversion:	88.16			
C ₃ +	68.42	85.84	8.707	147.24	14.70	1.491		210.5						(H ₂) (C ₂)	5.17	H ₂ *C ₂ O	88.77			
C ₄ +	58.95	73.91	7.497	126.77	11.93	1.210		171.0						Total	301.71	84.16	354.48			
Ult. Oil			82.59	8.377	141.66	13.05	1.324	187.1						H ₂ *C ₂ O = 9860 SCFH	#/hr	#/M gal/hr	GPM			
C ₂ O	15.53	61.05	6.190	104.67										C ₂ -C ₅	25.44	2.58	5.42	0.55		
H ₂ O			110.91	11.250	190.24	13.20	1.340	189.3						Rec 011	62.51	6.34	9.50	0.97		
														WSC	6.61	0.67	0.79	1.00		
															94.56	9.59	15.81	1.60		

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of measured at O.C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 B From Hr. 1200 to Hr. 0700 Hrs. 19-38

FLOWS			RUN CONDITIONS			DISTILLATIONS					CATALYST DATA				CATALYST ANALYSIS				
	SCFH	%	Generator Press.	413		A S T M			Hempel Dist.			In Reactor at Start of Period	1022	Particle Size					
Oxygen	3799		O ₂ Preheat, °F	400	Prod.	Naph			°F	%	A.P.I.	Fresh Catalyst Charged		Screen			Sedimentation		
Nat. Gas	5312		Gas Preheat, °F	627	A.P.I.	57.0			to 400	36.6	57.0	Catalyst Recharged		Frac.	M	%	M	%	
Total			Reactor Press.	387	I.B.P.	102			400-550	36.6	37.0	Total		On 40	420+	18.5	80+		
Fresh Feed	15937		Steam Back Press.	713		5%			550+	36.6		Catalyst Taken Out	172	100	419-150	32.2	80-40		
F. F. by C			Temperatures, °F			10% 140						In Reactor at End of Period	850	150	149-105	10.0	40-20		
Avg. F. F.			Heater Outlet	265	20	166								200	104-74	5.4	20-10		
Wet Gas	5547		Catalyst ±1	630	30	192	WATER						250	73-62	0.6	10-0			
Confracition			±2	530	40	216	Temp.	%	Reactor d-P, H ₂ O				325	61-44	1.0				
Recycle	19054		±3	648	50	236	200		Pounds in Reactor			1026	<325	43-0	2.2				
Bleed	968		±4	643	60	262	203		Density, lbs./cu. ft.			138	Density, lbs./cu. ft.			Chem. Anal.			
			±5		70	292	208		Bed Height, Feet			11.3	Aerated	134	% Fe				
Total	20022		Average	639	80	322							Settled	136	% C				
Total Feed	35050		Product Separator	64	90	356							Compacted	146	% Oil				
Recycle/F.F.	1.26				95	306			Space Vel. SCFH/lb. cat.				Sp. Grav.	4.3		Specific Surface			
Inlet Vel.	1.08				E.P.	402			Inventory Figures								m ² /gm		
Steam Flow					Rec.	97.5			From d-P Meters			16.5				4.8	ml.H ₂ O/gm		
					Res.	1.5			V/hr/V			2137							
					Loss.	1.0			GENERATOR ELEMENTAL BALANCE										
NATURAL GAS		PRODUCT INSPECTION							IN					OUT					
%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SEEN m/hr	C	H	O	Mol %	SEEN m/hr	C	H	O	
CO ₂	1.72	Neut. No.	45.3	42.6					O ₂	0.018 10.023			20.082	CO ₂	2.373	C.898	1.0	2.0	
CH ₄	95.27	Sap. No.	50.4	43.3					CO ₂	0.241	0.24		0.482	CO	37.377	15.717	15.7	15.7	
C ₂ H ₆	8.57	Hydrox. No.							CH ₄	11.951	11.9547.804			CH ₄	0.040	C.017	C.0	0.063	
C ₃ H ₈	3.43	Bromine No.	50.8						C ₂ H ₆	1.201	2.40	7.206		H ₂	58.837	24.740		49.480	
C ₄ H ₁₀	0.21	% Fe							C ₃ H ₈	0.481	1.44	3.849		N ₂	1.37L	0.577			
N ₂	2.67	% Alc		B.C					C ₄ H ₁₀	0.029	0.12	0.290		H ₂ O				7.651	
O ₂	0.13	* API	50.1	10.2					N ₂	0.094				Total	42.049	16.757.199	21.5		
MW	18.856								Total	16.1559.148	20.554			Balance		105.696.7	104.7		

Hz/CU	1.57	2.33	1.67	2.55	1.59						
ULTIMATE YIELDS						WEIGHT BALANCE	#/hr	%	#/hr	EFFLUENT RATIOS	CONTRACTION: 61.94
	% CO Fed	#/hr #/MCF	H2 / CO g/M3		H2 / CO Gal/MCF	cc/M3					
C1+C2	10.87	25.88	1.688	28.54			Wet Gas	297.05	324.85	H2/H2O 4.202	C0 Conversion: 80.27
C3+	52.82	116.74	7.614	128.8	20.01	1.305	Oil	65.73	65.73	CO2/CO 1.162	H2 Conversion: 70.75
C4+	46.52	102.81	6.705	113.4	16.78	1.094	Water	159.88	159.88	(H2) (CO2) (H2O) (CO) 4.883	H2+CO = 74.45
Ult. Oil		113.77	7.420	125.5	18.14	1.183	Total	522.66	94.95	550.46	
C02	16.58	114.72	7.482	126.5			H2+CO = 153.33 SCFH				
H2O		133.39	8.699	147.1			#/hr	#/M gal/hr	GPM		
							C3-C6	36.62	2.39	7.66	0.50
							Reo	01155.75	4.29	10.13	0.66
							WSC	12.79	0.83	1.53	0.10
								115.14	7.51	19.32	1.26
							No-O	147.09	9.51	17.64	1.15

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 C From Hr. 0700 to Hr. 0600 Hrs. 38-62

FLOWS			RUN CONDITIONS			DISTILLATIONS					CATALYST DATA			CATALYST ANALYSIS							
	SCFH	%	Generator Press.	423		A S T M			Hempel Dist.			In Reactor at Start of Period	850	Particle Size							
Oxygen	3835		O ₂ Preheat, °F	405	Prod.	Naph			°F	%	A.P.I.	Fresh Catalyst Charged		Screen Sedimentation							
Nat. Gas	5382		Gas Preheat, °F	625	A.P.I.	58.2			to 400	65.6	58.2	Catalyst Recharged		Frac.	M	%	M	%			
Total			Reactor Press.	387	I.B.P.	95			400-550	16.3	40.7	Total		On 40	420+	30.0	80+				
Fresh Feed	15896		Steam Back Press.	735	5%				550+	18.1		Catalyst Taken Out	56	100	419-150	62.0	80-40				
F. F. by C			Temperatures, °F		10%	128						In Reactor at End of Period	794	150	149-105	4.6	40-20				
Avg. F. F.			Heater Outlet	299	20	160								200	104-74	1.6	20-10				
Wet Gas	6309		Catalyst #1	633	30	195			WATER					250	73-62	0.2	10-0				
Contraction			#2	633	40	208			Temp.	%		Reactor d-P, H ₂ O									
Recycle	19451		#3	656	50	233			200			Pounds in Reactor	973	325	61-44	0.0					
Bleed	1013		#4	671	60	260			203			Density, lbs./cu. ft.	144	325	43-0	0.8					
			#5		70	286			208			Bed Height, Feet	10.2	Aerated	131	% Fe					
Total	20464		Average	648	80	318								Settled	133	% C	4.70				
Total Feed	36360		Product Separator	63	90	350								Compacted	150	% Oil					
Recycle/F.F.	1.29				95	376						Space Vel. SCFH/lb. cat.		Sp. Grav.	4.3	Specific Surface					
Inlet Vel.	1.09				E.P.	392						Inventory Figures					m ² /gm				
Steam Flow					Rec.	97.5						From d-P Meters	16.3	% H ₂ O	0.31	6.8 mLNH ₃ /gm					
					Res.	1.5						V/hr/V	2361								
					Loss	1.0						GENERATOR ELEMENTAL BALANCE									
NATURAL GAS		PRODUCT INSPECTION						IN						OUT							
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O		Mol %	SCFH m hr	C	H	O	
CO ₂	2.16	Neut No.	41.7	41.9					O ₂		10.146			20.292	CO ₂		1.072	1.1		2.1	
CH ₄	85.31	Sap No.	47.3	45.3					CO ₂		0.307	0.31		0.614	CO		15.450	15.5		15.5	
C ₂ H ₆	8.09	Hydrox No.							CH ₄		12.115	12.12	48.460		CH ₄		0.155	0.2	0.620		
C ₃ H ₈	3.06	Bromine No.	85.3						C ₂ H ₆		1.149	2.3C	5.894		H ₂		25.141		50.282		
C ₄ H ₁₀	0.16	% Fe							C ₃ H ₈		0.434	1.30	3.472		N ₂		0.125				
N ₂	1.04	% Alc	10.0						C ₄ H ₁₀		0.025	0.09	0.23C		H ₂ O				7.388	3.7	
O ₂	0.18	° API	51.3	30.5					N ₂		0.148				Total		41.943	16.7	59.289	21.3	
MW	18.831											16.11	59.356	20.905	Balance			16.3	59.289	7	10.6

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 D From Hr. 0800 to Hr. 0700 Hrs. 62-34

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	419		A S T M	Hempel Dist.	In Reactor at Start of Period	794		Particle Size						
Oxygen	3788		O ₂ Preheat, °F	408	Prod.	Reph		°F	%	A.P.I.	Fresh Catalyst Charged						
Nat. Gas	3788		Gas Preheat, °F	644	A.P.I.	57.4		to 400	70.0	57.4	Catalyst Recharged						
Total	5414		Reactor Press.	303	I.B.P.	38		400-550	17.6	30.0	Total						
Fresh Feed	15135		Steam Back Press.	710		5%		550+	12.4		Catalyst Taken Out	49					
F. F. by C			Temperatures, °F			10% 137					In Reactor at End of Period	745					
Avg. F. F.			Heater Outlet	259	20	169							200	104.74 2.2	20-10		
Wet Gas	6363		Catalyst #1	636	30	194							250	73.62 0.2	10-0		
Contraction			#2	636	40	218		Temp.	%		Reactor d-P, H ₂ O		325	61.44 0.4			
Recycle	17888		#3	665	50	240		200			Pounds in Reactor	875	<325	43.0 0.5			
Bleed	1006		#4	572	60	265		203			Density, lbs./cu. ft.	130			Density, lbs./cu. ft.		
			#5		70	292		208			Bed Height, Feet	10.2			Chem. Anal.		
Total	18894		Average	652	80	323							Aerated	143	% Fe		
Total Feed	35029		Product Separator	60	90	359							Settled	151	% C		
Recycle/F.F.	1.17				95	386							Compacted	152	% Oil		
Inlet Vel.	1.05				E.P.	398							Sp. Grav.	1.4	Specific Surface		
Steam Flow					Rec.	97.5									m ² gm		
					Res.	1.5									m ² Nm ³ /km		
					Loss.	1.2							V _v /hr/V	2397			
GENERATOR ELEMENTAL BALANCE																	
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	SCFH m/hr	C	H	O	Mol %	SCFH m hr	C	H	O
CO ₂	2.50	Neut. No.	45.3	46.9				O ₂		10.010		20.02	CO ₂	1.103	1.1		2.2
CH ₄	94.93	Sap. No.	40.6	40.0				CO ₂		0.371	0.37	0.74	CO	15.973	16.0		16.0
C ₂ H ₆	8.54	Hydrox No.						CH ₄		12.135	12.1348.532		CH ₄	0.109	0.1	0.436	
C ₃ H ₈	3.14	Bromine No.	84.9					C ₂ H ₆		1.148	2.30	6.360	H ₂	25.280			
C ₄ H ₁₀	0.24	% Fe						C ₃ H ₈		0.443	1.34	7.594	N ₂				50.560
N ₂	0.59	% Alc	10.0					C ₄ H ₁₀		0.034	0.14	0.340	H ₂ O				6.756 3.4
O ₂	0.15	API	50.6	10.5				N ₂		0.127			Total				17.2 57.752 21.6
KW	19.011							Total		16.28	59.344	20.76	Balance				105.6 97.3 103.9

ULTIMATE YIELDS						WEIGHT BALANCE			EFFLUENT RATIOS			CONTRACTION:	
	% C0 Fed	#/hr	H2 / CO		Gal/hr	H2 / CO			#/hr	%	#/hr	C0 Conversion: 52.40	
			#/MCF	g/M3		Gal/MCF	cc/M3	Wet Gas				H2/H20	5.424
C1+C2	9.059	22.09	1.413	23.80				Oil	56.30	56.30	C02/C0	0.393	H2 Conversion: 59.42
C3+	50.299	112.71	7.209	121.90	10.53	1.238	174.9	Water	125.88	125.88	(H2) (C02)		H2 Conversion: 59.42
C4+	43.391	97.27	6.291	105.20	15.77	1.000	142.6	Total	512.35	92.97	(H20) (CO)	2.132	H ₂ *CO = 65.47
Ult. Oil		107.48	6.874	116.24	17.04	1.090	154.0	H ₂ *CO = 15.35 SCFM					
C02	18.299	128.67	8.230	139.17				#/hr	#/M	gal/hr	GPM		
H2O		117.90	7.541	127.52				6.3-5	33.22	2.175	7.07	0.452	
								Dec 011	56.30	3.601	8.70	0.556	
								NSC	12.52	0.782	1.31	0.097	
									102.10	6.555	1.728	1.105	

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

FLOWS			RUN CONDITIONS			DISTILLATIONS					CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	422		A S T M			Hempel Dist.		In Reactor at Start of Period	745	Particle Size							
Oxygen	3806		O ₂ Preheat, °F	358	Prod.	Naph			°F	%	A.P.I.	Fresh Catalyst Charged		Screen						
Nat. Gas	5498		Gas Preheat, °F	722	A.P.I.	55.5			to 400	58.556.5		Catalyst Recharged		Frac.	M	%	M	%		
Total			Reactor Press.	418	I.B.P.	106			400-550	15.540.4		Total		On 40	420+	16.5	80+			
Fresh Feed	16566		Steam Back Press.	730		5%			550+	15.8		Catalyst Taken Out	43	100	419-150	65.9	80-40			
F. F. by C			Temperature, °F			10%	140					In Reactor at End of Period	742	150	149-105	9.9	40-20			
Avg. F. F.			Heater Outlet	237		20	171							200	104-74	4.1	20-10			
Wet Gas	6873		Catalyst #1	636		30	198		WATER					250	73-62	0.8	10-0			
Contraction			#2	636		40	218		Temp.	%	Reactor d-P, H ₂ O			325	61-44	0.4				
Recycle	17223		#3	656		50	240		200		Pounds in Reactor		819	<325	43.0	2.4				
Bleed	1015		#4	664		60	262		203		Density, lbs./cu. ft.		128	Density, lbs./cu. ft.			Chem. Anal.			
			#5			70	293		208		Bed Height, Feet		9.77	Aerated	148	% Fe				
Total	18238		Average	648		80	320							Settled	150	% C	8.63			
Total Feed	54804		Product Separator	67		90	356							Compacted	162	% Oil				
Recycle/F.F.	1.10					95	388				Space Vel. SCFH/lb. cat.			Sp. Grav.	4.4	Specific Surface				
Inlet Vel.	1.05					E.P.	398				Inventory Figures		20.23				m ² /gm			
Steam Flow						Rec.	98.0				From d-P Meters			% H ₂	0.45	8.0	mL-NH ₃ /EM			
						Res.	1.5				V/I ₂ /V		2588							
						Loss	0.5				GENERATOR ELEMENTAL BALANCE									
NATURAL GAS									IN					OUT						
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O		Mol %	SCFH m hr	C	H	O
CO ₂	1.90	Neut. No.	40.3	40.0					O ₂		10.068		20.136	CO ₂		1.097	1.1		2.2	
CH ₄	85.21	Sap. No.	44.2	41.8					CO ₂		0.276	0.28	0.552	CO		16.290	16.0		16.0	
C ₂ H ₆	8.64	Hydrox. No.							CH ₄		12.466	12.4749.884		CH ₄		0.100	0.1	C ₄ 400		
C ₃ H ₈	2.53	Bromine No.	84.4						C ₂ H ₆		1.253	2.51	7.518	H ₂		26.352		52.704		
C ₄ H ₁₀	3.20	% Fe							C ₃ H ₈		0.367	1.10	2.936	N ₂		0.170				
N ₂	0.88	% Alc	10.0						C ₄ H ₁₀		0.029	0.12	0.290	H ₂ O				6.256	3.1	
O ₂	0.17	API	FC.5	10.5					N ₂		0.090			Total		43.709	17.2	59.360	21.3	
Ar	19.680								Total		14.506	12.4760.608	20.698	Balance		104.4	97.940	103.0		

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 F From Hr. 0700 to Hr. 0700 Hrs. 108-152

FLOWS			RUN CONDITIONS			DISTILLATIONS					CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	422		A S T M			Hempel Dist.		In Reactor at Start of Period	742	Particle Size					
Oxygen	3752		O ₂ Preheat, °F	405	Prod.	Naph			°F	%	A.P.I.	Fresh Catalyst Charged		Screen				
Nat. Gas	5490		Gas Preheat, °F	671	A.P.I.	56.6			to 400	70.6	56.6	Catalyst Recharged		Frac.	M	%	M	%
Total			Reactor Press.	414	I.B.P.	102			400-550	16.0	40.3	Total		On 40	420+	16.2	80+	
Fresh Feed	16380		Steam Back Press.	706		5%			550+	13.4		Catalyst Taken Out	41	100	419-150	56.1	80-40	
F. F. by C			Temperatures, °F			10%	148					In Reactor at End of Period	701	150	149-105	8.2	40-20	
Avg. F. F.			Heater Outlet	237		20	176							200	104-74	4.3	20-10	
Wet Gas	7036		Catalyst #1	639	30	200			WATER					250	73-62	1.0	10-0	
Contraction			#2	639	40	284			Temp.	%	Reactor d-P, H ₂ O			325	61-44	0.4		
Recycle	16982		#3	658	50	247			200		Pounds in Reactor	764	<325	43-0	3.1			
Bleed	1004		#4	657	60	268			203		Density, lbs./cu. ft.	122		Density, lbs./cu. ft.			Chem. Anal.	
			#5		70	292			208		Bed Height, Feet	9.42		Aerated	144	% Fe		
Total	17986		Average	648	80	322								Settled	147	% C		
Total Feed	34366		Product Separator	70	90	360								Compacted	160	% Oil		
Recycle F.F.	1.10				95	392					Space Vel. SCFH/lb. cat.			Sp. Grav.	4.2		Specific Surface	
Inlet Vel.	1.03				E.P.	403					Inventory Figures						m ² gm	
Steam Flow					Rec.	98.0					From d-P Meters	21.44					7.3 m ₁ .N ₂ /fm	
					Res.	1.5					v/hr/v	2615						
					Loss	0.5					GENERATOR ELEMENTAL BALANCE							
NATURAL GAS			PRODUCT INSPECTION						IN					OUT				
%	Oil	Water	Product	Pour °F	SUS @ °F				Mol %	SCFH/m ³	C	H	O	Mol %	SCFH/m ³	C	H	O
CO ₂	2.55	Neut. No.	39.1	40.1					O ₂		9.952		19.904	CO ₂		1.138	1.1	2.3
CH ₄	31.17	Sap. No.	42.8	41.1					CO ₂		0.369	0.37	0.738	CO		15.930	15.2	15.8
C ₂ H ₆	8.55	Hydrox. No.							CH ₄		12.192	12.19	49.768	CH ₄		0.127	0.1	0.509
C ₃ H ₈	6.77	Bromine No.	31.1						C ₂ H ₆		1.238	2.43	7.428	H ₂		25.955	51.710	
C ₄ H ₁₀	0.15	% Fe							C ₃ H ₈		0.401	1.20	3.208	N ₂		0.215		
N ₂	1.46	% Alc		12.0					C ₄ H ₁₀		0.022	0.29	0.320	H ₂ O				6.140 3.1
O ₂	0.35	* API	50.7	30.7					N ₂		0.211			Total		43.265	17.2	59.358 21.3
MW	12.095								Total		16.33	59.624	20.642	Balance		105.3	27.88	123.1

ULTIMATE YIELDS						WEIGHT BALANCE		#/hr	%	#/hr	EFFLUENT RATIOS	CONTRACTION:
	% CO Fed	H ₂ / CO		H ₂ / CO								
		#/MCF	g/M3	Gal/hr	Gal/MCF	cc/M3						
C1+C2	8.97	21.70	1.300	21.98			Wet Gas	337.95	1.128	381.37	H2/H2O	6.01
C3+	wet gas 15.10	33.96	2.044	34.56	6.83	0.431	Oil	53.98		53.98	CO2/CO	0.9993
C4+		53.98	3.408	57.63	8.35	0.587	Water	121.11		121.11	(H2) (CO2) (H2O) (CO)	6.0057
WS Chem OH-CH ₃	12.11 99.47	0.764 6.330	12.92 107.04	1.45 16.63	0.09155 1.04955	12.956 174.936	Total	513.04	92.20	556.46		
C02	18.83	132.02	7.890	131.90			H ₂ *CO = 15858 SCFH					
H2O		104.23	7.993	133.47	14.99	0.946	#/hr	/M	gal/hr	GPM		
							C ₃ -C ₅	33.96	2.14	7.16	0.452	
							Reg 011	53.98	3.41	8.35	0.527	
							WSC	12.11	0.765	1.45	0.082	
								100.05	6.315	16.96	1.071	
												Yield Calculations assume "oil" is CH ₂ , and is found by difference on Carbon, and H2O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at O C and 14.7 psig. g/M3 = 16.91 * #/MCF. cc/M3 = 141.3 * gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 G From Hr. 0700 to Hr. 0700 Hrs. 132-156

FLOWS		RUN CONDITIONS		DISTILLATIONS					CATALYST DATA			CATALYST ANALYSIS					
	SCFH	%	Generator Press.	425	A S T M			Hempel Dist.		In Reactor at Start of Period	701	Particle Size					
Oxygen	3790		O ₂ Preheat, °F	375	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged						
Nat. Gas	5654		Gas Preheat, °F	667	A.P.I.	56.6		to 400	67.3	56.6	Catalyst Recharged						
Total			Reactor Press.	419	I.B.P.	11.0		400-550	15.3	41.7	Total						
Fresh Feed	16874		Steam Back Press.	720		5%		550+	17.4		Catalyst Taken Out	57	On 40	420+	18.2	80+	
F. F. by C			Temperature, °F			10% 148					In Reactor at End of Period	644	100	419-150	65.9	80-40	
Avg. F. F.			Heater Outlet	203	20	178							200	104.74	3.6	20-10	
Wet Gas	7711		Catalyst #1	631	30	205	WATER					250	73.62	0.6	10-0		
Contraction			#2	631	40	227	Temp.	%	Reactor d-P, H ₂ O			325	61.44				
Recycle	10978		#3	654	50	246		200	Pounds in Reactor			<325	43.0	2.2			
Bleed	1041		#4	659	60	262		203	Density, lbs./cu. ft.			120	Density, lbs./cu. ft.			Chem. Anal.	
			#5	70	70	293		208	Bed Height, Feet			3.2	Aerated	143	% Fe		
Total	18019		Average	644	80	322							Settled	145	% C	8.63	
Total Feed	34893		Product Separator	70	90	356							Compacted	161	% Oil		
Recycle/F.F.	1.07				95	324	Space Vel. SCFH/lb. cat.					Sp. Grav.	4.2	Specific Surface			
Inlet Vel.	1.05				E.P.	400	Inventory Figures									m ² gm	
Steam Flow					Rec.	98.0	From d-P Meters					83.23	\$ Hg 0.38	6.7	m ³ .NH ₃ /gm		
					Res.	1.5						1/3/7	2779				
					Loss	0.5	GENERATOR ELEMENTAL BALANCE										
NATURAL GAS		PRODUCT INSPECTION						IN					OUT				
%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	66PM m/hr	C	H	O	Mol %	66PM m/hr	C	H	O
CO ₂	2.38	Neut No.	37.2	39.8				O ₂	0.034				CO ₂	1.037	1.0		2.1
CH ₄	84.12	Sap No.	45.0	46.1				CO ₂	0.355	0.35	0.710		CO	15.949	16.0		16.0
C ₂ H ₆	8.34	Hydrox No.						CH ₄	12.551	12.550	2.04		CH ₄	0.530	0.5	2.220	
C ₃ H ₈	3.05	Bromine No.	78.3					C ₂ H ₆	1.244	0.12	7.464		H ₂	26.837			53.674
C ₄ H ₁₀	0.20	% Fe						C ₃ H ₈	0.452	0.12	2.816		N ₂	0.169			
N ₂	1.68	% Alc		11.0				C ₄ H ₁₀	0.050	0.12	0.700		H ₂ O				6.00
O ₂	0.23	API	50.6	10.7				N ₂	0.251				Total	44.523	17.5	21.404	20.2
MW	18.048							Total	16.0761	5.594	20.0760		Balance		103.8	99.0	100.2

