THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 Q
HOURS 241-365

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At Wt Balance m/hr	WET GAS At Wt Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	36.710	15.077	422.51	14.283	2.206	61.79	8.752	23.829	10.252	-12.871	360.52
H_2 2.016	59.200	24.313	49.02	44.087	6.810	13.73	27.016	51.329	33.826	-17.503	35.29
CO_2 44.010	2.896	1.189	52.33	25.743	3.976	174.98	15.775	16.964	19.751	2.787	122.65
N_2 28.014	1.137	0.467	13.08	1.930	0.298	8.35	1.183	1.650	1.481		
CH_4 16.042	0.057	0.023	0.37	5.820	0.899	14.42	3.566	3.589	4.465	0.876	14.05
C_2H_4 28.052				2.197	0.339	9.51	1.346	1.346	1.686	0.339	9.51
C_2H_6 30.068				0.837	0.129	3.88	0.513	0.513	0.642	0.129	3.88
C_1+C_2											
C_3H_6 42.078				2.157	0.333	14.01	1.322	1.322	1.655	0.333	14.01
C_3H_8 44.094				0.380	0.059	2.60	0.233	0.233	0.292	0.059	2.60
C_4H_8 56.104				1.330	0.205	11.50	0.815	0.815	1.020	0.205	11.50
C_4H_{10} 58.120				0.413	0.064	3.72	0.253	0.253	0.317	0.064	3.72
C_5H_{10} 70.130				0.593	0.092	6.45	0.363	0.363	0.455	0.092	6.45
C_5H_{12} 72.146				0.090	0.014	1.01	0.055	0.055	0.069	0.014	1.01
C_6H_{12} 84.156				0.140	0.022	1.85	0.085	0.085	0.107	0.022	1.85
C_3+C_6											41.14
TOTAL		41.070			15.447		61.278	102.348			
H_2+CO		39.390	14,929 S.C.F.H.		9.016		35.768	75.158	44.785	30.374	
H_2/CO		1.61	669846		3.09			2.15		1.36	

	YIELD BASIS H_2+CO FED — CONDENSATE #/MCF	#/gal	gal/hr	gal/MCF	POLYMER #/hr	#/MCF	#/gal	gal/hr	gal/MCF	% Unsats.
CO 28.010					Distribution of					
H_2 2.016					Recovered Oil					
CO_2 44.010	8.216					400 EP			0.545	
N_2 28.014						400-550			0.137	
CH_4 16.042	0.241					550+			0.055	
C_2H_4 28.052	0.537									72.4
C_2H_6 30.068	0.260									
C_1+C_2	1.838									
C_3H_6 42.078	0.936	4.32	3.243	0.217	12.6	0.845	6.25	2.018	0.135	85.0
C_3H_8 44.094	0.174	4.24	0.613	0.041						
C_4H_8 56.104	0.770	5.00	2.300	0.154	10.93	0.732	6.10	1.792	0.120	76.3
C_4H_{10} 58.120	0.249	4.86	0.765	0.051	3.72	0.249	4.86	0.765	0.051	
C_5H_{10} 70.130	0.432	5.45	1.183	0.079	6.45	0.432	5.45	1.183	0.079	86.8
C_5H_{12} 72.146	0.068	5.25	0.192	0.013	1.01	0.068	5.25	0.192	0.017	
C_6H_{12} 84.156	0.122	5.54	0.334	0.022	1.85	0.122	5.54	0.334	0.022	
C_3+C_6	2.756		8.630	0.578	36.57	2.450		6.284	0.421	
TOTAL										
H_2+CO										
H_2/CO										

CUMULATIVE TOTALS	H_2+CO MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 8.8

EFFLUENT										
RECOVERED OIL		71.38	4.781		11.008	0.737	71.38	4.781		11.008	0.742
TOTAL OIL		112.52	7.537		19.638	1.315	107.95	7.231		17.292	1.158
WATER SOLUBLE CHEMICALS		13.45	0.901	8.098	1.661	0.111	13.45	0.901		1.661	0.111
TOTAL LIQUID PRODUCTS C_3+		125.97	8.438		21.299	1.427	121.40	8.132		18.953	1.270
NET WATER	6.909	124.47	8.338	8.328	14.946	1.001					
GROSS WATER		137.92	9.239		16.607	1.112					
HYDROCARBON TOTAL—C_1+		153.41	10.276								

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
62.39	85.37	71.99	77.11	54.01	34.10	40.41	82.11

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	433	Fresh Feed	15566
Natural Gas	419	Recycle	23225
Generator Outlet	413	Combined Feed	38791
Reactor Inlet	398	Wet Gas—Measured	5382
Condenser Inlet		Adjusted	5855
Product Accumulator	376	Loss	473
TEMPERATURES—°F.		Recycle/Fresh Feed	1.492
Oxygen	412	Inlet Velocity—ft./sec.	1.240
Natural Gas	717	Fresh Feed Rate—S.C.F.H.	14929
Generator		per Cu. Ft. Dense Bed	1142
Quench Accumulator	153	per Lb. Catalyst	9.75
Reactor Inlet	322		
Condenser Inlet			
Product Accumulator	69	Heat Transfer Calculations	

Catalyst No.	Height "	
1	12.0	629
2	43.2	624
3	74.4	661
4	105.6	
5	136.8	637
6	168.0	655
7	199.2	649
8	230.4	649
9	261.6	639
10	292.8	629
12	342.0	624