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION					
	%	m/hr	#/hr	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	%	m/hr	a/hr	%	Hydrogen	Oxygen	Ultimate Oil	Unsats.
				m/hr	#/hr	m/hr	#/hr	m/hr		m/hr		m/hr		m/hr	a/hr	#/hr	#/gal	gal/hr
CO	35.82	15,949	446,73	20.57	4.19	117.2	4,785	134.03	9.779	25,728	27.945	14,564	19.01	-11,164	-11,164	30.00		-11,164
H2	60.29	26,837	54,10	52.52	10.69	21.5	12,217	24.63	24.969	51,306	56,271	37,186	49.53	-14,620			-29,240	
CO2	2.33	1,037	45.64	16.74	3.41	149.3	3,894	171.40	7.958	8,995	9,770	11,952	15.17	2,357	2,857	17.91		5.714
N2	0.38	0,169	4,73	0.52	0.11	2.9	0.120	3.36	0.245	0.414	0.449	0.365	0.48	0.048				
CH4	1.19	0,530	8,50	5.38	1.10	17.6	1,252	20.09	2.557	3,087	3,353	3,809	4.87	0.722	0.722	4.53	2,988	
C2H4				1.01	0.21	5.8	0,234	6.57	0.480	0.480	0.521	0.714	0.93	0.234	0.468	2.93	0.936	
C2H6				0.49	0.10	3.0	0.114	3.44	0.232	0.232	0.261	0.346	0.45	0.114	0.228	1.43	0.684	
C3H6				1.21	0.25	10.4	0.281	11.83	0.573	0.573	0.622	0.854	1.12	0.281	0.843	5.28	1,686	11.83 10.65
C3H8				0.23	0.05	2.1	0.054	2.37	0.109	0.109	0.118	0.163	0.21	0.354	0.162	1.02	0.433	4.24 9.63 9.20
C4H8				0.74	0.15	9.5	0.173	9.63	0.353	0.353	0.383	0.526	0.69	0.173	0.692	4.34	1,384	0.56 5.00 6.10
C4H10				0.21	0.04	2.5	0.049	2.06	0.092	0.099	0.107	0.148	0.19	0.049	0.195	1.23	0.490	2.36 4.45 1.51
C5H10				0.31	0.06	4.4	0.071	4.97	0.145	0.145	0.157	0.216	0.26	0.071	0.355	2.23	0.710	4.97 5.45 0.91
C6H12				0.03	0.02	1.4	0.018	1.54	0.036	0.036	0.039	0.054	0.07	0.019	0.103	0.62	0.216	1.54 5.5 0.28
OIL												0.453	0.59		4,523	28.42	9,066	53.58 6,460 9.83
WATER												5,374	7.01			10,748	5,450 5,374	
TOTAL	44,523	550,77		20.35	347.0	23,263	306.79	47,543	92,057		76,624		-21,162				92,80	14.82
H2+CO	12,726					17,002		34,742					-25,794					
H2/CO	1.63					2.55		2.55					1.31					

ULTIMATE YIELDS						WEIGHT BALANCE		#/hr	%	#/hr	EFFLUENT RATIOS		CONTRACTION: 47.75		
	% CO Fed	#/hr	H2 / CO #/MCF	g/M3	H2 / CO Gal/hr	Gal/MCF	cc/M3								
C1+C2	8.28%	21.60	1.332	22.524				Wet Gas	347.92		396.79	H2/H2O	6,919	CO Conversion: 70.00	
C3+	43.184	96.03	5.071	100.070	16.05	1.039	146.81	Oil	50.32		50.32	CO2/C0	0.8137	H2 Conversion: 54.48	
C4+	36.255	92.63	5.096	86.173	13.55	0.836	116.13	Water	112.59		112.59	(H2) (CO2) (H2O) (CO) 5.629		H2+CO = 60.26	
Ult. Oil								Total	509.93		91.11	559.70			
C02	17.910	125.76	7.755	131.137				H2+CO = 16216 SCFH #/hr #/M gal/hr GPM							
H2O								C3-C5 33.25 2,050 7.02 0.433 Rec 81150.32 3,103 7.79 0.480 WSC 12.58 0.763 1.48 0.000							
								65.05 5,028 16.00 0.000							

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 H From Hr. 0700 to 0700 Hrs. 156-180

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS			
	SCFH	%	Generator Press.	430		A S T M		Hempel Dist.		In Reactor at Start of Period	644	Particle Size				
Oxygen	3743		O ₂ Preheat, °F	419	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged					
Nat. Gas	5615		Gas Preheat, °F	685	A.P.I.	56.6		to 400	64.6	56.6	Catalyst Recharged					
Total			Reactor Press.	423	I.B.P.	104		400-550	16.6	41.7	Total			Screen	Sedimentation	
Fresh Feed	16636		Steam Back Press.	715		5%		550+	18.8		Catalyst Taken Out	25	100	419-150	53.4	
F. F. by C			Temperatures, °F			10% 146					In Reactor at End of Period	619	150	149-105	8.6	
Avg. F. F.			Heater Outlet	248		20 179							200	104-74	5.2	
Wet Gas	8222		Catalyst #1	629		30 204		WATER					250	73-62	1.0	
Contraction			#2	629		40 228		Temp.	%		Reactor d-P, H ₂ O		325	61-44	0.2	
Recycle	17438		#3	663		50 248		200			Pounds in Reactor	657	<325	43-0	5.2	
Bleed	1067		#4	665		60 269		203			Density, lbs./cu. ft.	123	Density, lbs./cu. ft.	Chem. Anal.		
			#5			70 298		208			Bed Height, Feet	8.09	Aerated	141	% Fe	
Total	18505		Average	646		80 322							Settled	143	% C	
Total Feed	35141		Product Separator	68		90 356							Compacted	160	% Oil	
Recycle/F.F.	1.11					95 388							Sp. Grav.	4.1	Specific Surface	
Inlet Vel.	1.06					E.P. 401							Inventory Figures		m ² /gm	
Steam Flow						Rec. 97.5							From d-P Meters	25.32	5.7 m ³ /NH ₃ /gm	
						Res. 1.5							Vapor /			
						Loss 1.0							GENERATOR ELEMENTAL BALANCE			

NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%	Oil	Water	Product	Pour °F	SUS @ °F		Mol %	kg/m ³	C	H	O	Mol %	kg/m ³	C	H	O
CO ₂	1.88	Neut. No.	38.0	39.7				O ₂		9.905		19.910	CO ₂		1.045	1.1	2.1
CH ₄	84.72	Sap. No.	39.8	41.0				CO ₂		0.278	0.28	0.556	CO		15.703	15.7	15.7
C ₂ H ₆	8.70	Hydrox No.						CH ₄		12.550	12.550	200	CH ₄		0.503	0.5	2.012
C ₃ H ₈	3.55	Bromine No.	86.7					C ₂ H ₆		1.289	2.58	7.734	H ₂		26.487	52.974	
C ₄ H ₁₀	0.22	% Fe						C ₃ H ₈		0.526	1.58	4.208	N ₂		0.158		
N ₂	0.73	% Alc		11.0				C ₄ H ₁₀		0.033	0.13	0.330	H ₂ O			6.316	3.2
O ₂	0.20	API	51.0	10.8				N ₂		0.108			Total		43.896	17.3	51.302
MW	18.9956							Total		17.12	52.472	20.366	Balance		100.8	98.13	102.9

FRESH FEED			WET GAS			RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION						
	%	m/hr	#/hr	%	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	%	m/hr	o/hr	%	o/hr	#/gal	gal/hr
CO	35.773	15.70	439.34	20.76	4.50	126.13	5.098	142.79	10.965	26.662	27.57	16.063	19.55	-10.605	-10.61	32.47	-10.605	
H ₂	60.340	26.49	53.40	54.04	11.72	23.63	13.272	26.75	28.547	55.034	56.90	41.919	50.89	-13.215			-26.430	
CO ₂	2.380	1.05	45.99	15.41	3.34	147.17	3.786	166.61	8.142	9.187	9.50	11.928	14.52	2.741	2.74	17.46	5.482	
N ₂	0.360	0.16	4.43	0.75	0.16	4.57	0.184	5.17	0.396	0.554	0.57	0.580	0.73	0.026				
CH ₄	1.147	0.50	8.07	4.85	1.05	16.87	1.191	19.10	2.560	3.063	3.17	3.751	4.57	0.693	0.69	4.38	2.752	
C ₂ H ₄				0.80	0.17	4.98	0.197	5.52	0.424	0.424	0.44	0.621	0.76	0.197	0.39	2.51	0.798	
C ₂ H ₆				0.40	0.09	2.62	0.098	2.97	0.212	0.212	0.22	0.310	0.38	0.098	0.20	1.25	0.588	
C ₃ H ₆				1.16	0.25	10.56	0.284	11.96	0.611	0.611	0.65	0.895	1.09	0.284	0.85	5.43	1.72	
C ₃ H ₈				0.52	0.11	4.98	0.128	5.64	0.274	0.274	0.28	0.402	0.49	0.128	0.39	2.45	1.024	
C ₄ H ₈				0.75	0.16	9.14	0.195	10.35	0.397	0.397	0.41	0.582	0.71	0.185	0.74	4.71	1.480	
C ₄ H ₁₀				0.16	0.04	2.03	0.040	2.30	0.084	0.084	0.09	0.124	0.15	0.040	0.16	1.02	0.400	
C ₅ H ₁₀				0.33	0.07	5.05	0.082	5.72	0.174	0.174	0.18	0.256	0.31	0.082	0.41	2.61	0.820	
C ₆ H ₁₂				0.07	0.02	1.26	0.017	1.43	0.036	0.036	0.37	0.053	0.06	0.017	0.10	0.65	0.204	
OIL												0.394	0.48		3.94	25.08	7.276	
WATER												4.397	5.35			8.794		
TOTAL	43.90	551.73		21.69	359.8924	5.560	406.31	52.830	96.718	82.715	-19.334					65.27	13.67	
H ₂ +CO	42.19																	
H ₂ /CO	1.69																	
ULTIMATE YIELDS			WEIGHT BALANCE			#/hr	%	#/hr	%	#/hr			EFFLUENT RATIOS					
C ₀ Fed													CONTRACTION: 44.05					
C ₁ +C ₂	8.14	19.52	1.221	20.647									CO Conversion: 67.53					
C ₃ +	41.95	92.63	5.793	97.960	16.51	1.033	145.963						H ₂ Conversion: 49.99					
C ₄ +	34.07	75.03	4.692	79.342	12.41	0.776	109.649						H ₂ *C ₂ 56.46					
Ult. Oil	85.27	5.333	90.18	13.67	0.855	120.81												
C ₀₂	17.46	120.62	7.543	127.552														
H ₂ O		92.30	5.772	97.605	12.255	0.766	108.236											

H₂*C₂ 15990 SCFH
H₂ #/M g/M gal/hr GPM

C₃-C₅ 37.40 2.339 7.95 0.497
H₂O 0.11 43.92 2.747 6.80 0.425

R₀ 0.11 45.92 2.747 6.80 0.425
WSC 11.17 0.699 1.34 0.084

92.49 5.784 16.09 1.006
H₂O 90.33 5.649 10.83 0.677

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction measured at 60 °F and 14.7 psig. Cubic Meters/gal = 141.3 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 I From Hr. 0700 to Hr. 0700 Hrs. 180-204

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS					
	SCFH	%	Generator Press.	433		A S T M		Hempel Dist.		In Reactor at Start of Period	619	Particle Size						
Oxygen	3626		O ₂ Preheat, °F	380	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged							
Nat. Gas	5610		Gas Preheat, °F	679	A.P.I.	56.1		to 400	54.0	56.1	Catalyst Recharged							
Total			Reactor Press.	424	I.B.P.	112		400-550	16.0	43.2	Total							
Fresh Feed	16521		Steam Back Press.	703	5%			550+	20.0		Catalyst Taken Out	24	On 40	420+	13.5	80+		
F. F. by C.			Temperatures, °F		10%	152					In Reactor at End of Period	595	100	419-150	57.7	80-40		
Avg. F. F.			Heater Outlet	322	20	187						200	104-74	2.8	20-10			
Wet Gas	8724		Catalyst #1	626	30	202		WATER				250	73-62	1.4	10-0			
Contraction			#2	626	40	234		Temp.	%	Reactor d-P, H ₂ O		325	61-44	1.0				
Recycle	17637		#3	650	50	254		200		Pounds in Reactor	607	<325	43.0	3.8				
Breed	1091		#4	660	60	278		203		Density, lbs./cu. ft.	124	Density, lbs./cu. ft. Chem. Anal.						
			#5		70	301		208		Bed Height, Feet	7.42	Aerated	135	% Fe	65.6			
Total	18728		Average	641	80	328					Settled	137	% C	9.7				
Total Feed	35249		Product Separator	71	90	360					Compacted	151	% Oil	2.4(ext)				
Recycle/F.F.	1.13				95	389					Sp. Grav.	4.0	Specific Surface					
Inlet Vel.	1.06				E.P.	403					Inventory Figures	27.22	% K ₂ O	0.12		m ² /gm		
Steam Flow					Rec.	97.0					From d-P Meters		% H ₂ O	0.63	5.4 mLNH ₃ /m ³			
					Res.	1.5					V/hr/V	3374	K ₂ O/100 Fe	0.18	41m ² /g N ₂ ads.			
					Loss.	1.5					GENERATOR ELEMENTAL BALANCE							
NATURAL GAS		PRODUCT INSPECTION						IN					OUT					
	%	Oil	Water	Product	Pour °F	SUS @ °F		Mol %	SCFH m/hr	C	H	O	Mol %	SCFH m hr	C	H	O	
CO ₂	2.05	Neut. No.	36.3	39.4				O ₂		9.601		19.202	CO ₂		0.915	0.92	1.8	
CH ₄	84.47	Sap. No.	39.8	41.2				CO ₂		0.305	0.31	0.610	CO		15.157	15.16	15.2	
C ₂ H ₆	8.52	Hydrox. No.						CH ₄		12.503	12.50	50.012	CH ₄		0.936	0.94	3.744	
C ₂ H ₈	3.59	Bromine No.	83.8					C ₂ H ₆		1.261	2.52	7.566	H ₂		26.267	52.534		
C ₄ H ₁₀	0.21	% Fe						C ₃ H ₈		0.531	1.59	4.248	N ₂		0.317			
N ₂	0.23	% Alc			11.5			C ₄ H ₁₀		0.031	0.12	0.310	H ₂ O				5.754	2.9
O ₂	0.22	API	49.9	10.7				N ₂		0.138			Total		43.592	17.01	62.032	12.9
MW	19.055							Total		17.0562	136	19.812	Balance		99.8	99.8	100.3	

FRESH FEED			WET GAS			RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION														
%	m/hr	#/hr	Measured	At Wt. Balance	m/hr	#/hr	m/hr	%	m/hr	%	m/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unsat.									
m/hr	#/hr		m/hr	#/hr	m/hr	#/hr	m/hr	%	m/hr	%	m/hr	%	m/hr	a/hr	%	a/hr	#/hr	#/gal	gal/hr	%						
CO	34.770	15.16	424.55	21.96	5.06	141.59	5.732	160.55	10.851	26.008	27.96	16.583	20.69	9.425	9.425	37.81		-9.425								
H ₂	60.256	26.27	52.95	54.77	12.61	25.42	14.295	28.82	27.063	53.330	57.33	41.358	51.60	11.972			-23.944									
CO ₂	2.100	0.92	40.27	13.41	3.09	135.86	3.500	154.06	6.626	7.541	8.11	10.126	12.63	2.585	2.585	17.05		5.170								
N ₂	0.727	0.32	8.88	1.24	0.29	7.98	0.323	9.05	0.611	0.928	1.00	0.934	1.17	0.006												
CH ₄	2.147	0.94	15.02	5.69	1.31	21.00	1.484	23.81	2.810	3.746	4.03	4.294	5.36	0.548	0.548	3.62		2.192		65.20						
C ₂ H ₄				0.69	0.16	4.46	0.180	5.06	0.340	0.340	0.37	0.520	0.65	0.180	0.360	2.38	0.720									
C ₂ H ₆				0.34	0.08	2.38	0.090	2.70	0.169	0.169	0.18	0.259	0.32	0.090	0.180	1.19	0.540									
C ₃ H ₆				0.81	0.19	7.87	0.212	8.92	0.401	0.401	0.43	0.613	0.77	0.212	0.536	4.20	1.272		8.92	4.32	2.06					
C ₃ H ₈				0.14	0.03	1.46	0.037	1.66	0.070	0.070	0.08	0.107	0.13	0.037	0.111	0.73	0.296		8.03	6.25	1.28	84.31				
C ₄ H ₈				0.49	0.11	6.34	0.128	7.19	0.242	0.242	0.26	0.370	0.46	0.128	0.512	3.33	1.024		1.66	4.24	0.39					
C ₄ H ₁₀				0.16	0.04	2.09	0.041	2.37	0.077	0.077	0.09	0.118	0.15	0.041	0.164	1.09	0.410		7.19	5.00	1.44	6.83	6.10	1.12	75.20	
CSH10				0.23	0.05	3.79	0.061	4.30	0.115	0.115	0.12	0.176	0.22	0.061	0.305	2.01	0.610		4.30	5.45	0.79					
C ₆ H ₁₂				0.07	0.02	1.35	0.018	1.53	0.034	0.034	0.04	0.052	0.07	0.018	0.108	0.71	0.220		1.53	5.5	0.28					
OIL														0.392	0.49	-3.916	25.84	7.832		54.32	6.50	8.43				
WATER														4.255	5.31			8.332		4.418	-4.255					
TOTAL	43.59	541.67		23.02	361.59	26.102	410.02	49.415	93.001	80.157		-17.491						77.38		12.39						
H ₂ +CO	41.42						20.027	37.314				-21.397														
H ₂ /CO	1.73						2.49				1.27															
ULTIMATE YIELDS			WEIGHT BALANCE			#/hr		#/hr		EFFLUENT RATIOS		CONTRACTION: 40.12														
C ₁ C ₂	%	C ₀ Fed	#/hr	H ₂ / CO	#/MCF	G ₁ / M ₃	Gal/hr	H ₂ / CO	#/MCF	G ₂ / M ₃	Gal/hr	Wet Gas	361.59	410.02	H ₂ /H ₂ O	9.719	C ₀ Conversion:	62.18								
C ₃ +C ₂	3.452	16.55	1.054	17.823								Oil	40.64	40.64	C ₀₂ /C ₀	0.610	H ₂ Conversion:	45.57								
C ₃	37.947	80.79	5.146	87.018								Water	91.01	91.01	(H ₂) (CO ₂)	5.928	H ₂ *CO=	51.65								
C ₄	18.924	70.21	4.472	75.621								Total	493.24	91.06	(H ₂) (CO)	5.928										
Ult. Oil		77.88	4.961	83.890	9.43	0.5369	75.863																			
C ₀₂	17.054	113.79	7.248	122.563																						
H ₂ O		158.99	10.126	171.23																						

$H_2 \cdot CO = 15700 \text{ SCFH}$
 $\frac{\#/\text{hr}}{\#/\text{MCF}} \cdot \frac{\text{gal}/\text{hr}}{\text{GPM}}$
 $C_3-C_5 = 25.97 \quad 1.654 \quad 5.45 \quad 0.347$
 $\text{Rec O}1 = 40.64 \quad 2.589 \quad 6.26 \quad 0.399$
 $WSC = 10.47 \quad 0.667 \quad 1.26 \quad 0.080$
 $77.08 \quad 4.910 \quad 12.97 \quad 0.826$
 $H_2 \quad 80.54 \quad 5.130 \quad 9.66 \quad 0.615$

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂ by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of measured at O.C. and 14.7 psig. GPM = $16.91 \cdot \frac{\#/\text{MCF}}{\text{GPM}}$. cc/MCF = $141.3 \cdot \frac{\text{gal}/\text{MCF}}{\text{GPM}}$.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 J From Hr. 1000 to Hr. 0700 Hrs. 204-225

FLOWS			RUN CONDITIONS			DISTILLATIONS			CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	431		A S T M		Hempel Dist.	In Reactor at Start of Period	595		Screen	M	%	M	%		
Oxygen	3624		O ₂ Preheat, °F	317	Prod.	Naph		°F % A.P.I.	Fresh Catalyst Charged	257								
Nat. Gas	5733		Gas Preheat, °F	736	A.P.I.	56.5		to 400 56.3 56.5	Catalyst Recharged									
Total			Reactor Press.	422	I.B.P.	108		400-550 15.6 42.9	Total									
Fresh Feed	16861		Steam Back Press.	710		5%		550+ 18.1	Catalyst Taken Out	99	100	419-150 63.7	14.9	80+				
F. F. by C			Temperatures, °F			10% 150			In Reactor at End of Period	753	150	149-105 10.9	40-20					
Avg. F. F.			Heater Outlet	198		20 180					200	104-74 6.7	20-10					
Wet Gas	7488		Catalyst #1	632	30	207					250	73-62 1.4	10-0					
Contraction			#2	632	40	228					325	-44 1.0						
Recycle	16835		#3	669	50	251		200			Pounds in Reactor	937	<325 43.0	1.4				
Bleed	1011		#4	664	60	272		203			Density, lbs./cu. ft.	134						
			#5		70	295		208			Bed Height, Feet	10.60	Aerated 128	% Fe				
Total	17847		Average	649	80	325						Settled 130	% C					
Total Feed	34708		Product Separator	70	90	359						Compacted 147	% Oil					
Recycle/F.F.	1.06				95	398						Space Vel. SCFH/lb. cat.	Sp. Grav. 4.2	Specific Surface				
Inlet Vel.	1.04					E.P. 403						Inventory Figures		m ² /gm				
Steam Flow						Rec. 97.0						From d-P Meters	17.19		6.1 ml.NH ₃ /gm			
						Res. 1.5						V/hr/V	2410					
						Loss. 1.5						G E N E R A T O R E L E M E N T A L B A L A N C E						
NATURAL GAS		PRODUCT INSPECTION							IN			OUT						
	%	Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH/m/hr	C	H	O	Mol %	SCFH/m/hr	C	H	O
CO ₂	2.06	Neut. No.	39.2	38.6				O ₂		9.594		19.188		CO ₂		0.887	0.9	1.8
CH ₄	84.47	Sap. No.	44.4	40.8				CO ₂		0.312	0.31	0.624		CO		16.049	16.1	16.1
C ₂ H ₆	8.52	Hydrox. No.						CH ₄		12.776	12.78	51.104		CH ₄		1.084	1.1	4.356
C ₃ H ₈	3.59	Bromine No.						C ₂ H ₆		1.289	2.58	7.734		H ₂		26.229	52.458	
C ₄ H ₁₀	0.21	% Fe						C ₃ H ₈		0.543	1.63	4.344		N ₂		0.240		
N ₂	0.93	% Alc			10.0			C ₄ H ₁₀		0.032	0.13	0.320		H ₂ O				5.344 2.7
O ₂	0.22	API	50.9	10.4				N ₂		0.141				Total		44.489	18.0 52.138	20.5
MW	19.055							Total		17.42	63.502	19.812	Balance			103.497.8	103.4	