Steam Rate = 348.6 #/hr
@ 817 psia & 521°F
= 1196 BTU/#
Water in @ 176°F = 146 BTU/#
Heat Transferred/lb. steam
= 1050 BTU/#
(1050)(348.6) = 366000 BTU/hr
Ave. Bed Temperature
= 642°F
dT = 642-521 = 121°F
Tube Area = 30.9 ft²
$K = \frac{366000}{(121)(30.9)} = 98.0$

PRODUCT TESTS

	OIL	WATER
°API	50.2	10.4
Neut. No.	43.7	43.1
Sap. No.	50.4	48.1
Hydrox. No.		
Bromine No.	71.7	
Pour °F.		
Chemicals, % by K_2CO_3		10.0
HEMPEL, DIST. %		°API
205 °F.		
400	74.0	56.2
400-550	18.6	35.9
550+	7.4	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	98.0	
10%	130	
50%	230	
90%	352	
EP	399	
	97.0	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	1970
Fresh Catalyst Added 50#	76
Total	2046
Catalyst Recovered	154
In Reactor at End of Period	1892
REACTOR d-p, Inches H_2O	
No. Height "	
1 12 - 43.2	58
2 43.2 - 74.4	56
3 74.4 - 105.6	60
4 105.6 - 342.0	250
(Calc) 0-12"	22
total	446
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	116
Inventory, Lbs.	1531
Bed Depth, Ft.	19.80
Volume, Cu Ft	13.07

PARTICLE SIZE — Screen Analysis: Mesh	Microns	%	Sedimentation: Microns	%
On 40	419+	13.1	80+	
100	150	71.5	40—80	
150	105	9.3	20—40	
200	74	4.4	10—20	
250	62	0.8	0—20	
325	44	0.5		
<325		0.4		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	146
Settled	148
Compacted	162
Particle Density, gm./cc.	3.8
NH_3 Value, ml./gm.	11.88
N_2 Surface, m²/gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
Fe_5C_2	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR				AVERAGE
FRESH FEED				
CO 28.010	36.77	36.70	36.66	36.710
H_2 2.016	58.96	59.38	59.26	59.200
CO_2 44.010	3.06	2.74	2.89	2.896
N_2 28.016	1.16	1.12	1.13	1.137
CH_4 16.042	0.05	0.06	0.06	0.057
			M. W.	13.07816
			H_2O 18.016	
			BALANCE	
WET GAS	1700	2100	0900	
CO 28.010	14.45	15.34	13.06	14.283
H_2 2.016	43.85	42.93	45.48	44.087
CO_2 44.010	25.73	25.91	25.52	25.743
N_2 28.016	1.30	2.36	2.13	1.930
CH_4 16.042	6.09	5.35	6.02	5.820
C_2H_4 28.052	2.38	2.14	2.07	2.197
C_2H_6 33.068	0.92	0.81	0.78	0.837
C_3H_6 42.078	2.20	2.20	2.07	2.157
C_3H_8 44.094	0.45	0.44	0.25	0.380
C_4H_8 56.104	1.35	1.33	1.31	1.330
C_4H_{10} 58.120	0.38	0.41	0.45	0.413
C_5H_{10} 70.130	0.63	0.58	0.57	0.593
C_5H_{12} 72.146	0.09	0.08	0.10	0.090
C_6H_{12} 84.156	0.18	0.12	0.12	0.140
			M. W.	21.22130

GENERATOR BALANCE

	M/HR	C	H	O
CO 28.010	15.077	15.077		15.077
H_2 2.016	24.313		48.626	
CO_2 44.010	1.189	1.189		2.378
N_2 28.016	0.467			
CH_4 16.042	0.023	0.023	0.092	
H_2O 18.016			10.432	5.216
		16.289	59.150	22.671
		22.02	98.67	101.79

	Mol %	M/Hr	C	H	O
O_2 32.000	0.46	0.067			21.738
CO 28.010		10.802			
H_2 2.016					
CO_2 44.010	1.84	0.267	0.267		0.534
N_2 28.016	2.67	0.388			
CH_4 16.042	82.74	12.013	12.013	48.052	
C_2H_6 30.068	8.42	1.222	2.444	7.332	
C_3H_8 44.094	3.67	0.533	1.599	4.264	
C_4H_{10} 58.120	0.16	0.023	0.092	0.230	
C_5H_{12}	0.04	0.006	0.036	0.072	
TOTAL			16.451	59.950	22.272

WEIGHT BALANCE

	# hr Measured	At. Wt. Balance
WET GAS	301.35	327.82
OIL	71.38	71.38
WATER	137.92	137.92
TOTAL	510.65	510.65
FRESH FEED	537.12	
WEIGHT BALANCE	95.07	
WET GAS FACTOR		1.08783
INDICATED LOSS—S C F H		473

GAS FLOW RATES

	$\sqrt{H}$	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
FRESH FEED 79.31	6.581	397.9 / 20.313	74	0.9868 15566	1.4878	41.070
WET GAS 158.44	7.198	1.906 / 4.075	69	0.9915 5382	1.1680	14.200
RECYCLE 115.14	8.502	400.8 / 20.384	116	0.9501 22144	1.1680	58.426
BLEED 5.02	9.52	400.8 / 20.384	116	0.9501 1081	1.1680	2.852
NATURAL GAS 28.43	8.565	419.0 / 20.825	204	0.8849 23225 5503	1.2263	61.278 / 14.519
OXYGEN 27.07	7.240	432.6 / 21.149	75	0.9877 4094		10.802
STEAM 215.7	8.10	36.7 / 0.3169		348.66/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL AT 60	API° #/GAL	#	# HR GAL HR
OIL	6'11	366.77	65	0.9975	365.85	50.2	2372.2	71.38
	1'11½	102.89	66	0.9970	102.58	6.484	665.1	11.008
					+0.93		+6.0	
					264.20		1713.1	
WATER	7'2	379.86	78	0.9979	379.06		3297.6	137.92
	4'7½	246.74	74	0.9985	246.37		2046.1	16.607
	5'3	279.48	72	0.9987	279.12	10.4	2318.1	
	0'3	13.28	83	0.9971	13.24	8.305	101.0	
					298.57		3310.1	