FRESH FEED			WET GAS			RECYCLE			COMB. FEED			EFFLUENT			NET CHANGE ON REACTION							
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	#/hr	m/hr	%	m/hr	%	m/hr	%	m/hr	a/hr	%	a/hr	#/hr	%/gal	gal/hr	
CO	36.073	16.05	449.53	17.76	3.51	98.29	3,903	109.34	8.363	24.411	26.65	12.5	16.13	-12.15	-12.15	24.319		-12.146				
H ₂	58.957	26.23	52.88	50.49	9.98	20.111	111.097	22.37	23.774	50.003	54.59	34.871	45.87	-15.13			-30.264					
CO ₂	1.993	0.89	39.04	17.13	3.38	148.93	3,764	165.67	8.064	8.950	9.77	11.827	15.56	2.88	2.88	17.926		5.754				
N ₂	0.540	0.24	6.72	1.78	0.35	9.86	0.392	10.97	0.838	1.078	1.18	1.230	1.62	0.15								
CH ₄	2.437	1.08	17.39	8.15	1.61	25.83	1.791	28.73	3.838	4.921	5.37	5.628	7.40	0.71	0.71	4.405	2.828					
C ₂ H ₄				1.13	0.22	6.23	0.247	6.93	0.530	0.530	0.58	0.777	1.02	0.25	0.49	3.08	0.988				71.37	
C ₂ H ₆				0.42	0.08	2.50	0.092	2.78	0.198	0.198	0.22	0.308	0.41	0.09	0.18	1.15	0.552					
C ₃ H ₆				1.32	0.26	10.98	0.290	12.21	0.622	0.622	0.68	0.912	1.20	0.29	0.87	5.42	1.740					
C ₃ H ₈				0.27	0.05	2.29	0.058	2.55	0.125	0.125	0.14	0.183	0.24	0.06	0.17	1.08	0.464					
C ₄ H ₈				0.88	0.17	9.71	0.192	10.20	0.412	0.412	0.45	0.604	0.80	0.19	0.77	4.79	1.556					
C ₄ H ₁₀				0.24	0.05	2.67	0.051	2.97	0.111	0.111	0.12	0.162	0.21	0.05	0.20	1.27	0.51					
C ₅ H ₁₀				0.34	0.07	4.70	0.075	5.23	0.160	0.160	0.18	0.235	0.31	0.08	0.38	2.34	0.75					
C ₆ H ₁₂				0.05	0.01	0.72	0.011	0.80	0.024	0.024	0.26	0.035	0.05	0.01	0.06	0.34	0.11					
OIL				0.09	0.02	1.51	0.020	1.68	0.042	0.042	0.05	0.062	0.08	0.02	0.12	0.75	0.24					
WATER												0.532	0.70	- 5.32	33.135	10.636		74.5	6.459	11.54		
TOTAL	44.49	565.56		19.76	344.33	21.980	383.03	47.088	91.585			6.392	8.41			9.91		4.955	6.392			
H ₂ +CO	42.28			13.49		15.000		32.137										106.4		17.01		
H ₂ /CO	1.63			2.84		2.84		2.84	2.048		2.84		1.25									
ULTIMATE YIELDS			WEIGHT BALANCE			#/hr	%	#/hr		EFFLUENT RATIOS			CONTRACTION:			50.59						
	%	C ₀ Fed	#/hr	H ₂ /C ₀	#/MCF	g/M3	Gol/hr	H ₂ /MCF	cc/M3	Wet Gas	344.33		585.05	H ₂ /H ₂₀	5.455	C ₀ Conversion:	75.68					
C ₁ +C ₂	8.629	21.05	1.31	22.152						Oil	57.05		57.05	C ₀₂ /C ₀	0.964	H ₂ Conversion:	57.69					
C ₃ +	49.120	110.75	6.912	116.873						Water	125.48		125.48	(H ₂) (C ₀₂)		H ₂ *C ₀₂	64.52					
C ₄ +	42.616	95.99	5.990	101.295						Total	526.86		93.16	565.56								
Ult. Oil		106.44	6.643	112.324	17.01	1.061	149.919			H ₂ *C ₀₂ 16023 SCFH												
C ₀₂	17.926	126.63	7.903	133.639						#/hr	#/M	Gal/hr	GPM									
H ₂ O		115.16	7.187	121.530						C ₃ -C ₅	56.24	2,262	7.62	0.476								
										Rec Oil	57.05	3,560	8.83	0.551								
										WSC	12.55	0.783	1.50	0.094								
										105.84	6.605	17.95	1.120									
										H ₂ O	112.93	7.048	13.54	0.845								

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of measured oil at 60°F and 14.7 psig. Cubic Meters measured at 60°F and 14.7 psig. GPM = 14.91 * #/MCF. cc/M3 = 14.13 * gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 K From Hr. 0700 to Hr. 0700 Hrs. 225-249

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	430		A S T M		Hempel Dist.		In Reactor at Start of Period	753	Screen		Particle Size			
Oxygen	3651		O ₂ Preheat, °F	332		Prod. Naph		°F	%	A.P.I.	Fresh Catalyst Charged	51					
Nat. Gas	5724		Gas Preheat, °F	707		A.P.I.	56.4		to 400	70.6	56.4	Catalyst Recharged					
Total			Reactor Press.	423		I.B.P.	104		400-550	15.6	39.9	Total					
Fresh Feed	16701		Steam Back Press.	720			5%		550+	13.8		Catalyst Taken Out	42	100	419-150 63.4	80-40	
F. F. by C			Temperatures, °F				10% 142					In Reactor at End of Period	762	150	149-105 10.2	40-20	
Avg. F.F.			Heater Outlet	206			20	174						200	104.74 6.4	20-10	
Wet Gas	7049		Catalyst #1	632			30	200	WATER					250	73.62 0.3	10-0	
Contraction		#2		632			40	222						325	61.44 0.8		
Recycle	15752		#3	658			50	244		200		Pounds in Reactor	944	<325	43.0 1.2		
Bleed	1026		#4	646			60	266		203		Density, lbs./cu. ft.	133			Density, lbs./cu. ft.	
			#5				70	294		208		Bed Height, Feet	10.75	Aerated	143	% Fe	
Total	16778		Average	642			80	326				Settled	145	% C	6.65		
Total Feed	33499		Product Separator	70			90	356				Compacted	156	% Oil			
Recycle.F.F.	1.00						95	383				Sp. Grav.	4.3	Specific Surface		m ² /gm	
Inlet Vel.	1.01						E.P.	403				Inventory Figures					
Steam Flow							Rec.	97.5				From d-P Meters	17.71 % H ₂ 0.87	6.4	ml:NH ₃ /cm ³		
							Res.	1.5				V/hr/N	2357				
							Loss	1.0				GENERATOR ELEMENTAL BALANCE					
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O			
CO ₂	1.08		Neut. No.	40.5	39.0				O ₂		0.658		19.316	CO ₂	1.088	1.1	2.2
CH ₄	91.93		Sap. No.	49.3	46.3				CO ₂		0.299	0.30	0.599	CO	15.246	15.8	15.8
C ₂ H ₆	8.60		Hydrox. No.						CH ₄		12.819	12.825	1.276	CH ₄	0.993	1.0	3.972
C ₃ H ₈	3.48		Bromine No.	89.5					C ₂ H ₆		1.299	2.80	7.794	H ₂	26.268	52.136	
C ₄ H ₁₀	0.20		% Fe						C ₃ H ₈		0.525	1.58	4.200	N ₂	0.124		
N ₂	0.68		% Alc						C ₄ H ₁₀		0.030	0.12	0.300	H ₂ O			5.624 28.2
O ₂	0.17		°API	50.3	49.6				N ₂		0.104			Total	44.118	17.9 61.732 20.8	
MW	18.972								Total		17.4163.570	19.914	Balance		103.097.1	104.6	

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION					
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	%	m/hr	%	m/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Insats.
CO	35.91715.846	443.85	18.66	3.47	37.22	3.930	110.07	8.261	24.107	27.27	12.191	16.87	11.916	+11.916				
H ₂	59.08626.068	52.55	47.56	9.85	17.84	10.020	20.20	21.064	47.132	53.32	31.054	43.01	16.048	-32.096				
CO ₂	2.467	1.062	47.88	19.03	3.54	155.80	4.008	176.35	9.425	9.513	10.76	12.433	17.20	2.920	2.920	18.425	5.940	
N ₂	0.280	0.124	3.47	1.09	0.20	5.63	0.228	6.37	0.479	0.603	0.68	0.707	0.98	0.104				
CH ₄	2.250	0.983	15.83	8.52	1.59	25.43	1.794	28.79	3.773	4.766	5.39	5.567	7.70	0.801	0.901	5.05	3.204	
C ₂ H ₄								1.42	0.26	7.40	0.412	8.38	0.627	0.627	0.71	1.496	71.28	
C ₂ H ₆								0.52	0.10	2.88	0.109	3.27	0.228	0.228	0.26	0.637	0.654	
C ₃ H ₈								1.41	0.26	11.07	0.298	12.53	0.625	0.625	0.71	0.923	1.288	
C ₃ H ₈								0.10	0.02	0.84	0.021	0.95	0.044	0.044	0.05	0.065	0.095	
C ₄ H ₁₀								0.89	0.17	9.26	0.137	10.49	0.399	0.399	0.44	0.579	10.46 5.00 2.10	
C ₄ H ₁₀								0.25	0.05	2.73	0.653	3.09	0.110	0.110	0.12	0.163	9.96 6.1 1.63 77.23	
C ₅ H ₁₀								0.39	0.07	4.98	0.690	5.64	0.168	0.168	0.19	0.240	3.09 4.36 0.64	
C ₆ H ₁₂								0.56	0.01	0.37	0.014	0.03	0.027	0.027	0.03	0.041	6.62 5.45 1.21	
OIL								0.99	0.02	1.43	0.019	1.62	0.041	0.041	0.05	0.060	1.62 5.50 0.29	
WATER													0.470	0.65	4.652	28.36	65.17 6.48 10.06	
TOTAL	44.112	563.68		18.60	343.39	21.058	452.94	44.269	88.787	72.275			6.068	9.40		12.136	6.068 - 6.076	
H ₂ +CO	41.914			12.82		13.950											27.964	
H ₂ /CO	1.64				2.55			2.55		1.955		2.55		1.35				
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr									
	%	CO Fed	#/hr	H ₂ /CO	#/MCF	g/M3	Gal/hr	Gal/MCF	H ₂ /CO	cc/M3	Wet Gas	543.39	388.77	H ₂ /H ₂ O	5.115	C ₀ Conversion:	75.20	
C ₁ +C ₂	11.628	24.51	1.543	26.092							Oil	54.21	54.21	C ₀₂ /C ₀	1.019	H ₂ Conversion:	61.56	
C ₃ +	45.135	35.209	2.222	37.574							Water	120.70	120.70	(H ₂) (C ₀₂)		H ₂ + CO =	66.72	
C ₄ +	39.097	21.81	1.373	23.217							Total	518.30	91.95	(H ₂₀) (C ₀)	5.212			
Ult. Oil	96.29	6.061	102.491	15.627	0.9837	139.00					H ₂ + CO = 15885 SCFH							
C ₀₂	13.425	120.51	8.090	136.802							#/hr	#/M	Gal/hr	GPM				
H ₂ O	109.47	6.891	116.526								C ₃ -C ₅	35.29	2.22	7.56	0.463	Yield Calculations assume "oil" is CH ₂ , and is found by difference on Carbon, and H ₂ O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at O C and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.		
											Rec	01154.21	3.413	8.37	0.527			
											WSC	13.28	0.336	1.59	0.100			
											H ₂ O	102.78	6.470	17.32	1.090			
												107.42	6.762	12.98	0.811			

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 L From Hr. 0700 to Hr. 0700 hrs. 249-273

FLOWS			RUN CONDITIONS			DISTILLATIONS					CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	431		A S T M			Hempel Dist.		In Reactor at Start of Period	762	Particle Size					
Oxygen	3730		O ₂ Preheat, °F	388	Prod.	Naph			°F	%	A.P.I.	Fresh Catalyst Charged	50	Screen			Sedimentation	
Nat. Gas	5692		Gas Preheat, °F	665	A.P.I.	56.4			to 400	70.3	56.4	Catalyst Recharged		Frac.	M	%	M	%
Total			Reactor Press.	422	I.B.P.	102			400-550	20.0	40.6	Total		On 40	420+	18.8	80+	
Fresh Feed	16969		Steam Back Press.	721		5%			550+	9.7		Catalyst Taken Out	36	100	419-150	63.2	80-40	
F. F. by C			Temperatures, °F	*		10%	142					In Reactor at End of Period	776	150	149-105	9.3	40-20	
Avg. F.F.			Heater Outlet	200		20	170							200	104-74	6.1	20-10	
Wet Gas	7040		Catalyst #1	634		30	196		WATER					250	73-62	C.8	10-0	
Contraction			#2	633		40	220		Temp.	%	Reactor d-P, H ₂ O			325	61-44	0.8		
Recycle	16710		#3	663		50	242		200		Pounds in Reactor			<325	43-0	0.9		
Bleed	1020		#4	654		60	262		203		Density, lbs./cu. ft.			132	Density, lbs./cu. ft.			Chem. Anal.
			#5			70	290		208		Bed Height, Feet			10.66	Aerated	148	% Fe	
Total	17730		Average	646		80	320							Settled	150	% C		
Total Feed	34699		Product Separator	74		90	351							Compacted	163	% Oil		
Recycle/F.F.	1.04					95	382		Space Vel. SCFH/lb. cat.					Sp. Grav.	4.3	Specific Surface		
Inlet Vel.	1.04					E.P.	400		Inventory Figures								m ² /gm	
Steam Flow						Rec.	97.5		From d-P Meters					18.27			5.7	m ³ NH ₃ /gm
						Res.	1.5		V/hr/V					2412				
						Loss	1.0		GENERATOR ELEMENTAL BALANCE									
NATURAL GAS		PRODUCT INSPECTION						IN					OUT					
%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	SCFH m/hr	C	H	O	Mol %	SCFH m hr	C	H	O	
CO ₂	1.80	Neut. No.	50.4	43.4				O ₂		9.861		19.722	CO ₂		0.975	1.0		2.0
CH ₄	25.29	Sap. No.	43.4	41.7				CO ₂		0.285	0.29	0.570	CO		16.045	16.5		16.1
C ₂ H ₆	9.62	Hydrox. No.						CH ₄		12.810	12.61	51.240	CH ₄		0.285	0.9	3.540	
C ₃ H ₈	3.37	Bromine No.	94.5					C ₂ H ₆		1.304	2.61	7.824	H ₂		26.790		53.580	
C ₄ H ₁₀	0.19	% Fe						C ₃ H ₈		0.506	1.52	4.048	N ₂		0.077			
N ₂	0.45	% Alc		10.0				C ₄ H ₁₀		0.029	0.12	0.290	H ₂ O				5.388	2.7
O ₂	0.12	API	49.7	10.6				N ₂		0.068			Total		44.773	17.9	62.508	20.7
MW	18.899							Total		17.34	63.402	20.292	Balance			103.3	98.6	102.0

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 M

From

Hr. 0700

to

4-8700

43

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS			
	SCFH	%	Generator Press.	430		A S T M		Hempel Dist.		In Reactor at Start of Period	776					
Oxygen	3964		O ₂ Preheat, °F	409	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged	52			Particle Size	
Nat. Gas	5628		Gas Preheat, °F	696	A.P.I.	56.4		to 400	70.6	56.4	Catalyst Recharged				Screen	
Total			Reactor Press.	420	I.B.P.	102		400-550	18.0	38.9	Total				Frac.	M
Fresh Feed	17077		Steam Back Press.	700	5%			550+	11.4		Catalyst Taken Out	75	100	419-150	63.7	80-40
F. F. by C			Temperatures, °F		10%	141					In Reactor at End of Period	755	150	149-105	10.5	40-20
Avg. F. F.			Heater Outlet	204	20	168							200	104-74	7.7	20-10
Wet Gas	7000		Catalyst #1	636	30	196		WATER					250	73-62	0.6	10-0
Contraction			#2	635	40	218		Temp.	%	Reactor d-P, H ₂ O			325	61-44	0.2	
Recycle	16693		#3	663	50	240		200		Pounds in Reactor		944	<325	43.0	1.9	
Bleed	1020		#4	553	60	262		203		Density, lbs./cu. ft.		132	Density, lbs./cu. ft.		Chem. Anal.	
			#5		70	290		208		Bed Height, Feet		10.83	Aerated	148	% Fe.	
Total	17713		Average	647	80	314							Settled	151	% C	7.87
Total Feed	34790		Product Separator	71	90	350							Compacted	162	% Oil	
Recycle/F.F.	1.04				95	382				Space Vel. SCFH/lb. cat.			Sp. Grav.	4.5	Specific Surface	
Inlet Vel.	1.05				E.P.	403				Inventory Figures					m ² /gm	
Steam Flow					Rec.	98				From d-P Meters		18.09	H ₂ 0.52	8.4	ml:NH ₃ /gm	
					Res.	1.5				V/hr/r		2390				
					Loss.	0.5				GENERATOR ELEMENTAL BALANCE						
NATURAL GAS			PRODUCT INSPECTION						IN				OUT			
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O		
CO ₂	2.02	Neut. No.	44.9	42.5					O ₂		10.473		20.946	CO ₂		
CH ₄	83.86	Sap. No.	49.3	42.9					CO ₂		0.300	0.30	0.600	CO	1.107	1.1
C ₂ H ₆	9.27	Hydrox. No.							CH ₄		12.448	12.45	49.792	CH ₄	16.053	16.1
C ₃ H ₈	3.80	Bromine No.	83.7						C ₂ H ₆		1.376	2.75	8.256	H ₂	0.041	0.8
C ₄ H ₁₀	0.21	% Fe							C ₃ H ₈		0.564	1.69	4.512	N ₂	26.955	58.91
N ₂	0.78	% Alc		10.0					C ₄ H ₁₀		0.031	0.12	0.310	H ₂ O	0.102	
O ₂	0.09	° API	49.7	10.6					N ₂		0.116					6.08
MW	19.1693								Total		17.32	62.97021	54.54	Balance	45.056	18.0
														103.9100	8.00	

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at 0 C. and 14.7 psig. g/M3 = 16.91 X #/MCF. cc/M3 = 141.3 X gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 II From Hr. 0700 to Hr. 0700 Hrs. 297-321

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	433		A S T M		Hempel Dist.		In Reactor at Start of Period	755								
Oxygen	3535		O ₂ Preheat, °F	419	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged	50	Particle Size						
Nat. Gas	5742		Gas Preheat, °F	685	A.P.I.	55.5		to 400	70.0	55.5	Catalyst Recharged		Screen						
Total			Reactor Press.	423	I.B.P.	106.0		400-550	15.3	39.5	Total		M. %						
Fresh Feed	16936		Steam Back Press.	720		5%		550+	14.7		Catalyst Taken Out	71	100	419-150	64.6	80-40			
F.F. by C			Temperatures, °F			10% 148					In Reactor at End of Period	732	150	149-105	12.4	40-20			
Avg. F. F.			Heater Outlet	246		20 177							200	104-74	7.4	20-10			
Wet Gas	7472		Catalyst #1	632	30	203		WATER					250	73-62	1.0	10-0			
Contraction		±2	632	40	224			Temp.	%	Reactor d.P. H ₂ O		325	61-44	0.4					
Recycle	16718		#3	678	50	247		200		Pounds in Reactor		936	<325	43.0	1.4				
Bleed	1026		#4	655	60	268		203		Density, lbs./cu. ft.		132	Density, lbs./cu. ft. Chem. Anal.						
		±5		70	294			208		Bed Height, Feet		10.74	Aerated	149	% Fe	68.9			
Total	17744		Average	649	80	320		X-Ray Diffraction					Settled	151	% C	6.45			
Total Feed	34680		Product Separator	67	90	352		on Catalyst					Compacted	161	% Oil	1.9(ext)			
Recycle/F.F.	1.05			95	378					Space Vel. SCFH/lb. cat.			Sp. Grav.	4.3	Specific Surface				
Inlet Vel.	1.04			E.P.	400					Inventory Figures			% K ₂ O	0.80	m ² /gm				
Steam Flow				Rec.	98					From d.P. Meters			% H ₂ O	0.22	ml.NH ₃ /gm				
				Res.	1.5					V/hr/V			2390	K ₂ O/100 Fe 0.29	<1m ² /g N ₂ ads.				
				Loss	0.5								GENERATOR ELEMENTAL BALANCE						
NATURAL GAS		PRODUCT INSPECTION								IN				OUT					
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	m³/hr	C	H	O	Mol %	m³/hr	C	H	O
CO ₂	1.82		Neut. No.	43.6	42.9			O ₂		9.357		18.714		CO ₂		0.933	0.9	1.9	
CH ₄	84.75		Sap. No.	43.3	43.4			CO ₂		0.276	0.28	0.552		CO		15.541	15.5	15.5	
C ₂ H ₆	8.56		Hydrox. No.					CH ₄		12.840	12.845	1.360		CH ₄		1.786	1.8	7.144	
C ₃ H ₈	3.48		Bromine No.					C ₂ H ₆		1.297	2.59	7.782		H ₂		26.290	52.580		
C ₄ H ₁₀	0.20	% Fe						C ₃ H ₈		0.527	1.58	4.216		N ₂		0.135			
N ₂	0.99	% Alc		10.0				C ₄ H ₁₀		0.030	0.12	0.300		H ₂ O				3.826	
O ₂	0.20	*API	49.3	10.7				N ₂		0.150				Total		44.685	18.3	63.550	
MW	18.9625							Total		17.4163	6.688	19.266	Balance			104.9	99.83	100.3	

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION						
	%	m/hr	#/hr	%	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	%	m/hr	a/hr	%	a/hr	#/hr	#/gal	gal/hr
CO	34.790	15.541	435.30	16.13	3.18	89.1	3.560	99.72	7.551	23.092	25.24	11.111	14.71	-11.991	-11.991	22.90		-11.981	
H ₂	50.833	26.290	53.00	49.67	9.79	19.7	10.964	22.10	23.254	49.544	54.15	34.218	45.31	-15.326		-30.65			
CO ₂	2.087	0.933	41.06	17.44	3.44	151.3	3.849	169.40	8.163	9.096	9.94	12.012	15.90	2.916	2.915	18.76		5.832	
N ₂	0.303	0.135	3.78	0.51	0.10	2.3	0.113	3.17	0.240	0.375	0.41	0.353	0.47	-0.022					
CH ₄	3.997	1.786	28.65	11.28	2.22	35.7	2.490	39.95	5.281	7.067	7.72	7.771	10.29	0.704	0.704	4.53	2.92		
C ₂ H ₄				1.20	0.24	6.7	0.265	7.44	0.563	0.563	0.62	0.828	1.10	0.265	0.530	3.41	1.06		73.01
C ₂ H ₆				0.42	0.08	2.5	0.092	2.75	0.195	0.195	0.21	0.297	0.38	0.092	0.184	1.18	0.55		
C ₃ H ₆				1.32	0.26	10.3	0.291	12.25	0.615	0.615	0.67	0.907	1.20	0.291	0.373	5.62	1.75		12.3 4.32 2.94 11.0 6.25 1.76 73.62
C ₃ H ₈				0.45	0.09	3.3	0.100	4.39	0.812	0.212	0.23	0.312	0.41	0.100	0.300	1.93	0.90		4.4 4.24 1.04
C ₄ H ₈				0.87	0.17	9.6	0.191	10.74	0.405	0.405	0.44	0.596	0.79	0.191	0.764	4.92	1.53		10.7 5.00 2.15 10.2 6.10 1.67 90.51
C ₄ H ₁₀				0.20	0.04	2.3	0.045	2.60	0.095	0.095	0.10	0.140	0.19	0.045	0.180	1.16	0.45		2.6 4.36 0.53
C ₅ H ₁₀				0.40	0.08	5.5	0.088	6.20	0.188	0.188	0.21	0.276	0.37	0.088	0.440	2.93	0.98		6.6 5.45 1.21
C ₆ H ₁₂				0.02	0.01	0.4	0.006	0.40	0.010	0.010	0.03	0.016	0.02	0.006	0.030	0.19	0.05		
OIL				0.08	0.02	1.4	0.018	1.51	0.038	0.038	0.04	0.056	0.07	0.018	0.108	0.69	0.22		1.5 5.5 0.27
WATER												0.495	0.66		4.952	31.96	9.90		69.4 6.52 10.64
TOTAL				44.685	561.79		19.72	341.8	22.073	452.00	46.818	91.496	75.527		6.149	8.14		10.64	5.32 -6.149
H ₂ +CO				41.831			12.97		14.524		30.905								101.3 16.09
H ₂ /CO				1.69			3.08		3.079		3.08	2.145	3.079		1.28				
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr	%	#/hr	%	EFFLUENT RATIOS						CONTRACTION: 50.60
	%	C O Fed	#/hr	#/MCF	g/M3	Gal/hr	Gal/MCF	cc/M3	Gal/hr	Gal/MCF	cc/M3	cc/M3	Weight Gas	341.76	382.62	H ₂ /H ₂ O	5.564	C O Conversion:	77.09
C ₁ +C ₂	9.122	21.49	1.355	22.913									Oil	60.25	60.25	C O ₂ /C O	1.081	H ₂ Conversion:	58.30
C ₃ +	49.201	107.47	6.778	114.615									Water	118.92	118.92	(H ₂) (C O ₂)	6.014	H ₂ + CO ₂	65.28
C ₄ +	41.654	90.93	5.729	96.977									Total	520.93	92.73	561.79			
Ult. Oil				101.32	6.390	108.054	16.086	1.0146	16.320				H ₂ *CO ₂ 158.54 SCFH						
CO ₂				18.763	128.34	8.095	136.886						#/hr	#/M	gal/hr	GPM			
H ₂ O					110.78	6.987	118.150						C ₃ -C ₅ 38.09 2.403 8.04 0.507						
													Rec 01160.25	3.800	9.23	0.582			
													WSC 11.89	1.43	0.43	0.090			
													110.23	6.953	18.70	1.180			
													H ₂ O 107.03	6.751	12.83	0.809			

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60° F and 14.7 psig. Cubic Meters measured at 0°C and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46-0 From Hr. 0700 to Hr. 0700 Hrs. 321-345

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION														
	%	m/hr	#/hr	Measured		At Wt Balance		m/hr	m/hr	%	m/hr	%	Carbon		Hydrogen		Oxygen		Ultimate Oil		Unsats.						
				m/hr	#/hr	m/hr	#/hr						a/hr	%	a/hr	%	a/hr	#/hr	#/gal	gal/hr							
CO	36.03	16.155	452.50	18.40	3.80	106.5	4.328	121.23	9.843	24.998	26.91	13.171	17.01	-11.827	-11.827	26.79			-11.827								
H2	59.55	26.713	53.85	51.54	10.65	21.5	12.124	24.45	24.775	51.482	55.42	36.899	47.65	-14.589					-29.178								
CO2	1.95	0.874	32.46	17.43	3.60	156.5	4.099	180.40	8.377	9.251	9.96	12.476	16.11	3.225	3.225	19.96			6.450								
N2	0.34	0.152	4.28	0.46	0.10	2.7	0.109	3.06	0.222	0.374	0.40	0.331	0.43	0.043													
CH4	2.10	0.943	15.13	7.82	1.62	25.9	1.840	29.52	3.760	4.703	5.06	5.60	7.23	0.897	0.897	5.55	3.588										
C2H4				1.44	0.50	8.4	0.339	9.51	0.693	0.693	0.75	1.032	1.33	0.339	0.678	4.20	1.356			72.54							
C2H6					0.51	0.11	3.2	0.119	3.60	0.245	0.245	0.26	0.364	0.47	0.119	0.238	1.47	0.714									
C3H6						1.14	0.24	9.9	0.269	11.30	0.549	0.549	0.59	0.818	1.06	0.269	0.807	5.00	1.614	11.30	4.32	2.62					
C3H8							0.12	0.03	1.1	0.028	1.25	0.057	0.057	0.06	0.085	0.11	0.028	0.084	0.52	0.224	10.17	6.25	1.63				
C4H8								0.66	0.14	7.6	0.155	8.68	0.317	0.317	0.34	0.472	0.61	0.155	0.620	3.84	1.240	1.25	4.24	0.30			
C4H10									0.15	0.03	1.9	0.036	2.12	0.073	0.073	0.08	0.109	0.14	0.036	0.144	0.89	0.36		2.12	4.86	0.44	
C5H10									0.25	0.05	3.6	0.058	4.07	0.118	0.118	0.13	0.176	0.23	0.058	0.290	1.90	0.58			4.65	5.45	0.85
C6H12									0.03	0.01	0.5	0.008	0.59	0.015	0.015	0.02	0.023	0.03	0.008	0.040	0.25	0.08					
OIL									0.04	0.01	0.7	0.009	0.76	0.019	0.019	0.02	0.028	0.04	0.009	0.054	0.33	0.11		0.76	5.5	0.14	
WATER																0.475	0.61	4.75	29.40	9.50			66.55	6.51	10.22		
TOTAL		44.837	564.20		20.57	352.0	23.523	400.54	48.070	92.90		77.436		-21.316						92.50		14.63					
H2+CO		42.868			14.46		16.452		33.618						-26.416												
H2/CO		1.65			2.80		2.80		2.80	2.06		2.80		1.23													
												5.377	6.94			9.81			4.907	5.377							

ULTIMATE YIELDS						WEIGHT BALANCE	#/hr	%	#/hr	EFFLUENT RATIOS	CONTRACTION: 47.54
	% CO Fed	H ₂ / C ₀		H ₂ / C ₀							
		#/#MCF	g/M3	Gal/hr	Gal/MCF	cc/M3					
C1+C2	11.221	27.50	1,693	28.628			Wet Gas	351.95	400.54	H ₂ /H ₂ O 6.862	CO Conversion: 73.21
C3+	42.020	95.31	5,866	99.194			Oil	52.22	52.22	C02/C0 0.947	H ₂ Conversion: 54.61
C4+	36.506	82.76	5,094	86.139			Water	111.44	111.44	(H ₂) (C02) (H ₂ O) (C0) 6.50	H ₂ *C0= 61.62
							Total	515.61	91.39	564.20	
Ult. Oil		92.50	5,693	96.268	14.628	90.03	H ₂ *C0= 16247 SCFH				
C02	19.952	141.94	8,756	147.725			#/hr	#/M	Gal/hr	GPM	
H2O		96.87	5,962	100.817			C ₃ -C ₅ 28.76	1.770	6.09	0.375	
							Rec 01152.22	3.214	8.01	0.493	
							WSC	12.26	0.755	1.47	0.090

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂0 by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at O.C. and 14.7 psig. g/M3 = 16.91 * #/MCF. cc/M3 = 141.3 * gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 P From Hr. 0700 to Hr. 0700 Hrs. 345-369

FLOWS			RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS			
	SCFH	%	Generator Press.	422		A S T M		Hempel Dist.	In Reactor at Start of Period	699					
Oxygen	3913		O ₂ Preheat, °F	359	Prod. Naph			°F % A.P.I.	Fresh Catalyst Charged	50					
Nat. Gas	5616		Gas Preheat, °F	689	A.P.I.	55.1		to 400	71.6 55.1	Catalyst Recharged					
Total			Reactor Press.	413	I.B.P.	101		400-550	16.6 39.2	Total					
Fresh Feed	16725		Steam Back Press.	716	5%			550+	11.8	Catalyst Taken Out	68	100	419-150	64.8	80-40
F. F. by C			Temperatures, °F		10% 150					In Reactor at End of Period	681	150	149-105	9.1	40-20
Avg. F. F.			Heater Outlet	212	20 179							200	104-74	5.9	20-10
Wet Gas	7381		Catalyst #1	633	30 203							250	73-62	0.4	10-0
Contraction		±2	632	40 227				Temp. %	Reactor d-P, H ₂ O			325	61-44	0.2	
Recycle	16624	#3	656	50 248				200		Pounds in Reactor	854	<325	43-0	4.0	
Bleed	1024	#4	646	60 272				203		Density, lbs./cu. ft.	128				Chem. Anal.
		#5	70 297					208		Bed Height, Feet	10,11	Aerated	148	% Fe	64.1
Total	17653	Average	642	80 323							Settled	150	% C	7.7	
Total Feed	34378		Product Separator	71	90 363						Compacted	163	% Oil	1.1(ext)	
Recycle/F.F.	1.06			95 394											Specific Surface
Inlet Vel.	1.04			E.P. 408	Fe ₂ C ₉ 40%										m ² /gm
Steam Flow				Rec. 98	Fe ₂ O ₄ 55%										
				Res. 1.5	Fe 5%										
				Loss 0.5											

NATURAL GAS		PRODUCT INSPECTION						IN					OUT					
	%	Oil	Water	Product	Pour °F	SUS @ °F		Mol %	mm/hr	C	H	O	Mol %	mm/hr	C	H	O	
CO ₂	1.86	Neut. No.	44.1	43.5				O ₂		10.367		20.734	CO ₂		1.087	1.1	2.2	
CH ₄	85.25	Sap. No.	48.8	45.3				CO ₂		0.276	0.28	0.552	CO		16.053	16.1	16.1	
C ₂ H ₆	8.27	Hydrox. No.						CH ₄		12.633	12.63		CH ₄		0.045	0.1	0.180	
C ₃ H ₈	3.24	Bromine No.	76					C ₂ H ₆		1.226	2.45	50.532	H ₂		26.876	53.352		
C ₄ H ₁₀	0.05	% Fe						C ₃ H ₈		0.490	1.44	7.356	N ₂		0.268			
N ₂	1.05	% Alc	11.0					N ₂		0.007	0.03	3.840	H ₂ O				8.192 4.1	
O ₂	0.28	*APT	49.4	10.7						0.156		0.070	Total		44.129	17.2	61.724 22.3	
MW	18.8225												Total		16.83	61.798	21.286 Balance	
																102.1	99.88	104.9

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION					
	%	m/hr	#/hr	%	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unsats. %	
CO	36.37716.053	449.64	19.03	3.71	103.8	4.234	118.80	8.865	24.918	27.47	13.089	17.47	-11.819	-11.819	26.38	-11.819		
H ₂	60.45026.676	53.78	53.24	10.37	20.9	11.844	23.97	24.798	51.474	56.75	36.642	48.86	-14.832			-29.664		
CO ₂	2.463	1.087	47.84	18.67	3.64	160.0	4.152	182.73	8.694	9.781	10.78	12.846	17.13	3.065	3.065	19.09	6.130	
N ₂	0.607	0.268	7.61	0.72	0.14	4.0	0.161	4.51	0.336	0.604	0.67	0.497	0.66	-0.107				
CH ₄	0.103	0.045	0.72	3.91	0.76	12.2	0.869	13.95	1.821	1.866	2.06	2.690	3.59	0.824	0.924	5.13	3.296	
C ₂ H ₄				1.24	0.24	6.8	0.275	7.72	0.577	0.577	0.64	0.852	1.14	0.275	0.550	3.43	1.100	
C ₂ H ₆				0.50	0.10	2.9	0.111	3.34	0.232	0.232	0.26	0.343	0.46	0.111	0.222	1.58	0.666	
C ₃ H ₈				1.17	0.23	9.6	0.260	10.95	0.546	0.546	0.60	0.806	1.08	0.260	0.780	4.86	1.560	
C ₃ H ₈				0.20	0.04	1.7	0.043	1.92	0.091	0.091	0.10	0.134	0.18	0.043	0.129	0.80	0.344	
C ₄ H ₈				0.73	0.14	8.0	0.163	9.16	0.341	0.341	0.38	0.504	0.67	0.163	0.652	4.06	1.304	
C ₄ H ₁₀				0.15	0.03	1.7	0.034	1.99	0.071	0.071	0.08	0.105	0.14	0.054	0.136	0.85	0.34	
C ₅ H ₁₀				0.32	0.06	4.4	0.071	4.97	0.149	0.149	0.16	0.220	0.29	0.071	0.355	2.21	0.71	
C ₆ H ₁₂				0.05	0.01	0.4	0.007	0.49	0.015	0.015	0.02	0.022	0.03	0.007	0.035	0.22	0.35	
OIL				0.08	0.02	1.3	0.017	1.44	0.035	0.035	0.04	0.052	0.07	0.017	0.102	0.64	0.20	
WATER												0.497	0.66		4.969	30.95	9.94	
TOTAL	44.129	559.49		19.48	337.6	22.245	385.64	46.577	90.700			5.689	7.59			9.85		
H ₂ +CO	42.729				14.08		16.078		33.663								97.07	15.56
H ₂ /CO	1.66				2.80		2.80		2.80	2.065	2.80		1.255					
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr				EFFLUENT RATIOS	CONTRACTION: 49.59				
C ₀ Fed	#/hr	H ₂ /CO	#/MCF	g/M3	Gal/hr	Gal/MCF	cc/M3											
C ₁ +C ₂	9.940	24.29	1.500	126.83														
C ₃ +C ₄	44.586	100.54	6.208	104.98														
C ₄ +C ₅	38.925	87.67	5.413	91.53														
Ult. Oil		97.07	5.993	101.34	15.363	94.867	134.05											
CO ₂	19.092	134.89	8.329	140.84														
H ₂ O		102.49	6.328	107.01														

H₂*CO = 16194 SCFH
#'/hr #'/M Gal/hr .GPM

C₃-C₅ 30.92 1.909 6.48 0.400
R₆ 81157.68 3.562 8.86 0.547
WSC 12.78 0.789 1.53 0.094

101.38 6.260 16.87 1.042

105.39 6.384 12.40 0.766

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂0 by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 °F and 14.7 psig. Cubic Meters measured at 0 °C and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 Q From Hr. 0700 to Hr. 0700 Hrs. 369-393

FLOWS			RUN CONDITIONS			DISTILLATIONS					CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	426		A S T M			Hempel Dist.		In Reactor at Start of Period	681	Particle Size					
Oxygen	3794		O ₂ Preheat, °F	388	Prod.	Naph			°F	%	A.P.I.	Fresh Catalyst Charged	100	Screen Sedimentation				
Nat. Gas	5609		Gas Preheat, °F	672	A.P.I.	54.8			to 400	75.0	54.8	Catalyst Recharged		Frac.	M	%	M	%
Total			Reactor Press.	418	I.B.P.	108			400-550	14.0	39.0	Total		On 40	420+	13.6	80+	
Fresh Feed	16644		Steam Back Press.	730	5%				550+	13.0		Catalyst Taken Out	82	100	419-150	63.0	80-40	
F. F. by C			Temperatures, °F		10%	146						In Reactor at End of Period	699	150	149-105	12.2	40-20	
Avg. F. F.			Heater Outlet	242	20	176								200	104.74	6.6	20-10	
Wet Gas	7045		Catalyst #1	635	30	204	WATER							250	73.62	1.0	10-0	
Contraction			#2	635	40	228			Temp.	%	Reactor d-P, H ₂ O			325	61.44	0.2		
Recycle	16015		#3	655	50	250			200		Pounds in Reactor	906	<325	43.0	3.4			
Bleed	1012		#4	643	60	276			203		Density, lbs./cu. ft.	130		Density, lbs./cu. ft.		Chem. Anal.		
			#5		70	302			208		Bed Height, Feet	10.56	Aerated	151	% Fe			
Total	17027		Average	642	80	332							Settled	153	% C			
Total Feed	33671		Product Separator	74	90	365							Compacted	167	% Oil			
Recycle/F.F.	1.02				95	391					Space Vel. SCFH/lb. cat.		Sp. Grav.	4.5	Specific Surface			
Inlet Vel.	1.01				E.P.	417					Inventory Figures					m ² /gm		
Steam Flow					Rec.	98.0					From d-P Meters	16.37		6.1	ml.NH ₃ /gm			
					Res.	1.5					v/hr/v	2390						
					Loss.	0.5					GENERATOR ELEMENTAL BALANCE							
NATURAL GAS			PRODUCT INSPECTION						IN					OUT				
%			Oil	Water	Product	Pour °F	SUS @ °F		Mol %	ppm/m ³	C	H	O	Mol %	ppm/m ³	C	H	O
CO ₂	1.80	Neut. No.	44.8	43.4					O ₂	10.037		20.074		CO ₂	1.053	1.1	2.1	
CH ₄	85.06	Sap. No.	48.8	42.9					CO ₂	0.266	0.27	0.532		CO	15.844	15.8	15.8	
C ₂ H ₆	8.27	Hydrox No.							CH ₄	12.587	12.59	50.348		CH ₄	0.224	0.2	0.896	
C ₃ H ₈	3.27	Bromine No.	84						C ₂ H ₆	1.224	2.45	7.344		H ₂	26.505	53.010		
C ₄ H ₁₀	0.22	% Fe							C ₃ H ₈	0.484	1.35	3.872		N ₂	0.289			
N ₂	1.13	% Alc		9.0					C ₄ H ₁₀	0.033	0.13	0.330		H ₂ O		6.650	3.3	
O ₂	0.26	* APT	49.3	10.6					N ₂	0.167			Total		43.914	17.1	60.556	21.3
MW	18.8936													16.7961	-894.20	-606.0	Balance	

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 R From Hr. 0700 to Hr. 0700 Hrs. 393-417

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS								
	SCFH	%	Generator Press.	432		A S T M	Hempel Dist.	In Reactor at Start of Period	699		Screen	Sedimentation	Frac.	M	%	M	%		
Oxygen	3850		O ₂ Preheat, °F	413	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged	164							
Nat. Gas	5466		Gas Preheat, °F	665	A.P.I.	54.9		to 400	74.0	54.0	Catalyst Recharged								
Total			Reactor Press.	423	I.B.P.	106		400-550	13.3	39.1	Total				On 40	420+			
Fresh Feed	16218		Steam Back Press.	677		5%		550+	12.7		Catalyst Taken Out	90	100	419-150	63.6	80-40			
F. F. by C			Temperatures, °F			10% 148					In Reactor at End of Period	773	150	149-105	11.8	40-20			
Avg. F. F.			Heater Outlet	232	20	178							200	104-74	6.4	20-10			
Wet Gas	6619		Catalyst #1	636	30	203		WATER					250	73-62	0.4	10-0			
Contraction			#2	633	40	228		Temp.	%		Reactor d.P., H ₂ O		325	61-44	1.2				
Recycle	15968		#3	659	50	250		200			Pounds in Reactor	996	<325	43.0	1.8				
Bleed	1002		#4	631	60	276		203			Density, lbs./cu. ft.	135							
			#5		70	304		208			Bed Height, Feet	11.18	Aerated	150	% Fe				
Total	16970		Average	640	80	333						Settled	151	% C					
Total Feed	33188		Product Separator	72	90	369						Compacted	170	% Oil					
Recycle/F.F.	1.05				95	398						Sp. Grav.	4.5		Specific Surface				
Inlet Vel.	1.00				E.P.	416									m ² /gm				
Steam Flow					Rec.	97.5						Inventory Figures							
					Res.	1.5						From d-P Meters	16.28						
					Loss.	1.0						v/hr/V	2198						
GENERATOR ELEMENTAL BALANCE																			
NATURAL GAS		PRODUCT INSPECTION						IN				OUT							
	%	Oil	Water	Product	Pour °F	SUS @ °F			Mol %	m/hr	C	H	O		Mol %	m/hr	C	H	O
CO ₂	1.97	Neut. No.	45.2	45.3				O ₂		10.148			20.296	CO ₂		1.054	1.1	2.1	
CH ₄	83.50	Sap. No.	48.8	44.8				CO ₂		0.284	0.28		0.568	CO	15.446	15.5	15.5		
C ₂ H ₆	8.38	Hydrox. No.						CH ₄		12.048	12.05	48.192		CH ₄	0.046	0.1	0.184		
C ₃ H ₈	3.79	Bromine No.	76					C ₂ H ₆		1.208	2.42	7.254		H ₂	26.021	52.042			
C ₄ H ₁₀	0.23	% Fe						C ₃ H ₈		0.547	1.64	4.376		N ₂	0.224				
N ₂	1.84	% Alc	10.0					C ₄ H ₁₀		0.035	0.13	0.330		H ₂ O			7.272	3.6	
O ₂	0.29	* APT	49.4	10.6				N ₂		0.265				Total	42.790	16.6	59.498	21.2	
MW	19.1949							Total		16.52	60.152	20.864	Balance		100.1	98.91	101.6		

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION					
%	m/hr	#/hr	Measured	At Wt. Balance		m/hr	m/hr	%	m/hr	%	m/hr	a/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unsats.
				%	m/hr													
CO	36.0971	5.446	432.64	17.47	3.05	85.5	3.375	94.54	7.820	25.266	26.57	11.195	15.9	-12.071	-12.071	21.85	-12.071	
H ₂	60.8102	6.021	52.46	51.06	8.92	18.0	9.864	19.89	22.860	48.881	55.82	52.724	46.3	-16.157	-38.314			
CO ₂	2.463	1.054	46.39	20.84	3.64	160.2	4.027	177.21	9.332	10.386	11.86	13.359	18.9	2.973	2.973	19.25	5.946	
N ₂	0.523	0.224	6.28	1.23	0.21	6.0	0.237	6.64	0.549	0.773	0.88	0.786	1.1	0.013				
CH ₄	0.107	0.046	0.74	3.89	0.68	10.9	0.751	12.05	1.741	1.787	2.04	2.492	3.5	0.705	0.705	4.56	2.820	
C ₂ H ₄				1.37	0.24	6.7	0.264	7.41	0.618	0.612	0.70	0.876	1.2	0.264	0.528	3.42	1.056	
C ₂ H ₆				0.55	0.10	2.9	0.106	3.20	0.246	0.246	0.28	0.352	0.5	0.106	0.212	1.37	0.636	
C ₃ H ₆				1.49	0.26	10.9	0.288	12.10	0.865	0.665	0.76	0.953	1.4	0.288	0.864	5.59	1.728	
C ₃ H ₈				0.34	0.06	2.6	0.065	2.88	0.150	0.150	0.17	0.215	0.3	0.065	0.195	1.26	0.520	
C ₄ H ₈				0.99	0.17	9.7	0.190	10.67	0.441	0.441	0.50	0.631	0.9	0.190	0.760	4.92	1.520	
C ₄ H ₁₀				0.23	0.04	2.4	0.045	2.65	0.104	0.104	0.12	0.149	0.2	0.045	0.45	2.91	0.45	
C ₅ H ₁₀				0.44	0.08	5.4	0.085	5.97	0.197	0.197	0.22	0.282	0.4	0.085	0.85	5.50	0.85	
C ₆ H ₁₂				0.03	0.01	0.4	0.01	0.48	0.014	0.014	0.02	0.021	0.0	0.007	0.07	0.45	0.07	
OIL				0.08	0.02	1.2	0.017	1.35	0.037	0.037	0.04	0.054	0.1	0.017	0.20	1.32	0.20	
WATER												0.426	0.6		4.26	27.58	8.52	
TOTAL	42.790	538.51		17.47	322.7	19.321	357.02	44.775	87.559	70.640	-23.470				13.94	6.970	6.125	
H ₂ +CO	41.467			11.97		13.239		30.68								62.92	10.20	
H ₂ /CO	1.68			2.92		2.92	2.10		2.92		1.34							
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr		%/hr		#/hr		EFFLUENT RATIOS					
%	C ₀ Fed	#/hr	H ₂ / C ₀	g/MCF	g/M3		Gal/hr	Gal/MCF	cc/M3	Wet Gas	322.74	357.02	H ₂ /H ₂ O	5.343	C ₀ Conversion:	78.15		
C ₁ +C ₂	9.355	21.92	1.395	23.589						Oil	59.27	59.27	C ₀ 2/C ₀	1.193	H ₂ Conversion:	62.09		
C ₃ +	49.546	67.54	4.298	72.679						Water	122.22	122.22	(H ₂) (C ₀ 2)		H ₂ * CO ₂	68.07		
C ₄ +	42.690	52.55	3.344	56.547						Total	504.23	93.65	(H ₂) (C ₀)	6.374				
Ult. Oil		62.92	4.004	67.708	10.201	0.649	91.704			H ₂ *CO ₂ 15716 SCFH								
C ₀₂	19.248	130.82	9.324	140.759						#/hr	#/M	gal/hr	6PM					
H ₂ O		125.57	7.990	136.111						C ₅ -C ₅	36.08	2.296	7.58	0.482				
										Rec 011	59.27	5.771	9.10	0.579				
										WSC	12.22	0.778	1.47	0.084				
											107.57	6.845	18.15	1.155				
										H ₂ O	110.00	6.999	15.19	0.839				

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60°F and 14.7 psig. Cubic Meters measured at O.C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 S From Hr. 0700 to Hr. 0700 Hrs. 417-441

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	425		A S T M		Hempel Dist.		In Reactor at Start of Period	773	Particle Size					
Oxygen	3636		O ₂ Preheat, °F	439	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged	173	Screen				
Nat. Gas	5541		Gas Preheat, °F	696	A.P.I.	56.1		to 400	71.0	56.1	Catalyst Recharged		Frac.	M	%	Sedimentation	
Total			Reactor Press.	418	I.B.P.	103		400-550	16.0	39.4	Total		On 40	420+	14.5	80+	
Fresh Feed	16519		Steam Back Press.	718		5%		550+	13.0		Catalyst Taken Out	258	100	419-150	62.2	80-40	
F. F. by C			Temperatures, °F			10%	140				In Reactor at End of Period	688	150	149-105	11.8	40-20	
Avg. F. F.			Heater Outlet	209		20	170						200	104-74	6.3	20-10	
Wet Gas	7117		Catalyst #1	634		30	195	WATER					250	73-62	0.8	10-0	
Contraction			#2	631		40	218	Temp.	%	Reactor d-P, H ₂ O			325	61-44	2.1		
Recycle	16617		#3	664		50	240		200		Pounds in Reactor	925		<325	43.0	2.3	
Bleed	1039		#4	648		60	264		203		Density, lbs./cu. ft.	137		Density, lbs./cu. ft.		Chem. Anal.	
			#5			70	290		208		Bed Height, Feet	10.23	Aerated	152	% Fe		
Total	17656		Average	644.250		80	320				Settled	154		% C			
Total Feed	34175		Product Separator			90	358				Compacted	172		% Oil			
Recycle/F.F.	1.07					95	385				Space Vel. SCFH/lb. cat.		Sp. Grav.	4.6	Specific Surface		
Inlet Vel.	1.03					E.P.	402				Inventory Figures				m ² /gm		
Steam Flow						Rec.	97.5				From d-P Meters	17.86		5.6	mL NH ₃ /gm		
						Res.	1.5				V/hr/V	2447					
						Loss.	1.0				GENERATOR ELEMENTAL BALANCE						
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O			
CO ₂	2.07	Neut. No.	43.6	44.1				O ₂	9.631		19.262	CO ₂		0.921	0.9	1.8	
CH ₄	83.73	Sap. No.	48.0	44.9				CO ₂	0.303	0.30	0.606	CO		15.461	15.5	15.5	
C ₂ H ₆	8.57	Hydrox No.						CH ₄	12.241	12.2448.984		CH ₄		0.690	0.7	2.76	
C ₃ H ₈	3.90	Bromine No.	79.9					C ₂ H ₆	1.253	2.51	7.518	H ₂		26.326	52.65		
C ₄ H ₁₀	0.23	% Fe						C ₃ H ₈	0.570	1.71	4.560	N ₂		0.187			
N ₂	1.24							C ₄ H ₁₀	0.034	0.14	0.340	H ₂ O			5.55	2.8	
O ₂	0.26	API	49.8	10.6				N ₂	0.181			Total		43.586	17.1	60.98200.8	
TW	19.2037											16.9061.3821.868	Balance		101.0	20.571.61	