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 B
HOURS 365-389

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	At. Wt. Balance m/hr	At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	37.193	15.503	434.24	15.157	2.403	67.31	9.377	24.880	11.780	-13.100	366.93
H_2 2.016	58.990	24.588	49.57	44.776	7.099	14.31	27.699	52.287	34.798	-17.489	35.26
CO_2 44.010	2.667	1.112	48.94	24.616	3.903	171.77	15.228	16.340	19.131	2.791	122.28
N_2 28.016	0.820	0.342	9.58	2.367	0.375	10.51	1.464	1.806	1.839	0.033	0.92
CH_4 16.042	0.330	0.138	2.21	5.490	0.870	13.96	3.396	3.534	4.266	0.732	11.75
C_2H_4 28.052				2.057	0.326	9.14	1.273	1.273	1.599	0.326	9.14
C_2H_6 30.068				0.790	0.125	3.76	0.489	0.489	0.614	0.125	3.76
C_1+C_2											24.65
C_3H_6 42.078				2.057	0.326	13.72	1.273	1.273	1.599	0.326	13.72
C_3H_8 44.094				0.243	0.039	1.72	0.150	0.150	0.189	0.039	1.72
C_4H_8 56.104				1.307	0.207	11.61	0.809	0.809	1.016	0.207	11.61
C_4H_{10} 58.120				0.353	0.056	3.25	0.218	0.218	0.274	0.056	3.25
C_5H_{10} 70.130				0.577	0.091	6.38	0.357	0.357	0.448	0.091	6.38
C_5H_{12} 72.146				0.097	0.015	1.08	0.060	0.060	0.075	0.015	1.08
C_6H_{12} 84.156				0.113	0.018	1.51	0.070	0.070	0.088	0.018	1.51
C_3-C_6											39.27
TOTAL		41.682			15.854		61.863	103.546			
H_2+CO		40.091	15,194 S.C.F.H.		9.502		37.076	77.167	46.578	30.589	
H_2/CO	1.59		658133				2.95	2.10		1.34	

	YIELD BASIS H_2+CO FED CONDENSATE #/MCF	#/gal	gal/hr	gal/MCF	POLYMER #/hr	#/MCF	#/gal	gal/hr	gal/MCF	% Unsats.
					Distribution of Recovered Oil					
	8.048					400 EP			0.537	
	0.061					400-550			0.097	
	0.773					550+			0.095	
	0.602									70.9
	0.247									
	1.622									
	0.903	4.32	3.176	0.209	12.36	0.813	6.28	1.976	0.130	88.9
	0.113	4.24	0.406	0.027						
	0.764	5.00	2.322	0.153	11.03	0.726	6.10	1.808	0.119	78.1
	0.214	4.86	0.669	0.044	3.25	0.214	4.86	0.669	0.044	
	0.420	5.45	1.171	0.077	6.38	0.420	5.45	1.171	0.077	85.5
	0.071	5.25	0.206	0.014	1.08	0.071	5.25	0.206	0.014	
	0.099	5.54	0.273	0.018	1.51	0.099	5.54	0.273	0.018	
	2.584		8.223	0.541	35.60	2.343		6.103	0.402	

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT								
	RECOVERED OIL		71.77	4.723		11.092	0.730	71.77
	TOTAL OIL		111.04	7.308		19.315	1.271	107.37
	WATER SOLUBLE CHEMICALS		14.55	0.958	8.061	1.805	0.119	14.55
	TOTAL LIQUID PRODUCTS C_3+		125.59	8.265		21.120	1.390	121.92
	WET WATER	7.110	128.10	8.431	8.328	15.382	1.012	
	GROSS WATER		142.65	9.388		17.187	1.131	
	HYDROCARBON TOTAL—C_1+		150.24	9.888				

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 7.9

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
61.96	84.50	71.13	76.30	52.65	33.45	39.64	83.59

g/M3 = 16.91 × #/MCF
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	434	Fresh Feed	15797
Natural Gas	421	Recycle	24546
Generator Outlet	414	Combined Feed	40343
Reactor Inlet	399	Wet Gas—Measured	5377
Condenser Inlet		Adjusted	6008
Product Accumulator	375	Loss	631
TEMPERATURES—°F.		Recycle/Fresh Feed	1.554
Oxygen	489	Inlet Velocity—ft./sec.	1.393
Natural Gas	724	Fresh Feed Rate—S.C.F.H.	15194
Generator		per Cu.Ft. Dense Bed	1244
Quench Accumulator	150.7	per Lb. Catalyst	10.44
Reactor Inlet	315		
Condenser Inlet			
Product Accumulator	69		

Catalyst No.	Height"
1	12.0
2	43.2
3	74.4
4	105.6
5	136.8
6	168.0
7	199.2
8	230.4
9	261.6
10	292.8
12	342.0

665
639
649
652
649
641
634
629
632
634

Heat Transfer Calculations
Steam Rate = 330.3 #/hr
@ 816 psia & 520°F
= 1196 BTU/#
Water in @ 174°F
= 142 BTU/#
Heat Transferred/lb. steam
= 1054 BTU/#
(1054)(330.3) = 349500 BTU/hr
Ave. Bed Temperature = 649°F
dT = 649-520 = 129°F
Tube Area = 30.9 ft²
$K = \frac{349500}{(129)(30.9)} = 87.8$