ULTIMATE YIELDS						WEIGHT BALANCE			EFFLUENT RATIOS			CONTRACTION:			
	% CO Fed	#/hr	H2 / CO #/MCF	g/M3	H2 / CO Gal/hr	Gal/MCF	cc/M3	Wet Gas	#/hr	%	#/hr	H2/H2O	6.023	CO Conversion:	50.91
C1+C2	9.758	22.88	1.445	24.434				Oil	55.02	55.02		C02/C0	0.9977	H2 Conversion:	75.45
C3+	47.152	102.27	6.457	109.187				Water	124.32	124.32		(H2) (C02) (H2O) (C0)	6.0091	H2+CO2	57.27
C4+	40.886	88.65	5.597	94.645				Total	498.51	91.81	542.97				64.00
Ult. Oil		99.32	6.271	106.042	16.574	1.0465	147.870	H2+CO2 = 15837 SCFH #/hr #M gal/hr GPM							
C02	18.536	126.14	7.965	134.688				C3-C5	29.60	1.869	6.28	0.397			
H2O		106.91	6.750	114.142				Rec	811	55.02	3.474	8.47	0.535		
								WSC	11.81	0.746	1.42	0.090			

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 T From Hr. 0700 to Hr. 0700 Hrs. 441-465

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	A S T M		Hempel Dist.		In Reactor at Start of Period	688	Particle Size							
Oxygen	3697		O ₂ Preheat, °F	418	Prod. Naph			°F % A.P.I.	Fresh Catalyst Charged	193	Screen			Sedimentation			
Nat. Gas	5545		Gas Preheat, °F	698	A.P.I.	56.7		to 400	71.6 56.7	Catalyst Recharged	Frac.	M	%	M %			
Total			Reactor Press.	419	I.B.P.	106		400-550	19.3 37.9	Total	On 40	420+	15.6	80+			
Fresh Feed	16506		Steam Back Press.	694		5%		550+	9.1	Catalyst Taken Out	97	100	419-150	80-40			
F. F. by C			Temperatures, °F		10%	138				In Reactor at End of Period	784	150	149-105	40-20			
Avg. F. F.			Heater Outlet	211	20	171						200	104-74	5.6	20-10		
Wet Gas	6657		Catalyst #1	637	30	193	WATER				250	73-62	0.5	10-0			
Contraction			#2	632	40	216	Temp.	%	Reactor d-p, H ₂ O		325	61-44	0.4				
Recycle	15583		#3	664	.50	238	200		Pounds in Reactor	1074	<325	43.0	0.9				
Bleed	1025		#4	642	60	260	203		Density, lbs./cu. ft.	146	Density, lbs./cu. ft.			Chem. Anal.			
			#5		70	287	208		Bed Height, Feet	11.15	Aerated	155	% Fe	71.3			
Total	16608		Average	644	80	320	X-Ray Diffraction				Settled	158	% C	6.18			
Total Feed	33114		Product Separator	71	90	353	on Catalyst				Compacted	177	% Oil	0.9(ext)			
Recycle/F.F.	1.01				95	383	Fe ₂₀ C ₉	30%	Space Vel. SCFH/lb. cat.		Sp. Grav.	4.7	Specific Surface				
Inlet Vel.	1.00				E.P.	403	Fe ₈₀ C ₄	60%	Inventory Figures		% K ₂ O	0.23		m ² /gm			
Steam Flow					Rec.	97.5	Fe	10%	From d-P Meters	15.37	% H ₂ O	0.26					
					Res.	1.5			V/hr/V	2243	K ₂ O/100 Fe	0.32	<1m ² /g N ₂ ads.				
					Loss.	1.0			GENERATOR ELEMENTAL BALANCE								
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	mm/h	C	H	O	Mol %	mm/h	C	H	O
CO ₂	1.98	Neut. No.	42.4	43.0			O ₂		9.790		19.580	CO ₂		1.077	1.1		2.2
CH ₄	84.40	Sap. No.	48.9	42.9			CO ₂		0.290	0.29	0.580	CO		15.477	15.5		15.5
C ₂ H ₆	8.48	Hydrox. No.					CH ₄		12.344	12.3449.376		CH ₄		0.393	0.4	1.572	
C ₃ H ₈	3.62	Bromine No.	87				C ₂ H ₆		1.240	2.48	7.440	H ₂		26.430		52.860	
C ₄ H ₁₀	0.18	% Fe					C ₃ H ₈		0.530	1.59	4.240	N ₂		0.174			
N ₂	1.09	% Alc		10.0			C ₄ H ₁₀		0.026	0.10	0.260	H ₂ O				5.970	3.0
O ₂	0.25	* API	50.2	10.6			N ₂		0.159			Total		43.552	17.0	50.402	20.6
MW	19.0468						Total		16.8161.31620.160	Balance				100.8	98.50	102.3	

ULTIMATE YIELDS						WEIGHT BALANCE		#/hr	%	#/hr	EFFLUENT RATIOS		CONTRACTION: 53.16	
	% C0 Fed	#/hr	H2 / CO #/MCF g/M3		Gal/hr	H2 / CO Gal/MCF cc/M3		Wet Gas	315.49	366.36	H2/H2O	5.224	C0 Conversion:	77.35
C1 + C2	10.944	25.70	1.618	27.360				Oil	63.96	63.96	C02/C0	1.120	H2 Conversion:	60.61
C3 +	47.995	104.28	6.564	110.997				Water	116.04	116.04	(H2) (C02) (H2O) (C0)	5.850	H2*COs	66.79
C4 +	41.096	89.27	5.620	95.034				Total	494.49	90.87		545.56		
Ult. Oil		101.42	6.385	107.970	16.211	1.020	144.126	H2*COs 15885 SCFH						
C02	18.407	125.59	7.895	133.804				#/hr	#/M	Gal/hr	GPM			
H2O		113.03	7.116	120.351				C ₀ -C ₅	37.59	2.367	7.88	0.496	Yield Calculations assume "oil" is CH ₂ , and is found by difference on Carbon, and H2O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at 0 C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.	
								R ₆₀ Oil	85.96	4.027	9.88	0.621		
								WSC	11.50	0.724	1.08	0.087		
									113.05	7.118	19.12	1.204		
								H ₂ O	105.54	6.519	12.41	0.781		

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 U From Hr. 0700 to Hr. 0700 Hrs. 465-489

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 V From Hr. 0700 to Hr. 0700 Brs. 489-513

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	417	A S T M		Hempel Dist.		In Reactor at Start of Period	758	Particle Size						
Oxygen	3620		O ₂ Preheat, °F	379	Prod.	Naph			°F % A.P.I.	Fresh Catalyst Charged	173						
Nat. Gas	5542		Gas Preheat, °F	681	A.P.I.	56.8			to 400	72.0 56.5	Catalyst Recharged						
Total			Reactor Press.	409	I.B.P.	100			400-550	17.3 58.5	Total						
Fresh Feed	16304		Steam Back Press.	719	5%				550+	11.7	Catalyst Taken Out	319	100	419-150 65.8	80-40		
F. F. by C			Temperatures, °F		10%	136					In Reactor at End of Period	612	150	149-105 11.9	40-20		
Avg. F. F.			Heater Outlet	194	20	167						200	104-74 6.4	20-10			
Wet Gas	6444		Catalyst #1	636	30	191	WATER					250	73-62 0.4	10-0			
Contraction			#2	630	40	216	Temp.	%	Reactor d-P, H ₂ O			325	61-44 0.1				
Recycle	16568		#3	656	50	240	200		Pounds in Reactor	957	<325	43-0	1.1				
Bleed	1009		#4	641	60	262	203		Density, lbs./cu. ft.	132	Density, lbs./cu. ft.		Chem. Anal.				
			#5	633	70	290	208		Bed Height, Feet	10.99	Aerated	151	% Fe				
Total	17577		Average	639.20	80	320			Settled	152	% C						
Total Feed	33981		Product Separator	70	90	354			Compacted	172	% Oil						
Recycle/F.F.	1.08				95	386			Space Vel. SCFH/lb. cat.		Sp. Grav.	4.6	Specific Surface				
Inlet Vel.	1.02				E.P.	403			Inventory Figures				m ² gm				
Steam Flow					Rec.	97.5			From d-P Meters	17.04		8.5	ml.NH ₃ /gm				
					Res.	1.5			V/hr/V	2250							
					Loss.	0.0			GENERATOR ELEMENTAL BALANCE								
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%	Oil	Water	Product	Pour °F	SUS @ °F		Mol %	mm/m ³	C	H	O	Mol %	mm/m ³	C	H	O
CO ₂	1.77	Neut. No.	44.7	42.5				O ₂		9.589		19.178	CO ₂		0.939	0.94	1.9
CH ₄	83.38	Sap. No.	48.4	43.9				CO ₂		0.259	0.26	0.518	CO		15.223	15.22	15.2
C ₂ H ₆	9.08	Hydrox. No.						CH ₄		12.192	12.19	48.768	CH ₄		0.795	0.80	3.180
C ₃ H ₈	4.25	Bromine No.	89.3					C ₂ H ₆		1.328	2.66	7.968	H ₂		25.911	51.822	
C ₄ H ₁₀	0.25	% Fe						C ₃ H ₈		0.621	1.86	4.968	N ₂		0.151		
N ₂	1.01	% Alc			10.0			C ₄ H ₁₀		0.037	0.15	0.370	H ₂ O				6.130 3.1
O ₂	0.26	* API	50.1	10.5				N ₂		0.148			Total		43.018	16.96	61.132
MW	19.270							Total		17.12	62.074	19.696	Balance		99.06	98.48	102.4

FRESH FEED		WET GAS				RECYC.	COMB. FEED	EFFLUENT		NET CHANGE ON REACTION							
%	m/hr	#/hr	%	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unsats.	
CO	35.39	15.223	426.40	18.170	3.090	86.55	3.567	99.92	8.426	23.549	26.456	11.993	16.5	-11.656	-11.65623.451	-11.656	
H ₂	60.23	25.911	52.24	49.827	8.473	17.08	9.782	19.72	23.107	49.018	54.836	32.889	45.2	-16.128	-32.258		
CO ₂	2.18	0.939	41.33	18.617	3.166	33.34	3.655	160.87	8.633	9.572	10.708	12.288	16.9	2.716	2.71617.841	5.432	
N ₂	0.35	0.151	4.23	0.257	0.044	1.23	0.051	1.42	0.119	0.270	0.302	0.170	0.2	-0.100			
CH ₄	1.85	0.795	12.75	7.903	1.344	21.56	1.552	24.89	3.665	4.460	4.988	5.217	7.2	0.757	0.757 4.972	3.028	
C ₂ H ₄				1.770	0.301	8.44	0.348	9.74	0.820	0.820	0.917	1.168	1.6	0.348	0.696 4.572	1.392	
C ₂ H ₆				0.527	0.090	2.71	0.104	3.13	0.244	0.244	0.272	0.348	0.5	0.104	0.208 1.566	0.624	
C ₃ H ₆				1.375	0.233	9.90	0.269	11.31	0.656	0.636	0.711	0.905	1.2	0.269	0.807 5.301	1.614	
C ₃ H ₈				0.030	0.005	0.22	0.006	0.25	0.013	0.013	0.014	0.019	0.0	0.006	0.018 0.118	0.048	
C ₄ H ₈				0.847	0.144	8.08	0.166	9.35	0.392	0.392	0.438	0.558	0.8	0.166	0.664 4.361	1.328	
C ₄ H ₁₀				0.183	0.033	1.92	0.038	2.22	0.089	0.089	0.099	0.127	0.2	0.038	0.152 0.998	0.38	
C ₅ H ₁₀				0.360	0.061	4.28	0.070	4.94	0.166	0.166	0.185	0.236	0.5	0.070	0.350 2.299	0.70	
C ₆ H ₁₂				0.043	0.007	0.51	0.008	0.59	0.019	0.019	0.021	0.027	0.0	0.008	0.040 0.262	0.08	
OIL				0.083	0.014	1.18	0.016	1.36	0.038	0.042	0.054	0.1	0.016	0.096 0.630	0.192		
WATER										0.515	0.7			5.152	35.845	10.304	
TOTAL	43.018	556.95		17.004	502.90	19.632	349.71	46.375	89.386	72.758		-23.387			72.16	6.49	11.12
H ₂ +CO	41.134			11.563		15.349		51.533				-27.786			6.264	6.224	
H ₂ /CO	1.70			2.74		2.74		2.74		2.74		1.38				100.33	15.82
ULTIMATE YIELDS		WEIGHT BALANCE				#/hr	%	#/hr	EFFLUENT RATIOS		CONTRACTION: 54.36						
C ₀ Fed	#/hr	H ₂ /CO	#/MCF	H ₂ /CO	g/M3	Gal/hr	Gal/MCF	cc/M3	Wet Gas	302.90	349.71	H ₂ /H ₂ O	5.284	C ₀ Conversion:	76.57		
C ₁ +C ₂	10.91	25.01	1.604	27.123					Oil	60.96	60.96	C ₀₂ /C ₀	1.024	H ₂ Conversion:	62.25		
C ₃ +	47.612	102.18	6.554	110.828					Water	126.28	126.28	(H ₂) (C ₀₂)		H ₂ CO ₂	67.55		
C ₄ +	42.393	90.62	5.812	98.280					Total	490.14	91.28	(H ₂) (C ₀)	5.410				
Ult. Oil		100.33	6.435	108.815	15.924	1.021	144.267		H ₂ CO ₂ 15590 SCFH								
C ₀₂	17.841	119.54	7.668	129.665					#/hr	#/M	gal/hr	GPM					
H ₂ O		112.13	7.192	121.616					50.00	1.924	6.28	0.403					
									Rec 011	60.96	3.910	9.40	0.603				
									WSC	12.63	0.810	1.51	0.097				
										105.59	6.644	17.19	1.103				
									H ₂ O	113.65	7.290	13.65	0.874				

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at O.C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 W From Hr. 0700 to Hr. 0700 Hrs. 513-537

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	420		A S T M		Hempel Dist.		In Reactor at Start of Period	612						
Oxygen	3729		O ₂ Preheat, °F	388	Prod.	Wash		°F	%	A.P.I.	Fresh Catalyst Charged	169					
Nat. Gas	5568		Gas Preheat, °F	689	A.P.I.	56.2		to 400	72.0	56.2	Catalyst Recharged						
Total			Reactor Press.	417	I.B.P.	104		400-550	15.6	38.7	Total						
Fresh Feed	16395		Steam Back Press.	713		5%		550+	12.4		Catalyst Taken Out	98	On 40	420+	21.2	80+	
F. F. by C			Temperatures, °F			10%	136				In Reactor at End of Period	683	100	419-150	54.4	80-40	
Avg. F. F.			Heater Outlet	196		20	166					150	149-105	9.9	40-20		
Wet Gas	6521		Catalyst #1	639		30	190	WATER				200	104.74	3.4	20-10		
Contraction			#2	634		40	215	Temp.	%	Reactor d-P, H ₂ O		250	73-62	0.4	10-0		
Recycle	16442		#3	655		50	237		200		Pounds in Reactor	1101	325	61-44	0.1		
Bleed	1002		#4	638		60	262		203		Density, lbs./cu. ft.	159	<325	43-0	0.6		
			#5	634		70	292		208		Bed Height, Feet	10.49	Density, lbs./cu. ft.	Chem. Anal.			
Total	17444		Average	640		80	321				Aerated	135		% Fe			
Total Feed	33859		Product Separator	68		90	354				Settled	134		% C			
Recycle/F. F.	1.06					95	380				Compacted	150		% Oil			
Inlet Vel.	1.02					E.P.	400				Space Vel. SCFH/lb. cat.		Sp. Grav.	4.4	Specific Surface		
Steam Flow						Rec.	98				Inventory Figures			m ² gm			
						Res.	1.5				From d-P Meters	14.86		10.1 ml.NH ₃ /gm			
						Loss.	0.5				V/hr/V	2368					
GENERATOR ELEMENTAL BALANCE																	
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%		Oil	Water	Product	Pour °F	SUS @ °F	Mol %	SCFH m/hr	C	H	O	Mol %	SCFH m hr	C	H	O
CO ₂	1.82		Neut. No.	49.1	44.3			O ₂		9.855		19.710	CO ₂	0.970	1.0	1.0	
CH ₄	84.00		Sap. No.	48.9	43.9			CO ₂		0.267	0.27	0.534	CO	15.635	15.6	15.6	
C ₂ H ₆	9.04		Hydrox. No.					CH ₄		12.336	12.344	12.344	CH ₄	0.622	0.6	2.488	
C ₃ H ₈	4.13		Bromine No.	86.9				C ₂ H ₆		1.328	2.65	7.968	H ₂	25.888	51.776		
C ₄ H ₁₀	0.21		% Fe					C ₃ H ₈		0.606	1.82	4.848	N ₂	0.144			
N ₂	0.69		% Alc					C ₄ H ₁₀		0.091	0.12	0.310	H ₂ O			6.772	
O ₂	0.11		°API	49.9	10.6			N ₂		0.101			Total	43.259	17.2	20.6	
MW	19.166							Total		17.2062	4.7020	2.244	Balance	100.2	97.70	103.5	

FRESH FEED			WET GAS			RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION					
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	%	m/hr	%	m/hr	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unsats.	
CO	56.14	15.635	437.94	17.82	3.07	85.88	3.501	98.07	8.200	23.835	26.695	11.701	16.12	-12.134	-12.134	-22.39	
H ₂	59.84	25.888	52.19	49.97	8.60	17.83	9.819	19.79	22.999	48.897	54.753	32.818	45.20	-16.069		-32.138	
CO ₂	2.24	0.970	42.69	19.54	3.361	48.01	3.840	169.02	8.995	9.965	11.161	12.835	17.68	2.870	2.870	18.36	
N ₂	0.35	0.144	4.03	0.47	0.08	2.24	0.091	2.56	0.215	0.359	0.402	0.306	0.42	-0.053		5.740	
CH ₄	1.44	0.622	9.98	6.79	1.17	18.74	1.334	21.40	3.124	3.746	4.196	4.458	6.14	0.712	0.712	4.55	
C ₂ H ₄				1.15	0.20	5.53	0.225	6.31	0.528	0.528	0.591	0.753	1.04	0.225	0.450	2.88	
C ₂ H ₆				0.63	0.11	3.25	0.123	3.71	0.290	0.290	0.325	0.413	0.57	0.123	0.246	1.57	
C ₃ H ₈				1.48	0.26	10.73	0.291	12.25	0.683	0.683	0.765	0.974	1.34	0.291	0.873	5.58	
C ₄ H ₈				0.60	0.10	4.54	0.118	5.18	0.276	0.276	0.309	0.394	0.54	0.118	0.354	2.26	
C ₄ H ₁₀				0.92	0.16	8.86	0.180	10.12	0.422	0.422	0.473	0.602	0.83	0.180	0.720	4.61	
C ₅ H ₁₀				0.18	0.03	1.80	0.035	2.06	0.084	0.084	0.094	0.119	0.16	0.035	0.140	0.90	
C ₆ H ₁₂				0.37	0.06	4.49	0.073	5.13	0.172	0.172	0.193	0.245	0.34	0.073	0.368	2.34	
OIL				0.08	0.01	1.18	0.016	1.35	0.038	0.038	0.043	0.054	0.07	0.016	0.098	0.192	
WATER												0.531	0.73		5.308	55.95	10.616
TOTAL				43.259	546.83		17.213	12.58	19.650	556.96	46.025	89.285	72.597				74.37
H ₂ +CO				41.523			11.66		13.320		31.199						103.57
H ₂ /CO				1.66			2.80		2.80		2.80		2.80		1.32		16.40
ULTIMATE YIELDS			WEIGHT BALANCE						#/hr	%	#/hr	Effluent Ratios	CONTRACTION: 54.58				
C ₀ Fed	%	#/hr	H ₂ / CO	#/MCF	g/M3	Gal/hr	H ₂ / CO	Gal/MCF	cc/M3								
C ₁ +C ₂	9.005	21.44	1.362	23.031										C ₀ Conversion: 77.61			
C ₃ +	50.246	110.46	7.019	118.691										H ₂ Conversion: 62.07			
C ₄ +	42.398	93.03	5.911	99.955										H ₂ +CO: 67.92			
Ult. Oil				103.57	6.581	111.285	16.401	1.042	147.235								
C ₀₂	18.356	126.33	8.027	135.737													
H ₂ O				115.19	7.320	123.781											

H₂+CO = 15737 SCFH
hr #/M Gal/hr GPM
C₃-C₅ 36.09 2.293 7.59 0.489
Rec 01161.81 3.928 9.52 0.605
WSG 12.81 0.914 1.54 0.098
110.71 7.035 18.75 1.191
H₂O 115.25 7.323 13.82 0.878

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂ by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of measured at O.C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46-X-1 From Hr. 1000 to Hr. 1600 Hrs. 540-546

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA				CATALYST ANALYSIS							
	SCFH	%	Generator Press.	434		A S T M	Hempel Dist.	In Reactor at Start of Period	683						Particle Size				
Oxygen	3836		O ₂ Preheat, °F	391	Prod.		%	Fresh Catalyst Charged											
Nat. Gas	5664		Gas Preheat, °F	652	A.P.I.		to 400	Catalyst Recharged											
Total			Reactor Press.	425	I.B.P.		400-550	Total				On 40	420+	80+					
Fresh Feed	16874		Steam Back Press	788	5%		550+	Catalyst Taken Out	67	100	419-150		100	149-105	80-40				
F. F. by C			Temperatures, °F		10%			In Reactor at End of Period	616	150	104-74		200	104-74	20-10				
Avg. F. F.			Heater Outlet	358	20								250	73-62	10-0				
Wet Gas	5941		Catalyst #1	653	30								325	61-44					
Contraction		#2	653	40			Temp.	Reactor d.P. H ₂ O											
Recycle	24221		#3	674	50		200	Pounds in Reactor	970	<325	43-0								
Bleed	986		#4	637	60		203	Density, lbs./cu. ft.	151	Density, lbs./cu. ft.					Chem. Anal.				
		#5	657	70			208	Bed Height, Feet	9.73	Aerated	% Fe								
Total	25207		Average	654.8	80			Settled		% C									
Total Feed	42081		Product Separator	85	90			Compacted		% Oil									
Recycle/F.F.	1.49				95			Space Vel. SCFH/lb. cat.		Sp. Grav.					Specific Surface				
Inlet Vel.	1.27				E.P.			Inventory Figures							m ² gm				
Steam Flow					Rec.			From d.P. Meters	17.39										
					Res.			V/hr/V	2628										
					Loss.			GENERATOR ELEMENTAL BALANCE											
NATURAL GAS		PRODUCT INSPECTION								IN				OUT					
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O	Mol %	SCFH m hr	C	H	O
CO ₂		Neut. No.						O ₂						CO ₂					
CH ₄		Sap. No.						CO ₂						CO					
C ₂ H ₆		Hydrox. No.						CH ₄						CH ₄					
C ₃ H ₈		Bromine No						C ₂ H ₆						H ₂					
C ₄ H ₁₀		% Fe						C ₃ H ₈						N ₂					
N ₂		% Alc						C ₄ H ₁₀						H ₂ O					
O ₂								N ₂						Total					
								Total											

FRESH FEED			WET GAS				RECYCLE	COMB. FEED		EFFLUENT		NET CHANGE ON REACTION								
	%	m/hr	#/hr	%	Measured	At Wt. Balance	m/hr	m/hr	%	m/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Un. losts.				
CO	35.41	15.766	441.61	18.50	2,900	81.23	3,234	90.58	12,304	28,070	25.28	15.538	16.68	-12.532	-12.532	20.516	-12.532			
H ₂	60.89	27.111	54.66	46.39	7,272	14.66	8,109	16.35	30,854	57,965	52.20	38,963	41.83	-19.002	-38.004					
CO ₂	2.19	0.975	42.91	20.34	3,188	40.30	3,555	56.45	13,528	14,503	13.06	18,058	19.39	-2,580	-16.364	5.160				
N ₂	0.37	0.165	4.62	0.72	0.113	3.17	0.126	3.55	0.478	0.643	0.58	0.604	0.65	-0.039						
CH ₄	1.14	0.508	8.15	7.64	1,198	19.22	1,336	21.43	5,081	5,589	5.03	6,417	6.89	0.828	0.828	5.251	3.31			
C ₂ H ₄				1.84	0.288	8.08	0.321	9.01	1,223	1,223	1.10	1,544	1.66	0.321	0.642	4.072	1.284	72.25		
C ₂ H ₆				0.66	0.103	3.10	0.115	3.46	0.438	0.438	0.39	0.553	0.59	0.115	0.230	1.458	0.690			
C ₃ H ₈				1.74	0.273	11.49	0.304	12.81	1.157	1.157	1.04	1,461	1.57	0.304	0.912	5.784	1.824	12.81	4.32	2.97
C ₃ H ₈															11.53	6.25	1.84	100.00		
C ₄ H ₈				1.12	0.176	9.87	0.196	11.01	0.744	0.744	0.67	0.940	1.01	0.196	0.784	4.972	1.568			
C ₄ H ₁₀				0.33	0.052	3.02	0.580	3.57	0.219	0.219	0.20	0.799	0.86	0.580	2,320	14.715	5.80			
C ₅ H ₁₀				0.50	0.078	5.47	0.087	6.10	0.352	0.352	0.30	0.419	0.45	0.087	0.435	2.758	0.87			
C ₆ H ₁₂				0.08	0.013	0.94	0.014	1.05	0.053	0.053	0.05	0.067	0.07	0.014	0.070	0.443	0.14			
OIL				0.14	0.022	1.85	0.025	2.06	0.093	0.093	0.08	0.118	0.13	0.025	0.150	0.951	0.30			
WATER												0.358	0.38	3.581	22.713	7.162		50.17	6.55	7.69
TOTAL	44.524	551.95		15.676	502.40	17,480	337.18	66,510	111,029	93,145	-26.523						15.054	7.372		
H ₂ +CO	42.877			10.172		11.343		43.156										84.74	12.67	
H ₂ /CO	1.719			2.51		2.51		2.51	2,065	2,51	1.52									
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr			EFFLUENT RATIOS								
	%	C ₀ Fed	#/hr	H ₂ /CO	#/MCF	g/M3	Gal/hr	H ₂ /CO	Gal/MCF	cc/M3		Wet Gas	302.38		337.18	H ₂ /H ₂₀	5.353	C ₀ Conversion:	79.49	
C ₁ +C ₂	10.781	25.75	1.585	26.802								Oil	68.52		68.52	C ₀₂ /C ₀	1.162	H ₂ Conversion:	70.09	
C ₃ +	46.553	86.57	5.327	90.079								Water	146.25		146.25	(H ₂) (C ₀₂)	6.196	H ₂ +C ₀₂	73.55	
C ₄ +	41.581	75.76	4.539	76.754								Total	517.17		93.70	551.95				
Ult. Oil		84.74	5.215	88.186	12.671	0.7797	110.172													
C ₀₂	16.364	113.54	6.987	118.150																
H ₂ O		132.81	8.173	138.205																

H₂*GOF = 18250 SCFM
#/hr #/M gal/hr GPM

C₃-C₅ 36.40 2,240 7.54 0.464
Rec 011 68.52 4.217 10.50 0.846
WSC 14.62 0.900 1.75 0.108

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂0 by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60° F and 14.7 psig. Cubic Meters measured at O.C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46-X-2 From Hr. 1600 to Hr. 0700 Hrs. 546-561

FLOWS			RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS					
	SCFH	%	Generator Press.	426			A S T M	Hempel Dist.	In Reactor at Start of Period	616			Screen	M	%	Particle Size	
Oxygen	3923		O ₂ Preheat, °F	384	Prod.	Naph		"F % A.P.I.	Fresh Catalyst Charged								
Nat. Gas	5682		Gas Preheat, °F	687	A.P.I.	55.0		to 400	73.0 55.0	Catalyst Recharged							
Total			Reactor Press.	418	I.B.P.	104		400-550	19.3 34.8	Total							
Fresh Feed	17250		Steam Back Press.	808	5%			550+	7.7	Catalyst Taken Out	33	100	419-150	64.9	80-40		
F. F. by C			Temperatures, °F		10%	140				In Reactor at End of Period	583	150	149-105	11.7	40-20		
Avg. F. F.			Heater Outlet	347	20	167						200	104.74	5.3	20-10		
Wet Gas	6769		Catalyst #1	699	30	190	WATER					250	73-62	1.0	10-0		
Contraction			#2	699	40	214		Temp.	%	Reactor d-P, H ₂ O		325	61-44	0.1			
Recycle	16267		#3	718	.50	240		200		Pounds in Reactor	880	<325	43-0	4.8			
Bleed	1013		#4	690	60	261		203		Density, lbs./cu. ft.	133					Chem. Anal.	
			#5	682	70	292		208		Bed Height, Feet	10.02	Aerated	152	α Fe			
Total	17280		Average	697.6	80	319					Settled	156	α C				
Total Feed	34530		Product Separator	65	90	358					Compacted	171	α Oil				
Recycle/F.F.	1.00				95	388				Space Vel. SCFH/lb. cat.		Sp. Grav.	4.6	Specific Surface			
Inlet Vel.	1.04				E.P.	408				Inventory Figures				m ² /gm			
Steam Flow					Rec.	97.5				From d-P Meters	19.60			8.1 ml.NH ₃ /gm			
					Res.	1.5				V/hr/V	2608						
					Loss	1.0											
NATURAL GAS																GENERATOR ELEMENTAL BALANCE	
	%		PRODUCT INSPECTION				IN				OUT						
			Oil	Water	Product	Pour °F	SUS @ °F			Mol %	m/hr	C	H	O			
CO ₂	2.10		Neut. No	44.1	42.9				O ₂	10.373		20.746	CO ₂		1.029	1.0	2.1
CH ₄	84.53		Sap. No	48.4	44.2				CO ₂	0.315	0.32	0.630	CO		16.303	16.3	16.3
C ₂ H ₆	8.60		Hydrox. No.						CH ₄	12.673	12.6750.692		CH ₄		0.191	0.2	0.764
C ₃ H ₈	3.62		Bromine No.	80					C ₂ H ₆	1.289	2.58 7.734		H ₂		27.828	55.656	
C ₄ H ₁₀	0.21		% Fe						C ₃ H ₈	0.543	1.65 4.344		N ₂				
N ₂	0.79		% Alc	10.0					C ₄ H ₁₀	0.031	0.12 0.310		H ₂ O				6.354 3.2
O ₂	0.15		*API	49.0	10.4				N ₂	0.118			Total		45.515	17.5 62.774	21.5
MW	19.0579								Total	17.3263.08021.376	Balance				101.2 99.51	100.7	

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION							
%	m/hr	#/hr	Measured	At Wt. Balance		m/hr	m/hr	%	m/hr	%	m/hr	%	Carbon	Hydrogen			Unsats. %			
				m/hr	#/hr									m/hr	%/hr	%	o/hr	#/hr		
CO	35.82	16.303456.65	18.56	3.315	92.87	3.784	106.01	8.462	24.76527.180	12.246	17.6	-12.519-12.51923.210					-12.519			
H ₂	61.14	27.82856.10	50.85	9.091	18.31	10.366	20.90	23.185	51.01355.98753.551	48.3	-17.462					-34.924				
CO ₂	2.26	1.02945.29	18.98	3.390149.19	3.870	170.30	8.654	9.68310.627	12.524	18.0	2.841	2.84117.426					5.682			
N ₂	0.36	0.1644.59	0.30	0.054	1.51	0.062	1.72	0.137	0.301	0.330	0.199	0.3	-0.102							
CH ₄	0.42	0.1913.06	5.88	1.050	16.84	1.199	19.22	2.681	2.872	3.152	3.880	5.6	1.008	1.008	6.183	4.032		72.6		
C ₂ H ₄			1.59	0.284	7.97	0.324	9.10	0.725	0.725	0.796	1.049	1.5	0.324	0.324	3.975	1.296				
C ₂ H ₆			0.56	0.100	3.01	0.114	3.43	0.255	0.255	0.280	0.369	0.5	0.114	0.114	2.399	0.684				
C ₃ H ₆			1.49	0.266	11.19	0.304	12.77	0.679	0.679	0.745	0.985	1.4	0.304	0.304	5.594	1.824		11.48 6.25 1.84		
C ₃ H ₈			0.12	0.021	0.93	0.024	1.06	0.055	0.055	0.060	0.079	0.1	0.024	0.024	0.442	0.192		10.76 5.0 2.15		
C ₄ H ₁₀			0.94	0.168	9.43	0.192	10.76	0.429	0.429	0.471	0.621	0.9	0.192	0.192	7.711	1.536		10.22 6.10 1.68		
C ₅ H ₁₀			0.21	0.038	2.21	0.043	2.52	0.096	0.096	0.105	0.139	0.2	0.043	0.043	1.055	0.43		2.52 4.86 0.52		
C ₅ H ₁₀			0.40	0.071	4.98	0.081	5.68	0.182	0.182	0.200	0.265	0.4	0.081	0.081	2.484	0.81				
C ₆ H ₁₂			0.05	0.009	0.65	0.010	0.74	0.023	0.023	0.025	0.035	0.1	0.010	0.010	0.307	0.10		6.42 5.45 1.18		
OIL			0.07	0.013	1.09	0.016	1.24	0.032	0.032	0.055	0.047	0.1	0.015	0.015	0.552	0.180		1.24 5.5 0.23		
WATER													0.5325	0.8	5.32532.662	10.650		74.60 6.5311.43		
TOTAL	45.515565.69		17.859320.18	20.386									2.913	4.2		13.190		6.595 6.837		
H ₂ +CO	44.131		12.396	14.150														106.50 16.88		
H ₂ /CO	1.71		2.74	2.74																
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr					CONTRACTION:						
%	C O Fed	#/hr	H ₂ / CO	H ₂ / CO	Gal/M3	g/M3	Gal/hr	Gal/MCF	cc/M3	Wet Gas	320.18	365.49	H ₂ /H ₂ O	11.52	C O Conversion:	76.79				
C1+C2	11.557	28.69	1.715	29.00						Oil	63.14	63.14	C O2/C O	1.023	H ₂ Conversion:	62.75				
C3+	47.807	109.37	6.539	110.574						Water	137.06	137.06	(H ₂) (C O2)		H ₂ *C O*	67.94				
C4+	41.771	95.54	5.712	96.590						Total	520.38	91.99	565.69							
Ult. Oil	106.50	6.367	107.666	16.876	1.009	142.572				H ₂ *C O*= 16726 SCFH #/hr #/M gal/hr GPM										
C O2	17.426	125.01	7.474	126.385						C ₅ -C ₆ 34.77	2.079	7.29	0.436							
H ₂ O			125.18	7.364	124.525					R _{CO} 01163.14	5.775	9.68	0.579							
										W _{CO} 13.71	0.820	1.64	0.098							
										H ₂ O 111.62	6.674	18.61	1.113							
										H ₂ O 123.35	7.375	14.79	0.884							

Yield Calculations assume "oil" is CH₄, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction measured at O.C. and 14.7 psig. Cubic Meters measured at 60° F and 14.7 psig. Cubic Meters g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 46 Y From Hr. 0700 to Hr. 1300 B.R.S. 561-580

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS				
	SCFH	%	Generator Press.	426		A S T M			Hempel Dist.	In Reactor at Start of Period	583	Particle Size					
Oxygen	3909		O ₂ Preheat, °F	428	Prod.	Naph			°F % A.P.I.	Fresh Catalyst Charged	120	Screen Sedimentation					
Nat. Gas	5724		Gas Preheat, °F	695	A.P.I.	53.2			to 400	74.0 53.2	Catalyst Recharged		Frac.	M	%		
Total			Reactor Press.	417	I.B.P.	104			400-550	20.0 33.3	Total	On 40	420+	14.0	80+		
Fresh Feed	17160		Steam Back Press.	825		5%			550+	6.0	Catalyst Taken Out	52	100	419-150	70.9	80-40	
F. F. by C			Temperatures, °F			10%	139				In Reactor at End of Period	651	150	149-105	12.6	40-20	
Avg. F. F.			Heater Outlet	370		20	166				770 lbs. weighed out at end of Run 46		200	104-74	2.0	20-10	
Wet Gas	6471		Catalyst #1	696		30	166		WATER			250	73-62	0.3	10-0		
Contraction			#2	695		40	191		Temp.	%	Reactor d-P, H ₂ O		325	61-44	0.1		
Recycle	16115		#3	716		50	213		200		Pounds in Reactor	981	<325	43-0	0.1		
Bleed	1011		#4	692		60	237		203		Density, lbs./cu. ft.	135	Density, lbs./cu. ft Chem. Anal.				
			#5	691		70	261		208		Bed Height, Feet	11.01	Aerated	151	% Fe	68.1	
Total	17126		Average	698		80	322		X-Ray Diffraction				Settled	152	% C	7.38	
Total Feed	34286		Product Separator	70		90	358		on Catalyst				Compacted	179	% Oil	0.2(ex)	
Recycle/F.F.						95	386		Fe _{20.0} g	30%	Space Vel. SCFH/lb. cat.		Sp. Grav.	4.3	Specific Surface		
Inlet Vel.	1.00					E.P.	400		Fe _{30.4} g	65%	Inventory Figures		% K ₂ O	0.24		m ² /gm	
Steam Flow						Rec.	98.0		Fe	5%	From d-P Meters	17.49	% H ₂	0.25	ml.NH ₃ /gm		
						Res.	1.5				V/hr/V	2362	K ₂ O/100 Fe O _{0.35}	<1m ² /g N ₂ ads.			
						Loss.	0.5				GENERATOR ELEMENTAL BALANCE						
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %	SCFH m/hr	C	H	O			
CO ₂	2.10	Neut. No.	39.5	40.9					O ₂	10.336		20.672	CO ₂		0.935	0.9	1.9
CH ₄	84.53	Sap. No.	53.4	40.0					CO ₂	0.317	0.32	0.634	CO		16.558	16.6	16.6
C ₂ H ₆	8.60	Hydrox. No.							CH ₄	12.766	12.77	51.064	CH ₄		0.174	0.2	0.690
C ₃ H ₈	3.62	Bromine No.	85.3						C ₂ H ₆	1.299	2.60	7.794	H ₂		27.456	54.912	
C ₄ H ₁₀	0.21	% Fe							C ₃ H ₈	0.547	1.64	4.376	N ₂		0.154		
N ₂	0.79	% Alc		10.0					C ₄ H ₁₀	0.032	0.13	0.320	H ₂ O			6.820	3.4
O ₂	0.15	* API	46.6	10.5					N ₂	0.119			Total		45.277	17.762	428 21.9
MW	19.057												17.4563	554.21.306	Balance	101.298.23	102.6

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 A From Hr. 0900 to Hr. 0700 Dirs. 0-22

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA		CATALYST ANALYSIS							
	SCFH	%	Generator Press.	417		A S T M	Hempel Dist.	In Reactor at Start of Period	1133		Particle Size						
Oxygen	3821	43.1	O ₂ Preheat, °F	423	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged						
Nat. Gas	5042		Gas Preheat, °F	698	A.P.I.	56.8		to 400	58.1	58.8	Catalyst Recharged						
Total	5042		Reactor Press.	386	I.B.P.	100		400-550	18.2	37.7	Total	1133	Frac. M %				
Fresh Feed	15079		Steam Back Press.	709		5%		550+	13.7		Catalyst Taken Out	86	On 40 420+ 27.4 80+				
F. F. by C	15623		Temperatures, °F			10%	142				In Reactor at End of Period	1047	100 419-150 60.2 80-40				
Avg. F. F.			Heater Outlet	151		20	170					150 149-105 6.6 40-20	200 104.74 2.8 20-10				
Wet Gas	4950		Catalyst #1	646		30	190						250 73.62 0.6 10-0				
Contraction	64.5		#2	647		40	204	Temp.	%		Reactor d-P, H ₂ O		325 61.44 0.6				
Recycle	15413		#3	670		50	236				Pounds in Reactor	1249	<325 43.0 1.6				
Bleed	1125		#4	655		60	258				Density, lbs./cu. ft.	149.0	Density, lbs./cu. ft.				
			#5	655		70	285				Bed Height, Feet	12.7	Chem. Anal.				
Total	16538		Average	647		80	316				Aerated		% Fe				
Total Feed	31617		Product Separator	70		90	350				Settled		% C				
Recycle/F.F.	1.10					95	370				Compacted		% Oil				
Inlet Vel.	1.046					E.P.	405				Space Vel. SCFH/lb. cat.		Sp. Grav. 4.7 Specific Surface				
Steam Flow						Rec.	97.0				Inventory Figures	14.402	m ² /gm				
						Res.	1.2				From d-P Meters	18.073					
						Loss	1.8				v/hr/v	1792					
GENERATOR ELEMENTAL BALANCE																	
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	m/hr	C	H	O	Mol %	m/hr	C	H	O
CO ₂	2.29	Neut No.	40.6	39.4				O ₂		0.041			CO ₂	2.57	1.022	1.02	2.04
CH ₄	81.09	Sap No.	47.9	40.5				CO ₂	10.078		20.278		CO	35.897	14.274	14.27	14.27
C ₂ H ₆	9.35	Hydrox No.						CH ₄	0.305	0.31	0.610		CH ₄	0.14	0.056	0.06	0.22
C ₃ H ₈	5.35	Bromine No.	93.3					C ₂ H ₆	10.785	10.79	43.140		H ₂	60.827	24.195		48.39
C ₄ H ₁₀	0.37	% Fe						C ₃ H ₈	1.244	2.49	7.464		N ₂	0.577	0.230		
N ₂	1.24	% Alc		8.5				C ₄ H ₁₀	0.049	0.20	0.49		H ₂ O				8.66 4.35
O ₂	0.31	*APT	49.6	9.7				N ₂	0.165				Total				15.35 57.27 20.65
MW	19.7492							Total		15.91	56.79020.8886	balance					96.49 100.8598.85

In product gas only

H₂O 116.269 7.972 13.941 0.956

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at 0 C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 B From Hr. 0700 to Hr. 0700 hrs. 23-46

FLOWS			RUN CONDITIONS			DISTILLATIONS			CATALYST DATA			CATALYST ANALYSIS					
	SCFH	%	Generator Press.	412		Prod.	Naph		Hempel Dist.	In Reactor at Start of Period	1047						
Oxygen	3991	42.8	O ₂ Preheat, °F	460	A.P.I.	56.5			°F % A.P.I.	Fresh Catalyst Charged							
Nat. Gas	5344		Gas Preheat, °F	711	I.B.P.	106			to 400 70.6 56.5	Catalyst Recharged							
Total	9335		Reactor Press.	385					400-550 17.6 38.7	Total	1047						
Fresh Feed	15350		Steam Back Press.	741		5%			550+ 11.8	Catalyst Taken Out	88	100	419-150	51.9 80-40			
F.F. by C	16207		Temperatures, °F			10%	143			In Reactor at End of Period	959	150	149-105	11.6 40-20			
Avg. F. F.			Heater Outlet	137		20	166					200	104-74	6.6 20-10			
Wet Gas	5968		Catalyst ±1	652		30	188					250	73-62	1.8 10-0			
Contraction	60.5		±2	643		40	210		Temp. %	Reactor d-P, H ₂ O		325	61-44	1.0			
Recycle	15290		±3	669		50	234		200	Pounds in Reactor	1131	<325	43-0	1.0			
Bleed	1026		±4	632		60	257		203	Density, lbs./cu. ft.	144						
			±5	631		70	282		208	Bed Height, Feet	11.9	Aerated	133	% Fe			
Total	16316		Average	645		80	309					Settled	135	% C			
Total Feed	31666		Product Separator	69		90	347					Compacted	151	% Oil			
Recycle/F.F.	1.063					95	381			Space Vel. SCFH/lb. cat.		Sp. Grav.	4.52	Specific Surface			
Inlet Vel.	1.040					E.P.	399			Inventory Figures	16.01			m ² /gm			
Steam Flow						Rec.	98.0			From d-P Meters	13.57			1.35 ml. NH ₃ /gm			
						Res.	1.5			V/hr/V	1954						
						Loss	0.5										
GENERATOR ELEMENTAL BALANCE																	
NATURAL GAS		PRODUCT INSPECTION						IN			OUT						
	%	Oil	Water	Product	Pour °F	SUS @ °F		Mol %	mm/hr	C	H	O	Mol %	mm/hr	C	H	O
CO ₂	2.42	Neut. No.	40.7	38.8				O ₂	10.528				CO ₂	2.74	0.111	0.11	0.22
CH ₄	82.41	Sap. No.	43.7	42.8				CO ₂	0.071				CO	36.62	14.879	14.88	14.88
C ₂ H ₆	8.24	Hypox. No.						CH ₄	0.341	0.34			CH ₄	0.08	0.035	0.03	0.13
C ₃ H ₈	3.72	Bromine No.	96.9					C ₂ H ₆	11.617	11.624	46.468		H ₂	60.03	24.390		48.78
C ₄ H ₁₀	0.23	% Fe						C ₃ H ₈	1.162	2.32	6.972		N ₂	0.53	0.215		
N ₂	2.478	% Alc	8.0					C ₄ H ₁₀	0.524	1.57	4.192		H ₂ O				11.78 5.39
O ₂	0.502	*APT	50.2	9.9				N ₂	0.032	0.13	1.28		Total				15.02 60.69 20.49
MW	19.392							Total									94.00103.0293.65

FRESH FEED			WET GAS			RECYCLE	COMB. FEED	EFFLUENT	NET CHANGE ON REACTION							
%	m/hr	#/hr	%	Measured	At Wt. Balance	m/hr	m/hr	%	m/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unscs.	
CO	36.62	14.879	416.761	11.52	1.814	50.81	1.851	51.842	4.958	19.837	-23.708	6.809	10.7	-13.028	-13.028	
H ₂	60.03	24.390	49.170	46.95	7.391	14.90	7.541	15.203	20.206	44.596	53.301	27.747	42.2	-16.849	-33.698	
CO ₂	2.74	1.113	48.985	27.46	4.323	190.26	4.411	194.119	11.818	12.931	115.455	16.229	24.7	3.298	5.298	22.165
N ₂	0.53	0.215	6.025	1.50	0.236	6.61	0.241	6.746	0.646	0.861	1.029	0.887	1.4	0.026		6.598
CH ₄	0.08	0.035	0.529	5.77	0.908	14.57	0.926	14.862	2.483	2.516	3.007	3.409	5.2	0.893	6.002	3.572
C ₂ H ₄				1.93	0.304	8.53	0.310	8.701	0.831	0.831	0.993	1.141	1.7	0.310	0.620	4.167
C ₂ H ₆				0.68	0.107	3.22	0.109	3.282	0.293	0.293	0.350	0.402	0.6	0.109	0.218	1.465
C ₃ H ₈				1.97	0.310	13.04	0.316	13.309	0.848	0.848	1.014	1.164	1.8	0.516	0.948	6.371
C ₃ H ₈				0.27	0.043	1.90	0.044	1.935	0.116	0.116	0.159	0.160	0.2	0.044	0.132	0.887
C ₄ H ₈				1.19	0.187	10.49	0.191	10.704	0.512	0.512	0.612	0.703	1.1	0.191	0.764	5.135
C ₄ H ₁₀				0.26	0.041	2.38	0.042	2.431	0.112	0.112	0.134	0.154	0.2	0.042	0.168	1.129
C ₅ H ₁₀				0.42	0.066	4.28	0.067	4.365	0.181	0.181	0.216	0.248	0.4	0.067	0.335	2.251
C ₆ H ₁₂				0.08	0.013	1.09	0.013	1.116	0.034	0.034	0.041	0.047	0.1	0.013	0.078	0.524
OIL											0.557	0.8		5.574	37.462	11.148
WATER											6.031	9.2		12.062		78.18 6.48 12.07
TOTAL	40.63	521.466		15.743	322.07	16.062	328.615	43.038	83.668	65.688					6.051	
H ₂ +CO	39.269														112.04	19.18
H ₂ /CO	1.639			4.074		4.075		4.075		4.075					108.24	17.15

ULTIMATE YIELDS			WEIGHT BALANCE			#/hr	%	#/hr	EFFLUENT RATIOS	CONTRACTION:		
C ₀ Fed	H ₂ / CO	#/hr	Gal/hr	H ₂ / CO	g/M3	Gal/MCF	cc/M3	Wet Gas	322.074	102.031	328.616	H ₂ /H ₂₀
C ₁ +C ₂	11.634	26.32	1.768	29.897						4.601		C ₀ Conversion: 87.560
C ₃ +	53.759	53.86	2.274	38.453								C ₂ /C ₀ : 2.383
C ₄ +	46.501	18.62	1.250	21.138								H ₂ Conversion: 69.082
Ult. Oil	108.24	7.271	122.955	17.145	1.152	162.778						H ₂ *CO ₂ 76.083
C ₀₂	22.165	145.14	9.749	164.856								
H ₂ O	115.64	7.781	131.577									

^{#/hr} #/M gal/hr GPM
^g 35.860 2.274 7.117 0.478
 Rec 01178.39 5.266 12.090 0.812
 WSC 9.157 0.615 1.098 0.074

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction measured at O.C. and 14.7 psig. Cubic Meters g/M3 = 16.91 #/MCF. cc/M3 = 14.3 gal/MCF.