PRODUCT TESTS

	OIL	WATER
°API	50.6	10.5
Neut. No.	40.7	41.1
Sap. No.	49.8	45.9
Hydrox. No.		
Bromine No.	93.8	
Pour °F.		
Chemicals, % by K_2CO_3		10.5
HEMPEL, DIST. %		°API
205 °F.		
400	73.6	55.5
400-550	13.3	36.7
550+	15.1	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	100	
10%	135	
50%	232	
90%	352	
EP	400	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	1892
Fresh Catalyst Added 50=	76
Total	1968
Catalyst Recovered	92
In Reactor at End of Period	1876
REACTOR d-p, Inches H_2O	
No. Height"	
1 12 - 43.2	58
2 43.2 - 74.4	60
3 74.4 - 105.6	58
4 105.6 - 342.0	225
(Calc) 0-12"	23
total	424
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	118
Inventory, Lbs.	1455
Bed Depth, Ft.	18.50
Volume, Cu Ft	12.21

PARTICLE SIZE

Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	12.3	80+	
100	150	67.3	40—80	
150	105	11.7	20—40	
200	74	4.9	10—20	
250	62	1.6	0—20	
325	44	1.4		
<325		0.8		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	141
Settled	143
Compacted	159
Particle Density, gm./cc.	4.3
NH_3 Value, ml./gm.	9.82
N_2 Surface, m²/gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
$Fe_{22}C_9$	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR	0900			AVERAGE
FRESH FEED				
CO 28.010	36.92	37.50	37.16	37.193
H_2 2.016	59.26	58.96	58.75	58.990
CO_2 44.010	2.79	2.18	3.03	2.667
N_2 28.016	0.91	0.57	0.98	0.820
CH_4 16.042	0.12	0.79	0.08	0.330
			M. W.	13.06341
			H_2O 18.016	
			BALANCE	
WET GAS	0900	2100	0500	
CO 28.010	14.75	14.77	15.95	15.157
H_2 2.016	45.08	44.46	44.79	44.776
CO_2 44.010	24.88	24.50	24.47	24.616
N_2 28.016	2.51	2.06	2.53	2.367
CH_4 16.042	5.11	6.45	4.91	5.490
C_2H_4 28.052	2.03	2.09	2.05	2.057
C_2H_6 30.068	0.81	0.77	0.79	0.790
C_3H_6 42.078	2.14	2.09	1.94	2.057
C_3H_8 44.094	0.29	0.25	0.19	0.243
C_4H_8 56.104	1.35	1.34	1.23	1.307
C_4H_{10} 58.120	0.27	0.43	0.36	0.353
C_5H_{10} 70.130	0.60	0.57	0.56	0.577
C_5H_{12} 72.146	0.07	0.09	0.13	0.097
C_6H_{12} 84.156	0.11	0.13	0.10	0.113
			M. W.	20.82094

GENERATOR BALANCE

	M/HR	C	H	O
CO	15,503	15,503		15,503
H_2	24,588		49,176	
CO_2	1,112	1,112		2,224
N_2	0.342			
CH_4	0.138	0.138	0.552	
H_2O			8,223	4,112
		16,750	57,951	21,839
	98.98	100.81	98.93	

	Mol %	M/Hr	C	H	O
O_2 32.000	0.50	10,718 0.075			21,582
CO 28.010					
H_2 2.016					
CO_2 44.010	1.68	0.246	0.246		0.492
N_2 28.016	2.08	0.304			
CH_4 16.042	82.27	12.040	12.040	48.160	
C_2H_6 30.068	8.87	1.298	2.596	3.894	
C_3H_8 44.094	4.50	0.659	1.977	5.272	
C_4H_{10} 58.120	0.05 0.05	0.007 0.007	0.028 0.035	0.070 0.084	
TOTAL			16.922	57.480	22.074

WEIGHT BALANCE

	# hr Measured	At. Wt. Balance
WET GAS	295.41	330.09
OIL	71.77	71.77
WATER	142.65	142.65
TOTAL	509.83	
FRESH FEED	544.51	544.51
WEIGHT BALANCE	93.63	
WET GAS FACTOR		1.11736
INDICATED LOSS—S C F H		631

GAS FLOW RATES

	$\sqrt{R}$	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
		399	73			
FRESH FEED 79.31	6.66	20.34	0.9877	15797	1.4887	41.682
		1.92	69			
WET GAS 158.44	7.12	4.077	0.9915	5377	1.1792	14.188
		401	115			
RECYCLE 115.14	8.50	20.39	0.9510	22378	1.1792	59.046
		401	115			
BLEED 5.02	9.3	20.39	0.9510	1068	1.1792	2.817
		421	206	24546		61.863
NATURAL GAS 28.43	8.66	20.87	0.8836	5547	1.2217	14.635
		434	74			
OXYGEN 27.07	7.18	21.18	0.9868	4062		10.718
		35.9				
STEAM 215.7	4.88	0.3158		330.3#/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL	7'3½	385.32	66	0.9970	384.16	50.2	2490.9	71.77
	6'11	366.77	65	0.9975	365.85	6.484	2372.2	11.092
	4'10½	259.84	60	1.000	259.84	50.6	1680.9	
	0'3	13.28	76	0.9920	13.17	6.469	85.2	
					+1.25		+8.0	
					266.21		1722.4	
WATER								
	7'1	375.50	66	0.9942	373.32		3100.4	142.65
	5'3	279.48	72	0.9987	279.12	10.4	2318.1	17.187
	6'3	331.85	70	0.9990	331.52	8.305	2751.3	
	0'3	13.28	83	0.9971	13.24	10.5	109.9	
						8.299	3423.7	

THE TEXAS COMPANY — MONTEBELLO LABORATORY

YIELD CALCULATIONS

RUN NO. 49 B

HOURS 369-413

53

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	36.43	15.221	426.32	15.42	2.415	67.64	9.495	24.716	11.910	-12.806	358.68
H_2 2.016	59.65	24.922	50.24	44.28	6.934	13.98	27.265	52.187	34.199	-17.988	36.26
CO_2 44.010	2.78	1.162	51.14	24.63	3.857	169.74	15.166	16.328	19.023	2.695	118.60
N_2 28.016	0.89	0.372	10.42	2.24	0.351	9.83	1.379	1.751	1.730		
CH_4 16.042	0.25	0.104	1.67	5.60	0.877	14.07	3.448	3.552	4.325	0.773	12.40
C_2H_4 28.052				2.18	0.341	9.57	1.342	1.342	1.683	0.341	9.57
C_2H_6 30.068				0.80	0.125	3.76	0.493	0.493	0.618	0.125	3.76
C_1+C_2										1.239	25.73
C_3H_6 42.078				2.13	0.334	14.05	1.312	1.312	1.646	0.334	14.05
C_3H_8 44.094				0.29	0.045	1.98	0.179	0.179	0.224	0.045	1.98
C_4H_8 56.104				1.25	0.196	11.00	0.770	0.770	0.966	0.196	11.00
C_4H_{10} 58.120				0.37	0.058	3.37	0.228	0.228	0.286	0.058	3.37
C_5H_{10} 70.130				0.60	0.094	6.59	0.369	0.369	0.463	0.094	6.59
C_5H_{12} 72.146				0.08	0.013	0.94	0.049	0.049	0.062	0.013	0.94
C_6H_{12} 84.156				0.13	0.020	1.68	0.080	0.080	0.100	0.020	1.68
C_3+C_6											39.61
TOTAL		41.781	539.79		15.660	328.20	61.575	103.356			
H_2+CO	96.08	40.143	15,218 S.C.F.H.				36.760	76.903	46.109	-30.794	
H_2/CO	1.64		657116					2.111		1.405	

YIELD BASIS H_2+CO FED	CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO 28.010					Distribution of					
H_2 2.016					Recovered Oil					
CO_2 44.010	7.793					200 BP			0.534	
N_2 28.016						400-550			0.137	
CH_4 16.042	0.815					550+			0.075	
C_2H_4 28.052	0.629									71.8
C_2H_6 30.068	0.247									
C_1+C_2	1.691									
C_3H_6 42.078	0.923	4.32	3.252	0.213	12.65	0.831	6.25	2.024	0.133	87.6
C_3H_8 44.094	0.130	4.24	0.467	0.031						
C_4H_8 56.104	0.723	5.00	2.200	0.145	10.45	0.687	6.10	1.713	0.113	76.5
C_4H_{10} 58.120	0.221	4.86	0.693	0.046	3.37	0.221	4.86	0.693	0.046	
C_5H_{10} 70.130	0.433	5.45	1.209	0.079	6.59	0.433	5.45	1.209	0.079	87.5
C_5H_{12} 72.146	0.062	5.25	0.179	0.012	0.94	0.062	5.25	0.179	0.012	
C_6H_{12} 84.156	0.110	5.54	0.303	0.020	1.68	0.089	5.54	0.303	0.020	
C_3+C_6	2.602		8.303	0.546	35.68	2.323		6.121	0.403	
TOTAL										
H_2+CO										
H_2/CO										

CUMULATIVE TOTALS	H_2+CO.MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 7.9

RECOVERED OIL		73.60	4.836		11.350	0.746	73.60	4.836		11.350	0.746
TOTAL OIL		113.21	7.439		19.653	1.291	109.28	7.181		17.471	1.148
WATER SOLUBLE CHEMICALS		13.45	0.884	8.093	1.662	0.109	13.45	0.884		1.662	0.109
TOTAL LIQUID PRODUCTS C_3+		126.66	8.323		21.315	1.401	122.73	8.065		19.133	1.257
NET WATER	6.913	124.54	8.184	8.328	14.954	0.983					
GROSS WATER		137.99	9.068		16.616	1.092					
HYDROCARBON TOTAL—C_1+		152.39	10.014								

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
62.52	84.13	72.18	76.71	51.81	34.47	40.04	83.11

g/M3 = 16.91 × #/MCF.

cc/M3 = 141.3 × gal/MCF

OPERATING CONDITIONS					
PRESSURES PSIG			RATES S.C.F.H.		
Oxygen		432	Fresh Feed		15839
Natural Gas		418	Recycle		23343
Generator Outlet		412	Combined Feed		39182
Reactor Inlet		398	Wet Gas—Measured		5448
Condenser Inlet			Adjusted		5937
Product Accumulator		374	Loss		489
TEMPERATURES—°F.			Recycle/Fresh Feed		1.474
Oxygen		480	Inlet Velocity—ft./sec.		1.363
Natural Gas		665	Fresh Feed Rate—S.C.F.H.		15218
Generator			per Cu.Ft. Dense Bed		1256
Quench Accumulator		152	per Lb. Catalyst		10.53
Reactor Inlet		338			
Condenser Inlet					
Product Accumulator		68	Heat Transfer Calculations		
Catalyst No.	Height"		Steam Rate = 331.5 #/hr		
1	12.0	673	@ 817 psia & 521°F		
2	43.2	645	= 1196 BTU/#		
3	74.4	656	Water in @ 173°F = 141 BTU/#		
4	105.6		Heat Transferred/lb. steam		
5	136.8	652	= 1055 BTU/#		
6	168.0	652	(1055)(331.5) = 350000 BTU/hr		
7	199.2	643	Ave. Bed Temperature		
8	230.4	634	= 654°F		
9	261.6	631	dT = 654-521 = 133°F		
10	292.8	635	Tube Area = 30.9 ft^2		
12	342.0	634	K = $\frac{350000}{(133)(30.9)}$ = 85.1		