* In product gas only

121.407 8.155 20.305 1.364
 H₂O 105.303 7.073 12.826 0.848

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 D From Hr. 0700 to Hr. 0700 Hrs. 71-94

FLOWS			RUN CONDITIONS			DISTILLATIONS			CATALYST DATA			CATALYST ANALYSIS		
	SCFH	%	Generator Press.	413		A S T M			Hempel Dist.	In Reactor at Start of Period	960	Particle Size		
Oxygen	4176	42.5	O ₂ Preheat, °F	488		Prod.	Naph		°F % A.P.I.	Fresh Catalyst Charged	100			
Nat. Gas	5655		Gas Preheat, °F	723		A.P.I.	55.2		to 400	89.3 55.2	Catalyst Recharged	113		
Total	9851		Reactor Press.	379	I.B.P.	108			400-550	16.6 36.2	Total	1175	On 40	420+ 21.3 80+
Fresh Feed	16465		Steam Back Press.	733		5%			550+	14.1	Catalyst Taken Out	224	100	419-150 87.4 80-40
F F by C	17154		Temperatures, °F			10%	158				In Reactor at End of Period	949	150	149-105 7.2 40-20
Avg. F. F.			Heater Outlet	150	20	168						200	104-74 3.2 20-10	
Wet Gas	6600		Catalyst #1	658	30	194						250	73-62 0.4 10-0	
Contraction	57.9		#2	645	40	216			Temp.	%	Reactor d-P, H ₂ O		325	61-44 0.2
Recycle	15722		#3	664	50	236			200		Pounds in Reactor	1148	<325	43-0 0.2
Bleed	1117		#4	625	60	260			203		Density, lbs./cu. ft.	138		Density, lbs./cu. ft. Chem. Anal.
			#5	653	70	284			208		Bed Height, Feet	12.6	Aerated	147 % Fe
Total	16859		Average	649	80	316						Settled	149 % C	
Total Feed	33304		Product Separator	70.8	90	350						Compacted	163 % Oil	
Recycle/F.F.	1.02				95	376						Sp. Grav.	4.6 Specific Surface	
Inlet Vel.	1.12				E.P.	396						Inventory Figures	17.350 m ² /gm	
Steam Flow					Rec.	98.0						From d-P Meters	14.342 2.73 ml.NH ₃ /gm	
					Res.	1.5						v/hr/V	1980	
					Loss.	0.5						GENERATOR ELEMENTAL BALANCE		
NATURAL GAS		PRODUCT INSPECTION							IN			OUT		
	%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	m/hr	C	H	O	
CO ₂	2.30		Neut. No.	58.3	39.4				O ₂	0.047 11.017		22.128	CO ₂	2.98 1.294 1.29 2.6
CH ₄	82.64		Sap. No.	43.3	41.3				CO ₂	0.343 0.34		0.686	CO	35.48 15.409 15.41 15.4
C ₂ H ₆	8.55		Hydrox No.						CH ₄	12.327 12.3349	49.308		CH ₄	0.10 0.043 0.04 0.172
C ₃ H ₈	4.63		Bromine No.	94.1					C ₂ H ₆	1.272 2.54	7.632		H ₂	60.79 26.401 52.802
C ₄ H ₁₀	0.27	% Fe							C ₃ H ₈	0.691 1.98	5.528		N ₂	0.65 0.282
N ₂	1.312	% Alc		10.0					C ₄ H ₁₀	0.640 0.16	0.400		H ₂ O	9.764 4.9
O ₂	0.518	APT	49.7	10.6					N ₂	0.195			Total	43.429 16.75 62.758
MW	19.5032								Total	25.932 17.3662 868 22.814 Balance				96.48 99.79 100.3

FRESH FEED			WET GAS			RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION							
	%	m/hr.	#/hr.	%	m/hr.	#/hr.	m/hr.	m/hr.	#/hr.	m/hr.	%	m/hr.	%	m/hr.	a/hr.	%	o/hr.	#/hr #/gal gal/hr	
CO	35.48	15.410431.634	13.61	2.37	66.58	2.490	69.735	6.046	21.45624.42	8.535	12.17-12.920-12.92016.158						-12.920		
H ₂	60.79	26.403	53.228	49.18	8.56	17.26	8.994	18.132	21.845	48.24854.92	30.839	45.95-17.409					-34.816		
CO ₂	2.98	1.294	56.949	25.36	4.42	19.450	4.638204.112	11.285	12.55914.30	15.903	22.68	3.344	3.34421.700				6.688		
N ₂	0.65	0.282	7.901	1.34	0.23	6.53	0.245	6.858	0.595	0.877	1.00	0.840	1.20-0.037						
CH ₄	0.10	0.043	0.690	4.58	0.80	12.79	0.837	13.430	2.034	2.077	2.36	2.872	4.10	0.794	5.152	3.176			
C ₂ H ₄				1.71	0.30	8.36	0.313	8.781	0.760	0.760	0.87	1.073	1.53	0.313	0.626	4.062	1.252	72.40	
C ₂ H ₆				0.61	0.11	3.19	0.111	3.548	0.271	0.271	0.51	0.383	0.55	0.111	0.222	1.441	0.666		
C ₃ H ₈				1.51	0.26	11.07	0.276	11.626	0.671	0.671	0.76	0.947	1.35	0.276	0.828	5.373	1.656	11.63 4.32 2.69	
C ₃ H ₈				1.05	0.18	10.27	0.192	10.785	0.466	0.466	0.53	0.658	0.94	0.192	0.768	4.984	1.536	10.79 5.00 2.16	
C ₄ H ₁₀				0.32	0.06	3.26	0.059	3.419	0.142	0.142	0.16	0.201	0.29	0.059	0.236	1.531	0.59	10.25 6.10 1.68 75.93	
C ₅ H ₁₀				0.56	0.10	6.80	0.102	7.146	0.249	0.249	0.28	0.351	0.50	0.102	0.510	3.310	1.02	7.15 5.45 1.31	
C ₆ H ₁₂				0.17	0.03	2.53	0.032	2.652	0.076	0.076	0.09	0.107	0.15	0.032	0.192	1.246	0.38	2.65 5.50 0.48	
OIL												0.540	0.77		5.40055.042	10.80		75.74 6.49 11.67	
WATER												6.869	9.80			15.74		6.869 6.232	
TOTAL		43.432550.414		17.41342.75	18.289350.024	44.420	87.852		70.118		-25.143						111.37	19.01	
H ₂ +CO	96.37	41.813				11.483										109.67	17.52		
H ₂ /CO	1.71	1.713	3.61			3.612		3.613	2.25				1.347						
ULTIMATE YIELDS			WEIGHT BALANCE			#/hr.	%	#/hr.		EFFLUENT RATIOS		CONTRACTION:	57.890						
	%		H ₂ /C ₀	#/hr.	g/M3	Gal/hr	H ₂ /C ₀	cc/M3		Wet Gas	342.783	105.046560.033	H ₂ /H ₂ O	4.490	C ₀ Conversion:	85.842			
C ₁ +C ₂	10.655	24.91	1.571	26.566						Oil	63.923		C ₀ /C ₀	1.863	H ₂ Conversion:	65.936			
C ₃ +	* 51.486	35.63	2.248	38.014						Water	126.458		(H ₂) (C ₀)	(H ₂₀) (C ₀) 8.365	H ₂ +C ₀	72.535			
C ₄ +	46.113	24.00	1.514	25.602						Total	535.114	96.86 550.414							
Ult. Oil		109.67	6.919	117.000	17.520	1.105	156.14			H ₂ O+O ₂ 15851 SCFF									
C ₀₂	21.700	147.16	9.284	156.992						#/hr #/M gal/hr GPM									
H ₂ O		112.28	7.083	119.774						C ₂ 35.628 2.248 7.344 0.463									
										Rec 01163.923 4.053 9.853 0.620									
										WSC 12.646 0.798 1.516 0.096									
										112.197 7.079 18.695 1.179									
										H ₂ O 113.812 7.180 13.647 0.861									

In product gas only

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂ by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at 60 F and 14.7 psig. g/m³ = 141.3 gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 E From _____ Hr. 0700 to _____ Hr. 0700 Hrs. 95-118

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS			
	SCFH	%	Generator Press.	415		A S T M	Hempel Dist.	In Reactor at Start of Period	949		Particle Size			
Oxygen	4167	42.1	O ₂ Preheat, °F	474	Prod.	Mph			949	Fresh Catalyst Charged	40	Screen		
Nat. Gas	5722		Gas Preheat, °F	686	A.P.I.	55.1		to 400	72.6	55.1	Catalyst Recharged	Frac.	M	%
Total	9889		Reactor Press.	380	I.B.P.	103		400-550	14.6	36.9	Total	989	On 40	420+
Fresh Feed	16584		Steam Back Press.	727				550+	12.8		Catalyst Taken Out	115	100	119-150
F. F. by C	17299		Temperatures, °F			5%					In Reactor at End of Period	874	150	149-105
Avg. F. F.			Heater Outlet	145		10%	142						200	104-74
Wet Gas	6796		Catalyst ±1	145		20	166						250	73-62
Contraction	56.3		±2	660		30	190						325	61-44
Recycle	15242		±3	643		40	214						430	0.2
Bleed	1079		±4	675		50	256		200		Pounds in Reactor	1075	<325	0.2
			±5	655		60	261		203		Density, lbs./cu. ft.	139.2		
Total	16321		Average	655		70	286		208		Bed Height, Feet	11.7		
Total Feed	32905		Product Separator	72		80	322						147	% Fe
Recycle/F.F.	0.904					90	360						149	% C
Inlet Vel.	1.103					95	386				Space Vel. SCFH/lb. cat.		165	% Oil
Steam Flow						E.P.	409				Inventory Figures	18.975		
						Rec.	97.5				From d-P Meters	15.427		
						Res.	1.5				V/hr/V	2148		
						Loss.	1.0							

FRESH FEED			WET GAS				RECYCLE			COMB. FEED			EFFLUENT			NET CHANGE ON REACTION					
%	m/hr	#/hr	%	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	m/hr	%	m/hr	a/hr	%	Carbon	Hydrogen	Oxygen	Ultimate Oil	Unsats.	
CO	35.54	15.546	35.443	12.73	2.282	63.92	2.436	68.232	5.481	21.027	24.23	7.917	11.45	-13.11	-15.11	15.670			-13.110		
H2	60.79	26.592	53.607	50.26	9.010	18.16	9.618	19.390	21.638	48.228	55.56	31.256	45.20	-16.97			-33.948				
CO2	2.94	1.286	56.597	25.39	4.558	200.33	4.858	213.801	10.931	12.217	14.08	15.789	22.83	3.57	3.57	22.977			7.144		
N2	0.52	0.228	6.416	1.04	0.186	5.21	0.199	5.575	0.448	0.677	0.78	0.647	0.94	-0.03							
CH4	0.21	0.092	1.476	4.92	0.882	14.15	0.941	15.096	2.118	2.210	2.55	3.059	4.42	0.85	0.85	5.461	3.396				
C2H4				1.71	0.307	8.61	0.327	9.173	0.736	0.736	0.85	1.063	1.54	0.33	0.65	4.207	1.308			73.68	
C2H6				0.57	0.102	3.07	0.109	3.277	0.245	0.245	0.28	0.354	0.51	0.11	0.22	1.402	0.654				
C3H6				1.48	0.265	11.15	0.285	11.908	0.637	0.637	0.73	0.920	1.33	0.28	0.85	5.461	1.698				
C3H8																					
C4H8				0.96	0.172	9.65	0.184	10.323	0.413	0.413	0.48	0.597	0.86	0.18	0.74	4.734	1.472				
C4H10				0.29	0.058	3.02	0.055	3.197	0.125	0.125	0.14	0.180	0.26	0.06	0.22	1.415	0.55				
C5H10				0.50	0.090	6.31	0.096	6.732	0.215	0.215	0.25	0.311	0.45	0.10	0.48	3.088	0.96				
C6H12				0.15	0.027	2.27	0.029	2.441	0.065	0.065	0.07	0.094	0.14	0.03	0.17	1.119	0.348				
OIL												0.536	0.78		5.36	34.465	10.716				
WATER												6.423	9.29				12.846				
TOTAL	43.745	553.558		17.927	345.861	9.135	368.974	43.052	86.797	69.146		-24.61							100.7	17.33	
H2+CO	42.137			11.292		12.054		27.119				-30.08							99.0	15.85	
H2/CO	1.711			3.948		3.948						1.30									
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr	EFFLUENT RATIOS	CONTRACTION:			56.258							

	% CO Fed	#/ <hr/>	H2/C0 #/MCF	g/M3	Gal/hr	H2/C0 Gal/MCF	cc/M3	Wet Gas	345.805	106.74	368.974	H2/H20	4.866	CONVERSION:	84.330
C1+C2	11.070	26.070	1.632	27.597				Oil	66.145		66.145	CO2/CO	1.994	C0 Conversion:	84.330
C3+	50.282	34.601	2.166	36.627				Water	118.420		118.420	(H2) (CO2) (H20) (CO)	9.705	H2 Conversion:	63.851
C4+								Total						CO+H2=71.396	

C4+	44.821	22.693	1.421	24.028		Total	530.370	95.814	553.539	
Ult. Oil	99.036	6.200	104.949	15.832	0.991	140.026	#/M ³	#/M ³	GPM	
C02	22.977	157.204	9.841	166.411			34.601	2.166	7.151	
H2O							001166.145	4.141	10.179	
*	107.483	6.729	113.787				USC	11.845	0.741	1.420
								0.086		
	112.588	7.048	18.750	1.174						

In product gas only

H_2O 106.578 6.672 12.779 0.800

B Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂O by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 F and 14.7 psig. Cubic Meters measured at 0 C. and 14.7 psig. g/M³ = 16.91 × #/MCF. cc/M³ = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 F From _____ Hr. 0700 to _____ Hr. 0700 Brs. 119-142

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA		CATALYST ANALYSIS							
	SCFH	%	Generator Press.	415		A S T M	Hempel Dist.	In Reactor at Start of Period	874	Particle Size							
Oxygen	4161	41.8	O ₂ Preheat, °F	449	Prod.	Naph		°F	%	A.P.I.	Fresh Catalyst Charged						
Nat. Gas	5787		Gas Preheat, °F	700	A.P.I.	55.4		to 400	74.0	55.4	Catalyst Recharged						
Total	9948		Reactor Press.	378	I.B.P.	108		400-550	15.6	37.6	Total	874	On 40				
Fresh Feed	16535		Steam Back Press.	710		5%		550+	10.4		Catalyst Taken Out	26	420+	15.4	80+		
F. F. by C	16896		Temperature, °F			10%	144				In Reactor at End of Period	848	100	419-150	55.5	80-40	
Avg. F. F.			Heater Outlet	185		20	171					150	149-105	10.9	40-20		
Wet Gas	7005		Catalyst #1	659	30	194						200	104-74	5.2	20-10		
Contraction	55.1		#2	648	40	217		Temp.	%	Reactor d-P, H ₂ O		250	73-62	0.8	10-0		
Recycle	16989		#3	677	50	240		200		Pounds in Reactor	1027	<325	43-0	1.6			
Bleed	1129		#4	641	60	261		203		Density, lbs./cu. ft.	139			Density, lbs./cu. ft.	Chem. Anal.		
			#5	656	70	268		208		Bed Height, Feet	11.2						
Total	17118		Average	656	80	522					Aerated	148	% Fe				
Total Feed	33653		Product Separator	68.6	90	558					Settled	150	% C				
Recycle/F.F.	1.04				95	591					Compacted	162	% Oil				
Inlet Vel.	1.13				E.P.	401				Space Vel. SCFH/lb. cat.		Sp. Grav.	4.35	Specific Surface			
Steam Flow					Rec.	97.0				Inventory Figures	19.499				m ² /gm		
					Res.	1.5				From d-P Meters	16,100				6.62 ml.NH ₃ /gm		
					Loss	1.5				V/hr/V	2237						
GENERATOR ELEMENTAL BALANCE																	
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
%		Oil	Water	Product	Pour °F	SUS @ °F		Mol %	2100 m/hr	C	H	O	Mol %	2100 m hr	C	H	O
CO ₂	2.38	Neut. No.	42.6	39.8				O ₂	0.064				CO ₂	1.239	1.24		2.5
CH ₄	85.13	Sap. No.	45.4	39.8				CO ₂	10.976				CO				
C ₂ H ₆	8.19	Hydrox. No.						CO ₂	0.363	0.36	0.726		15.628	15.63			15.6
C ₃ H ₈	3.65	Bromine No.	85.1					CH ₄	12.690	12.69	50.760		CH ₄	0.122	0.12	0.488	
C ₄ H ₁₀	0.22	% Fe						C ₂ H ₆	1.250	2.50	7.500		H ₂	26.292			52.584
N ₂	2.014	% Alc		11.5				C ₃ H ₈	0.557	1.87	4.456		N ₂	0.336			
O ₂	0.416	° API	49.7	10.8				C ₄ H ₁₀	0.034	0.14	0.340		H ₂ O				9.692 4.8
MW	19.2804							N ₂	0.307				Total	43.617	16.99	62.784	23.0
									26.241	17.356	63.056	22.806	Balance	97.86	99.54	100.6	

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION						
	%	m/hr	#/hr	%	Measured	At Wt.	Balance	m/hr	m/hr	%	m/hr	%	m/hr	a/hr	%	a/hr	Oxygen	Ultimate Oil	Unsats.
					m/hr	#/hr	m/hr	#/hr	m/hr	#/hr	m/hr	#/hr	m/hr	a/hr	%	a/hr	#/gal	gal/hr	%
CO	35.83	15.628	437.740	15.19	2.807	78.62	2.976	85.358	6.859	22.487	25.35	9.835	13.75	-12.652	-12.652	19.043	-12.652		
H2	60.28	26.231	55.003	42.96	9.232	16.61	9.787	19.751	22.560	48.851	55.04	32.347	45.22	-16.504	-16.504	33.008			
CO2	2.84	1.239	54.528	22.60	4.176	185.79	4.427	194.832	10.205	11.444	12.89	14.632	20.46	3.188	3.188	20.399	6.376		
N2	0.77	0.336	9.413	1.30	0.240	6.72	0.255	7.144	0.587	0.925	1.04	0.842	1.18	-0.081	-0.081				
CH4	0.28	0.122	1.957	5.01	0.926	14.86	0.982	15.737	2.262	2.384	2.69	3.244	4.54	0.860	0.860	5.503	3.440		
C2H4					1.60	0.598	6.30	0.513	8.780	0.722	0.722	0.81	1.035	1.45	0.318	0.318	4.006	1.252	73.00
C2H6					0.55	0.102	3.07	0.108	3.247	0.248	0.248	0.28	0.356	0.50	0.108	0.216	1.382	0.648	
C3H6					1.46	0.270	11.36	0.286	12.034	0.659	0.659	0.74	0.945	1.32	0.286	0.858	5.490	1.716	12.0 10.3
C3H8					0.52	0.096	4.23	0.102	4.498	0.235	0.235	0.26	0.337	0.47	0.102	0.306	1.958	0.315	4.5 10.5 10.0
C4H8					0.96	0.177	9.93	0.188	10.548	0.433	0.433	0.49	0.621	0.87	0.188	0.752	4.812	1.504	4.24 5.00 6.10
C4H10					0.25	0.046	2.67	0.049	2.848	0.113	0.113	0.13	0.162	0.23	0.049	0.196	1.254	0.490	2.8 4.86 0.59
C5H10					0.48	0.089	6.24	0.094	6.592	0.217	0.217	0.24	0.311	0.44	0.094	0.470	3.007	0.940	6.6 5.45 1.20
C6H12					0.12	0.022	1.85	0.024	2.020	0.064	0.064	0.06	0.078	0.11	0.024	0.144	0.921	0.288	2.0 5.80 0.37
OIL													0.504	0.70		5.036	32.224	10.072	70.6 6.50 10.87
WATER													6.276	8.77			11.942		5.921 6.276
TOTAL		43.616	556.627		18.475	350.29	19.591	371.369	45.154	88.770		71.525		-24.025				109.2 102.4	18.98 16.32
H2+CO		41.918			12.038	12.763		29.419	71.338		42.182		-29.156						
H2/CO		1.682			3.289	3.289		3.289	2.172		3.289		1.304						

ULTIMATE YIELDS						WEIGHT BALANCE			#/hr	%	#/hr	EFFLUENT RATIOS		CONTRACTION: 55.083	
	% C0 Fed	#/hr	H2 / C0 #/MCF	g/M3	Gal/hr	H2 / C0 Gal/MCF	cc/M3	Wet Gas	350.287	106.02	371.378	H2/H20	5.154	C0 Conversion:	80.957
C1 + C2	10.891	25.81	1.6239	27.460				Oil	63.011		63.011	C02/C0	1.488	H2 Conversion:	62.774
C3 + *	49.666	38.54	2.425	41.007				Water	122.238		122.238	(H2) (C02)		H2+CO2	69.553
C4 + *	42.218	22.01	1.385	23.420				Total	535.556	96.21	556.697	(H20) (C0)	7.668		
Ult. Oil		102.45	6.446	109.002	16.317	1.027	145.12	H2+CO2 = 18892 SCFH				#/hr #/M gal/hr .GPM			
C02	20.399	140.30	8.889	149.298				C3+	38.540	2.425	8.113	0.511			
H20		113.07	7.315	100.315				Req	01163.011	3.965	9.693	0.610			
								WSG	14.057	0.895	1.685	1.106			

* In product use only.