PRODUCT TESTS	OIL	WATER
°API	49.8	10.4
Neut. No.	50.8	41.5
Sap. No.	41.7	46.5
Hydrox. No.		
Bromine No.	94.9	
Pour °F.		
Chemicals, % by K_2CO_3		10.0
HEMPEL DIST. %		°API
205 °F.		
400	71.6	56.4
400-550	18.3	36.3
550+	10.1	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	104	
10%	136	
50%	232	
90%	349	
EP	398	

CATALYST DATA						
INVENTORY DATA		PARTICLE SIZE				
In Reactor at Start of Period	1876	Screen Analysis			Sedimentation	
Fresh Catalyst Added 49=	76	Mesh	Microns	%	Microns	%
Total	1952	On 40	419+	13.5	80+	
Catalyst Recovered	71	100	150	59.4	40—80	
In Reactor at End of Period	1881	150	105	9.3	20—40	
		200	74	4.8	10—20	
REACTOR d-p, Inches H_2O		250	62	1.2	0—20	
No. Height"		325	44	1.0		
1 12 - 43.2	58	<325		0.8		
2 43.2 - 74.4	60	CATALYST				
3 74.4 - 105.6	60	Bulk Density, Lbs./Cu.Ft.				
4 105.6 - 342.0	220	Aerated			136	
(Calc) 0-12"	23	Settled			138	
total	421	Compacted			154	
		Particle Density, gm./cc.			4.0	
CALCULATED FROM dp		NH_3 Value, ml./gm.			22.07	
Density, Lbs./Cu.Ft.	118	N_2 Surface, m^2/gm.				
Inventory, Lbs.	1445					
Bed Depth, Ft.	18.37	CHEMICAL ANALYSIS				
Volume, Cu Ft	12.12	Fe				
		C				
		O				
		H				
		K_2O, W+, % basis Fe				
		X-Ray Analysis—				
		$Fe_{20}C_9$				
		Fe_3O_4				
		Fe				

GAS ANALYSES	1300	2100	0500	AVERAGE
FRESH FEED				
CO 28.010	36.65	35.69	36.95	36.43
H_2 2.016	59.63	60.25	59.06	59.65
CO_2 44.010	2.35	2.99	3.00	2.78
N_2 28.016	0.75	1.00	0.92	0.89
CH_4 16.042	0.62	0.07	0.07	0.25
			M. W.	12.9195
			H_2O 18.016	
			BALANCE	

GENERATOR BALANCE	M/HR	C	H	O
FRESH FEED				
CO 28.010	15.221	15.221		15.221
H_2 2.016	24.922		49.844	
CO_2 44.010	1.162	1.162		2.324
N_2 28.016	0.372			
CH_4 16.042	0.104	0.104	0.416	
			10.124	5.062
		16.487	60.384	22.607
		97.46	98.41	102.20

	Mol %	M/Hr	C	H	O
O_2 32.000	0.50	0.073 10.741			21.628
CO 28.010					
H_2 2.016					
CO_2 44.010	1.68	0.246	0.246		0.492
N_2 28.016	2.08	0.304			
CH_4 16.042	82.27	12.038	12.038	48.152	
C_2H_4 30.068	8.87	1.298	2.596	7.788	
C_3H_8 44.094	4.50	0.658	1.974	5.264	
C_4H_{10} 58.120	0.05	0.007	0.028	0.070	
	0.05	0.007	0.035	0.084	
TOTAL			16.917	61.358	22.120

WEIGHT BALANCE	#/hr Measured	At. Wt. Balance
WET GAS	301.19	328.20
OIL	73.60	73.60
WATER	137.99	137.99
TOTAL	512.78	539.79
FRESH FEED	539.79	
WEIGHT BALANCE	95.00	
WET GAS FACTOR		1.089677
INDICATED LOSS—S C F H		489

WET GAS				
CO 28.010	14.82	15.55	15.89	15.42
H_2 2.016	44.72	43.45	44.66	44.28
CO_2 44.010	23.63	25.47	24.81	24.63
N_2 28.016	2.16	2.30	2.25	2.24
CH_4 16.042	6.65	5.16	4.99	5.60
C_2H_4 28.052	2.16	2.32	2.06	2.18
C_2H_6 30.068	0.82	0.78	0.79	0.80
C_3H_6 42.078	2.14	2.22	2.04	2.13
C_3H_8 44.094	0.26	0.39	0.23	0.29
C_4H_8 56.104	1.32	1.29	1.14	1.25
C_4H_{10} 58.120	0.44	0.31	0.37	0.37
C_5H_{10} 70.130	0.64	0.60	0.56	0.60
C_5H_{12} 72.146	0.09	0.06	0.08	0.08
C_6H_{12} 84.156	0.15	0.10	0.13	0.13
			M. W.	20.9579