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 G From _____ Hr. 0700 to _____ Hr. 0700 Hrs. 143-166

FLOWS		RUN CONDITIONS		DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS						
	SCFH	%	Generator Press.	410		A S T M	Hempel Dist.	In Reactor at Start of Period	848		Particle Size						
Oxygen	4176	42.0	O ₂ Preheat, °F	517	Prod.	Mph		%	A.P.I.	Fresh Catalyst Charged	Screen	M	%	M			
Nat. Gas	5771		Gas Preheat, °F	693	A.P.I.	55.2		°F	%	Catalyst Recharged	Frac.			Sedimentation			
Total	9947		Reactor Press.	367	I.B.P.	118		to 400	75.3	55.2	On 40	420+	16.7	80+			
Fresh Feed	16501		Steam Back Press.	697				400-550	15.3	37.3	Total	848	100	419-150			
F. F. by C	16588		Temperatures, °F			5%		550+	11.4		Catalyst Taken Out	29	150	149-105	80-40		
Avg. F. F.			Heater Outlet	189		10%	156			In Reactor at End of Period	819	200	104-74	3.6	20-10		
Wet Gas	7243		Catalyst #1	656		20	180				250	73-62	3.6	20-10			
Contraction	53.6		#2	645		30	202				325	61-44	0.4				
Recycle	17181		#3	673		40	222		Temp:	%	Reactor d-P, H ₂ O						
Bleed	1164		#4	644		50	242		200		Pounds in Reactor	987	<325	43.0	0.6		
			#5	650		60	265		203		Density, lbs./cu. ft.	156	Density, lbs./cu. ft.		Chém. Anal.		
Total	18345		Average	654		70	290		208		Bed Height, Feet	11.0	Aerated	147	% Fe		
Total Feed	34846		Product Separator	67.7		80	318				Settled	149	% C				
Recycle/F.F.	1.11					90	342				Compacted	163	% Oil				
Inlet Vel.	1.210					95	382				Space Vel. SCFH/lb. cat.		Sp. Grav.	1.45	Specific Surface		
Steam Flow						E.P.	406				Inventory Figures	20.148			m ² /gm		
						Rec.	97.5				From d-P Meters	16.718		4.06	ml.NH ₃ /gm		
						Res.	1.5				V/hr/V	2273					
						Loss.	1.0				GENERATOR ELEMENTAL BALANCE						
NATURAL GAS		PRODUCT INSPECTION						IN				OUT					
	%	Oil	Water	Product	Pour °F	SUS @ °F		Mol %	lb/m ³	C	H	O	Mol %	lb/m ³	C	H	O
CO ₂	2.24	Neut. No.	32.4	35.2				O ₂	0.072 11.016		22.176	CO ₂		1.097	1.10	2.8	
CH ₄	85.63	Sap. No.	37.6	37.5				CO ₂	0.341	0.34	0.682	CO	15.909	15.91	15.9		
C ₂ H ₆	7.88	Hydrox. No.						CH ₄	12.731	12.73	50.924	CH ₄	0.058	0.05	0.208		
C ₃ H ₈	3.42	Bromine No.	85.6					C ₂ H ₆	1.200	2.40	7.200	H ₂	26.146	52.292			
C ₄ H ₁₀	0.19	% Fe						C ₃ H ₈	0.521	1.56	4.168	N ₂	0.522				
N ₂	2.17	% Alc		10.00				C ₄ H ₁₀	0.029	0.12	0.280	H ₂ O			9.796	4.9	
O ₂	0.47	°API	50.7	10.9				N ₂	0.330			Total	43.596	17.0682	298	23.0	
MW	19.148							Total	26.240	17.1562	58.8222	Balance	99.4699	99.54	100.6		

FRESH FEED			WET GAS						RECYCLE		COMB. FEED		EFFLUENT			NET CHANGE ON REACTION												
	%	m/hr	#/hr	Measured		At Wt.		Balance	m/hr	m/hr	%	m/hr	%	m/hr	a/hr	Carbon	Hydrogen	Oxygen	Ultimate Oil	Oil/gal	Unsats.							
				m/hr	#/hr	m/hr	#/hr		m/hr	m/hr		m/hr	%	m/hr	a/hr	%	a/hr	%	#/hr	#/gal	%							
CO	36.55	15.91	445.6	16.69	3.19	89.32	3.387	94.310	8.076	23.99	26.10	11.44	15.16	-12.543	-32.543	21.163			-12.543									
H2	60.07	26.15	52.7	51.32	9.51	15.77	10.354	20.874	24.834	50.98	55.46	35.19	46.62	-15.795					-31.592									
CO2	2.52	1.10	48.4	20.70	3.96	174.06	4.176	183.766	10.017	11.12	12.10	14.19	18.80	3.076	3.076	19.334			6.152									
N2	0.74	0.32	9.0	1.41	0.27	7.54	0.284	79.565	0.682	1.00	1.09	0.97	1.29	-0.036														
CH4	0.12	0.05	0.8	4.43	0.85	13.57	0.894	14.342	2.144	2.19	2.58	3.04	4.03	0.844	0.844	5.305	3.376											
C2H4				1.27	0.24	6.82	0.256	7.181	0.615	0.62	0.67	0.87	1.15	0.256	0.512	3.218	1.024			67.50								
C2H6				0.57	0.11	3.28	0.115	3.458	0.276	0.28	0.51	0.39	0.52	0.115	0.230	1.446	0.690											
C3H6				1.44	0.28	11.57	0.291	12.245	0.697	0.70	0.76	0.99	1.31	0.291	0.873	5.487	1.746		12.2 11.0	4.32 6.25	2.83 1.76							
C3H8				0.56	0.11	4.72	0.113	4.983	0.271	0.27	0.29	0.38	0.50	0.113	0.359	2.131	0.904		5.0 10.3 9.8	4.24 5.00 6.10	1.18 2.06 1.61							
C4H8				0.91	0.17	9.76	0.184	10.323	0.440	0.44	0.48	0.62	0.82	0.184	0.736	4.626	1.472											
C4H10				0.25	0.05	2.79	0.050	2.906	0.121	0.12	0.15	0.17	0.23	0.050	0.200	1.257	0.50		2.9	4.86	0.60							
C5H10				0.35	0.07	4.70	0.071	4.979	0.169	0.17	0.19	0.24	0.32	0.071	0.355	2.231	0.71		5.0	5.45	0.91							
C6H12				0.10	0.02	1.60	0.020	1.683	0.048	0.05	0.05	0.07	0.09	0.020	0.120	0.754	0.24		1.7	5.50	0.31							
OIL														0.5256	0.70	5.258	33.048	10.516		73.7	6.47	11.40						
WATER														6.391	8.47			10.414		5.207 6.391								
TOTAL	43.53	556.44		19.11	349.49	20.176	369.06	48.390	91.93		75.477									110.9 104.1	19.29 16.59							
H2+CO	98.62	42.05			12.99		13.721		32.910																			
H2/CO	1.64	1.64			3.08		3.075		3.075	2.125		3.076		1.259														
ULTIMATE YIELDS												WEIGHT BALANCE			#/hr	%	#/hr	EFFLUENT RATIOS			CONTRACTION:	53.646						
	%	C0 Fed	#/hr	H2 / CO			#/MCF	g/M3	H2 / CO		Gal/hr	Gal/MCF	cc/M3	Wet Gas		349.49	105.60	378.98	H2/H20		5.506	C0 Converson:	78.837					
C1+C2	9.869	24.191	1.517	25.652					Oil					Oil		60.60		60.60	C02/C0		1.240	H2 Conversion:	80.405					
C3+*	49.554	37.119	2.529	39.385					Water					Water		116.86		116.86	(H2) (C02)		(H20) (C0)	6.827	H2+CO2	67.594				
C4+*	41.916	19.891	1.248	21.104					Total					Total		526.95		94.70	556.44									
Ult. Oil		104.148	6.553	110.473	16.589	1.041	147.09		H2+CO2 15941 SCFH																			
C02	19.354	135.388	8.493	143.617					#/hr #/m gal/hr GPM																			
H2O		115.140	7.223	122.141					Cg# 37.119 2.529 7.890 0.495																			
									Rec 011 60.60 3.802 9.378 0.588																			
									WSG 11.686 0.733 1.401 0.088																			
									109.405 6.864 18.663 1.171																			

In product gas only

THE TEXAS COMPANY — MONTEBELLO LABORATORY

DATA SUMMARY SHEET

Synthesis Run Number 48 H From Hr. 0700 to Hr. 0700 B.P.S. 167-190

FLOWS			RUN CONDITIONS			DISTILLATIONS				CATALYST DATA			CATALYST ANALYSIS					
	SCFH	%	Generator Press.	407		A S T M		Hempel Dist.		In Reactor at Start of Period	819							
Oxygen	4132	41.9	O ₂ Preheat, °F	463	Prod., Bph			°F	% A.P.I.	Fresh Catalyst Charged	40							
Nat. Gas	5740		Gas Preheat, °F	707	A.P.I.	54.9		to 400	72.0 54.9	Catalyst Recharged								
Total	9072		Radiator Press.	574	I.B.P.	115		400-550	50.0 37.9	Total	859	On 40	420+	15.2	80+			
Fresh Feed	16471		Steam Back Press.	702	5%			550+	31.4	Catalyst Taken Out	36	100	419-150	70.5	80-40			
F. F. by C	16729		Temperatures, °F		10%	150				In Reactor at End of Period	823	150	149-105	10.0	40-20			
Avg. F. F.			Heater Outlet	187	20	178						200	104-74	3.6	20-10			
Wet Gas	6967		Catalyst #1	662	30	197						250	73-62	0.4	10-0			
Contraction	54.5	±2	646	40	221			Temp.	%	Reactor d-P, H ₂ O		325	61-44	0.6				
Recycle	16025		#3	665	50	243		200		Pounds in Reactor	999	<325	43.0	1.0				
Bleed	1176		#4	653	60	265		203		Density, lbs./cu. ft.	135							
			#5	653	70	288		208		Bed Height, Feet	11.1	Aerated	145	% Fe				
Total	17201		Average	652	80	317					Settled	147	% C					
Total Feed	53672		Product Separator	67	90	350					Compacted	161	% Oil					
Recycle/F.F.	1.04				95	384					Sp. Grav.	4.3	Specific Surface					
Inlet Vel.	1.146				E.P.	400					Inventory Figures	20.001					m ² /gm	
Steam Flow					Rec.	97.5					From d-P Meters	16.654					ml.NH ₃ /gm	
					Res.	1.5					v/hr/v	2248						
					Loss.	1.0												
GENERATOR ELEMENTAL BALANCE																		
NATURAL GAS		PRODUCT INSPECTION						IN				OUT						
	%		Oil	Water	Product	Pour °F	SUS @ °F			Mol %								
CO ₂	2.53	Neut. No.	35.6	33.0						O ₂	0.068							
CH ₄	82.67	Sap. No.	41.8	35.8						CO ₂	10.899	21.934	CO ₂	1.117	1.12	2.23		
C ₂ H ₆	8.61	Hydrox. No.								CH ₄	0.355	0.35	CO	15.624	15.62	15.62		
C ₃ H ₈	3.50	Bromine No.	82.3							C ₂ H ₆	12.516	12.5250.064	CH ₄	0.087	0.09	0.35		
C ₄ H ₁₀	0.19	% Fe								C ₃ H ₈	1.304	2.61 7.824	H ₂	26.243	52.49			
N ₂	2.45	% Alc	10.00							C ₄ H ₁₀	0.500	1.50 4.000	N ₂	0.378				
O ₂	0.45	* A.P.T.	50.3	10.8						N ₂	0.029	0.12 0.290	H ₂ O			9.45 4.73		
MW	19.272									Total	26.040	17.0962.17822.640	Total	43.449	16.85	62.2922.59		
															98.45100.1899.76			

FRESH FEED			WET GAS				RECYCLE		COMB. FEED		EFFLUENT		NET CHANGE ON REACTION						
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	#/hr	m/hr	#/hr	m/hr	%	m/hr	a/hr	%	a/hr	%	#/hr	
CO	35.96	15.62	437.63	15.92	2.93	81.96	3.149	88.20	7.223	22.847	25.72	10.372	14.46	-12.475	-12.475	20.16	-12.475		
H ₂	60.40	26.24	52.90	50.08	9.20	18.56	9.905	19.97	22.723	48.965	55.15	32.628	45.48	-16.337	-32.674				
CO ₂	2.57	1.12	49.16	21.78	4.00	176.17	4.308	189.59	9.882	10.999	12.38	14.190	19.78	3.191	3.191	20.42	6.382		
N ₂	0.87	0.38	10.59	1.58	0.28	8.15	0.312	8.74	0.717	1.095	1.23	1.029	1.42	-0.066					
CH ₄	0.20	0.09	1.40	5.01	0.92	14.76	0.991	15.80	2.273	2.360	2.66	3.264	4.55	0.804	0.804	5.79	3.616		
C ₂ H ₄				1.24	0.23	6.40	0.245	6.88	0.563	0.563	0.63	0.808	1.13	0.245	0.490	3.14	0.980	63.74	
C ₂ H ₆				0.66	0.12	3.64	0.130	3.92	0.299	0.299	0.34	0.429	0.60	0.130	0.280	1.66	0.780		
C ₃ H ₆				1.36	0.25	10.52	0.269	11.32	0.617	0.617	0.69	0.886	1.24	0.269	0.807	5.17	1.614	11.3 4.32 2.62	
C ₃ H ₈				0.55	0.10	4.45	0.109	4.79	0.250	0.250	0.28	0.359	0.50	0.109	0.327	2.06	0.872	10.2 5.00 2.04	
C ₄ H ₈				0.92	0.17	9.48	0.182	10.20	0.417	0.417	0.47	0.599	0.84	0.182	0.728	4.66	1.456	9.7 6.10 1.59 74.11	
C ₄ H ₁₀				0.31	0.06	3.31	0.061	3.57	0.141	0.141	0.16	0.202	0.28	0.061	0.244	1.56	0.61	3.6 4.86 0.73	
C ₅ H ₁₀				0.48	0.09	6.17	0.095	6.64	0.218	0.218	0.25	0.315	0.44	0.095	0.475	3.04	0.95	6.6 5.45 1.21	
C ₆ H ₁₂				0.11	0.02	1.68	0.022	1.81	0.050	0.050	0.06	0.078	0.10	0.022	0.132	0.85	0.26	1.8 5.50 0.35	
OIL												0.492	0.69		4.917	31.47	9.83		
WATER												6.095	8.49			11.70			5.849 6.093
TOTAL	43.45	551.66		18.38	345.30	19.778	371.60	45.373	88.821		71.736		-26.870					107.3	18.72
H ₂ +CO	41.87			12.13		15.054		29.946					-28.812					100.9	18.15
H ₂ /CO	1.68			3.15		3.145		3.146		3.146		1.810							
ULTIMATE YIELDS			WEIGHT BALANCE				#/hr	%	#/hr	%	#/hr	%					CONTRACTION: 54.479		
	%	CO Fed	#/hr	H ₂ /CO	#/MCF	g/M3	Gal/hr	Gal/MCF	cc/M3	Gal/hr	Gal/MCF	cc/M3	Wet Gas	345.304	107.62	371.604	H ₂ /H ₂ O	5.355	CO Conversion: 79.845
C ₁ +C ₂	10.586	25.30	1.594	26.955									Oil	60.235		60.235	C ₂ CO ₂	1.368	H ₂ Conversion: 62.255
C ₃ +	48.855	38.33	2.415	40.858									Water	119.620		119.620	(H ₂) (CO ₂)		H ₂ CO ₂ 68.820
C ₄ +	41.577	22.22	1.400	23.674									Total	525.359	95.23	551.659	(H ₂) (CO ₂)	7.326	
Ult. Oil	100.87	6.356	107.463	16.150	1.018	143.642							H ₂ CO ₂ 15880 SCFH	#/hr	#/M	gal/hr	GPM		
C ₂ O ₂	20.424	140.43	8.848	149.620									C ₃ +	58.554	2.415	8.065	0.508		
H ₂ O	109.77	6.916	116.950										Rec	01160.235	5.795	9.295	0.586		
													WSC	11.982	0.755	1.437	0.091		
														110.551	6.965	18.798	1.185		
														107.858	6.795	12.580	0.815		

Yield Calculations assume "oil" is CH₂, and is found by difference on Carbon, and H₂0 by difference on Hydrogen. "Oil" figures therefore include hydrocarbon fraction of oxygenated compounds. Standard cubic feet measured at 60 °F and 14.7 psig. Cubic Meters measured at O.C. and 14.7 psig. g/M3 = 16.91 × #/MCF. cc/M3 = 141.3 × gal/MCF.

C. SUMMARY OF EQUIPMENT AND OPERATING PROBLEMS

SUMMARY OF EQUIPMENT AND OPERATING PROBLEMS

As is invariably the case in the early stages of the development of a new process, many operating and equipment problems were met at Montebello and most of them in connection with the synthesis reactor system have been solved satisfactorily. During the solution of these problems, much valuable knowledge and experience was gained. A discussion of these problems is included in the present report in the hope that this may result in the saving of both time and money at other laboratories where similar problems may be encountered.

1. Valves and Fittings

It was found that copper and brass were not suitable for practically any service in the generator or synthesis systems. Besides being not recommendable for high pressures and temperatures, these materials were attacked by the synthetic water-soluble and oil-soluble products, as well as by the fresh synthesis gas. Forged steel or cast steel valves and fittings were found to be the most practical. Semi-steel, cast iron, and malleable iron were considered unsafe because these materials tended to fracture under strain or sudden blows.

Most of the steel valves used at first at Montebello were manufactured by the Henry Vogt Machine Company. These valves were readily available in many styles and types, were easy to install because of the hexagonal-shaped ends, and were manufactured by an old, nationally-advertised company; but, by actual experience, it was found that almost every type of Vogt valve tried was unsatisfactory. They frequently would leak around the bonnets and past the seats in every type of service from cold water to high

pressure steam. The possibility that this was caused by the type of service, as suggested by the Vogt representative, was eliminated when it was found that valves made by many other manufacturers were quite satisfactory.

At present the following valves are being used successfully: Edwards (globe); Crane, Chapman, and Worcester (gate); Nordstrom (cock); and Grove and Dragon (meter). The latter two are 1/4" barstock valves used on orifice runs and meter manifolds. Barstock valves have usually proved unsatisfactory, but these two appear to be made with more precision than is normally encountered.

Nordstrom plug valves (cocks) have been used on catalyst lines and although they have been the best of those tried, they are not completely adequate. Other kinds tried were Porter, Wedgeplug, Hamer, and Walworth; but there does not seem to be any small valve available which will give tight shut-off on high pressure lines containing powdered catalyst and hot (650-700°F.) gas.

2. Threaded Pipe Connections

In order to get leak-proof threaded pipe connections, it was necessary to cut perfect pipe threads. There was a tendency for the workmen to use whatever pipe-die lubricant was handy: motor oil, carbon tetrachloride, or even water. Pipe thread troubles were ended when the use of Sultex B cutting oil was made mandatory except for oxygen lines where the use of water was continued.

Pipe threads on oxygen lines were sealed with litharge

and glycerine, whereas white lead was employed on other lines. White lead was not entirely satisfactory; it was expensive, prone to be wasted, poisonous, and unsuitable for hot lines. Several commercial compounds proved to be more adequate. "PIPETITE-Stik" compound made by Lake Chemical Company of Chicago, Illinois, fulfilled the requirements of a general purpose sealer, and was obtained in convenient pencil-length sticks for easy application. "Aviation Permatex" was also satisfactory. On hot lines which were to be disconnected later, the threads were coated with "Seal-rite No. 5" made by Macksons Company, New York, N. Y. This key-paste type of material permitted breaking connections easily even after extended exposure to high temperature. Since it was water-soluble in absence of heat, it was used only on steam and hot-gas lines.

3. Steam Traps

Yarway steam traps were tried on the 185 psig utility steam lines but were observed to be subject to fouling by small pieces of scale in the lines. This might have been eliminated by filters in the line, but Armstrong traps worked very well without the added expense of filters.

4. Packing

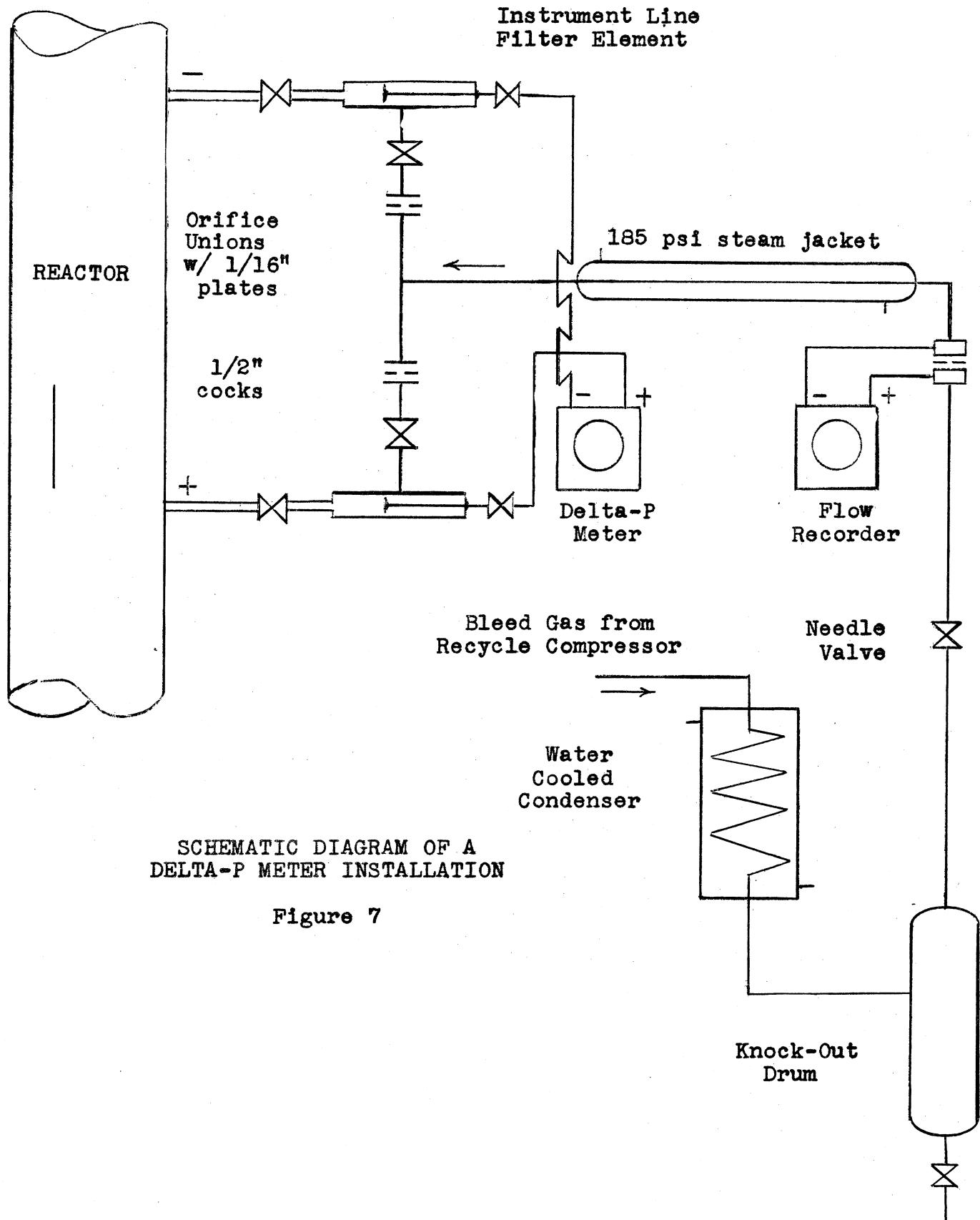
The piston-rod packing glands on the recycle compressor and on the generator quench-water pumps leaked frequently on high pressure or after several weeks of service. The rods were often scored by metallic packing such as Durametallic, and impregnated asbestos packing would not hold up under pressure and wear. Garlock Chevron packing alleviated this problem. At the present time all hand operated oxygen valves are packed with dry Johns-Manville pure braided asbestos. Motor actuated valves on oxygen service are lubricated with Nordstrom DC-234-S, a silicone base lubricant.

The meters were connected to the taps as indicated in the table below:

<u>METER</u>	<u>RANGE</u>	<u>TAPS</u>	<u>DISTANCE BETWEEN TAPS</u>
Cat Dens. or No. 1 dP	100" H ₂ O	1, 2	31.2"
Cat Dens. or No. 2 dP	100"	2, 3	31.2"
No. 3 dP	200"	3, 4	62.4"
No. 4 dP	50"	4, 5	62.4"
Steam Header or No. 5 dP	50"	5, 6	31.2"
Total dP	500"	1, 5	187.2"

The main difficulties experienced with the delta-P system were caused by plugging of the pressure taps and getting catalyst into the meters. The final scheme which proved satisfactory is shown in Figure 7, following. The filter elements were made from 1" stainless-steel immersion tubes (porosity E) manufactured by Micro Metallic Corp., Brooklyn, N. Y. Aloxite filters had been tried before, but they were not only too fragile but plugged too easily.

The orifice unions served two purposes: to take up the pressure drop from the bleed gas supply and to allow the even distribution of the bleed gas. One bleed gas supply was used for the three bottom taps, and one for the remaining taps. When everything was functioning properly, the flow of bleed gas could be varied several fold without affecting the delta-P readings. Each tap was purged with 300-500 SCFH of bleed gas. The gas bled through the lower two taps was considered part of the recycle and added thereto.



The following formulas were used to compute catalyst data:

BED HEIGHT

$$\frac{\text{ht. (ft.)} \times 12}{\text{Total dP*}} = \frac{62.4}{\text{Cat. Dens.}}$$

(*in inches of water)

$$\text{total height (ft.)} = \frac{5.2 \times \text{total dp}}{\text{cat. dens.}} \text{ plus 1(1)}$$

CATALYST DENSITY

$$\text{density (#/cu. ft.)} = 2 \times \text{dP No. 1}$$

$$\text{or} = \text{dP No. 1 plus dP No. 2}$$

CATALYST INVENTORY

$$\text{Inventory (pounds)} = \text{total bed ht.} \times 0.66 \times \text{cat.dens. (2)}$$

(1) Added because the first pressure tap is 1 foot from reactor bottom.

(2) The area of open cross-section in the reactor was 0.66 sq. ft.