GAS FLOW RATES		$\sqrt{h}$	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
			398.3	72			
FRESH FEED	79.31	6.64	20.3224	0.9887	15839	1.4969	41.781
			1.948	68			
WET GAS	158.44	7.225	4.0802	0.9924	5448	1.1753	14.371
			400.5	116			
RECYCLE	115.14	8.50	20.3765	0.9501	22269	1.1753	58.742
			400.5	116			
BLEED	5.02	9.4	20.3765	0.9501	1074	1.1753	2.833
			417.7	204	23343		61.575
NATURAL GAS	28.43	8.68	20.7942	0.8849	5547	1.2217	14.632
			451.7	72			
OXYGEN	27.07	7.20	21.1289	0.9887	4072		10.741
			35.2				
STEAM	215.7	4.94	0.3111		331.5#/hr		

LIQUID PRODUCT RATES	HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
	OIL	7'4	388.59	75	0.9925	385.68	50.6	2495.0	
		4'10½	259.84	60	1.000	259.84	6.469	1680.9	
		3'1	165.75	60	1.000	165.75	49.8	1077.0	
		0'4½	19.92	71	0.9946	19.81	6.498	128.7	73.60
						+0.62 272.40		44.0 1766.4	11.350
	WATER								
		6'8½	355.86	70	0.9990	355.50	10.4	2952.4	137.99
		6'3	331.85	70	0.9990	331.52	8.305	2753.5	16.616
		7'4	388.59	72	0.9987	388.08	10.4	3223.0	
		0'3	13.20	70	0.9990	13.27	8.305	110.2	
						398.79		3311.7	

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 T
HOURS 413-437

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr	YIELD BASIS H_2+CO FED CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO 28.010	38.063	15.556	435.71	15.823	2.499	69.99	9.622	25.178	12.181	-13.067	365.72					Distribution of					
H_2 2.016	57.754	23.603	47.58	42.380	6.693	13.49	25.772	49.375	32.465	-16.910	34.09					Recovered Oil					
CO_2 44.010	2.933	1.199	52.77	25.040	3.955	174.04	15.228	16.427	19.183	2.756	121.27	8.169					400 EP			0.531	
N_2 28.016	0.943	0.385	10.79	2.757	0.435	12.19	1.677	2.062	2.112								400-550			0.112	
CH_4 16.042	0.307	0.125	2.01	6.067	0.958	15.37	3.690	3.815	4.648	0.833	13.36	0.900					550+			0.089	
C_2H_4 28.052				2.127	0.336	9.43	1.293	1.293	1.629	0.336	9.43	0.635									71.6
C_2H_6 30.068				0.843	0.133	4.00	0.513	0.513	0.646	0.133	4.00	0.269									
C_1+C_2											26.79	1.904									
C_3H_6 42.078				2.157	0.341	14.35	1.312	1.312	1.653	0.341	14.35	0.967	4.32	3.322	0.223	12.92	0.870	6.25	2.067	0.139	88.8
C_3H_8 44.094				0.273	0.043	1.90	0.166	0.166	0.209	0.043	1.90	0.128	4.24	0.448	0.030						
C_4H_8 56.104				1.270	0.201	11.28	0.772	0.772	0.973	0.201	11.28	0.760	5.00	2.256	0.152	10.72	0.722	6.10	1.757	0.118	76.8
C_4H_{10} 58.120				0.383	0.060	3.49	0.233	0.233	0.293	0.060	3.49	0.235	4.86	0.718	0.048	3.49	0.235	4.86	0.718	0.048	
C_5H_{10} 70.130				0.640	0.101	7.08	0.389	0.389	0.490	0.101	7.08	0.477	5.45	1.299	0.088	7.08	0.477	5.45	1.299	0.088	88.6
C_5H_{12} 72.146				0.080	0.013	0.94	0.049	0.049	0.062	0.013	0.94	0.063	5.25	0.179	0.012	0.94	0.063	5.25	0.179	0.012	
C_6H_{12} 84.156				0.160	0.025	2.10	0.097	0.097	0.122	0.025	2.10	0.141	5.54	0.379	0.026	2.10	0.141	5.54	0.379	0.026	
C_3-C_6											41.14	2.771		8.601	0.579	37.25	2.508		6.399	0.431	
TOTAL		40.868	548.86		15.793	339.65	60.813	101.681													
H_2+CO	95.817	39.159	14,845 S.C.F.H.		9.192			74.553	44.586	-29.967											
H_2/CO	1.52		673627																		

CUMULATIVE TOTALS	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 7.4

EFFLUENT									
RECOVERED OIL		70.58	4.754		10.873	0.732	70.58	4.754	10.873	0.732	
TOTAL OIL		111.72	7.526		19.474	1.312	107.83	7.264	17.272	1.163	
WATER SOLUBLE CHEMICALS		13.43	0.905	8.042	1.670	0.112	13.43	0.905	1.670	0.112	
TOTAL LIQUID PRODUCTS C_3+		125.15	8.430		21.144	1.424	121.26	8.168	18.942	1.276	
NET WATER	6.949	125.20	8.434	8.328	15.034	1.013					
GROSS WATER		138.63	9.338		16.704	1.125					
HYDROCARBON TOTAL—C_1+		151.94	10.235								

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
61.35	85.94	71.64	76.53	51.86	34.25	40.20	82.36

g/M3 = 16.91 × #/MCF
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS				PRODUCT TESTS	OIL	WATER
PRESSURES PSIG		RATES S.C.F.H.				
Oxygen	432	Fresh Feed	15493	°API	49.9	10.5
Natural Gas	419	Recycle	23054	Neut. No.	41.3	40.9
Generator Outlet	412	Combined Feed	38547	Sap. No.	48.0	44.7
Reactor Inlet	399	Wet Gas—Measured	5352	Hydrox. No.		
Condenser Inlet		Adjusted	5987	Bromine No.	82.2	
Product Accumulator	375	Loss	635	Pour °F.		
				Chemicals, % by K_2CO_3		10.0
TEMPERATURES—°F.		Recycle/Fresh Feed	1.488			
Oxygen	418	Inlet Velocity—ft./sec.	1.352			
Natural Gas	692	Fresh Feed Rate—S.C.F.H.	14845	HEMPEL, DIST. %		°API
Generator		per Cu.Ft. Dense Bed	1203	205 °F.		
Quench Accumulator	150	per Lb. Catalyst	10.45	400	72.6	55.4
Reactor Inlet	339			400-550	15.3	36.4
Condenser Inlet				550+	12.1	
Product Accumulator	71	Heat Transfer Calculations				
Catalyst No. Height"		Steam Rate = 343.9 #/hr		A. S. T. M. DIST. ON		
1 12.0	683	@ 825 psia & 522°F		Naphtha °F.		
2 43.2	641	= 1196 BTU/#		IBP	104	
3 74.4	654	Water in @ 178°F = 146 BTU/#		10%	137	
4 105.6		Heat Transferred/lb. steam		50%	235	
5 136.8	652	= 1050 BTU		90%	354	
6 168.0	650	(1050)(343.9) = 361000 BTU/hr		EP	402	
7 199.2	639	Ave. Bed Temperature			98.0	
8 230.4	633	= 653°F				
9 261.6	630	dT = 653-522 = 131°F				
10 292.8	635	Tube Area = 30.9 ft^2				
12 342.0	635	$K = \frac{361000}{(131)(30.9)} =$	89.2			

CATALYST DATA						
INVENTORY DATA		PARTICLE SIZE				
In Reactor at Start of Period	1881	Screen Analysis			Sedimentation	
Fresh Catalyst Added 50=	76	Mesh	Microns	%	Microns	%
Total	1957	On 40	419+	11.7	80+	
Catalyst Recovered	56	100	150	67.8	40—80	
In Reactor at End of Period	1901	150	105	10.7	20—40	
		200	74	5.6	10—20	
REACTOR d-p, Inches H_2O		250	62	1.8	0—20	
No. Height"		325	44	1.8		
1 12 - 43.2	57	<325		0.6		
2 43.2 - 74.4	57	CATALYST				
3 74.4 - 105.6	58	Bulk Density, Lbs./Cu.Ft.				
4 105.6 - 342.0	220	Aerated			140	
(Calc) 0-12"	22	Settled			142	
total	414	Compacted			155	
		Particle Density, gm./cc.			4.0	
CALCULATED FROM dp		NH_3 Value, ml./gm.			24.42	
Density, Lbs./Cu.Ft.	114	N_2 Surface, m²/gm.				
Inventory, Lbs.	1421					
Bed Depth, Ft.	18.70	CHEMICAL ANALYSIS				
Volume, Cu Ft	12.34	Fe				
		C				
		O				
		H				
		K_2O, W+, % basis Fe				
		X-Ray Analysis—				
		$Fe_{20}C_9$				
		Fe_3O_4				
		Fe				

GAS ANALYSES HOUR	1300	2100	0500	AVERAGE
FRESH FEED				
CO 28.010	36.26	39.42	38.51	38.063
H_2 2.016	59.75	56.49	57.02	57.754
CO_2 44.010	2.52	3.06	3.22	2.933
N_2 28.016	0.78	0.92	1.15	0.943
CH_4 16.042	0.69	0.11	0.12	0.307
			M. W.	13.4300
			H_2O 18.016	
			BALANCE	
WET GAS				
CO 28.010	15.02	16.29	16.16	15.823
H_2 2.016	44.25	39.36	43.53	42.380
CO_2 44.010	23.67	26.53	24.92	25.040
N_2 28.016	2.17	3.78	2.32	2.757
CH_4 16.042	7.04	5.92	5.24	6.067
C_2H_4 28.052	2.06	2.22	2.10	2.127
C_2H_6 30.068	0.82	0.90	0.81	0.843
C_3H_6 42.078	2.32	2.25	1.90	2.157
C_3H_8 44.094	0.33	0.25	0.24	0.273
C_4H_8 56.104	1.28	1.24	1.29	1.270
C_4H_{10} 58.120	0.31	0.40	0.44	0.383
C_5H_{10} 70.130	0.55	0.61	0.76	0.640
C_5H_{12} 72.146	0.07	0.09	0.09	0.080
C_6H_{12} 84.156	0.11	0.17	0.20	0.160
			M. W.	21.5066

GENERATOR BALANCE	M/HR	C	H	O
CO 28.010	15.556	15.556		15.556
H_2 2.016	23.603		47.206	
CO_2 44.010	1.199	1.199		2.398
N_2 28.016	0.385			
CH_4 16.042	0.125	0.125	0.500	
H_2O 18.016			10.744	5.372
		16.880	58.450	23.326
BALANCE		100.10	95.57	106.17

	Mol %	M/Hr	C	H	O
O_2 32.000	0.50	0.073 10.667			21.480
CO 28.010					
H_2 2.016					
CO_2 44.010	1.68	0.245	0.245		0.490
N_2 28.016	2.08	0.303			
CH_4 16.042	82.27	11.999	11.999	47.996	
C_2H_6 30.068	8.87	1.294	2.588	7.764	
C_3H_8 44.094	4.50	0.656	1.968	5.248	
C_4H_{10} 58.120	0.05	0.007	0.028	0.07	
	0.05	0.007	0.035	0.084	
TOTAL			16.863	61.162	21.970

WEIGHT BALANCE	#/hr Measured	At. Wt. Balance
WET GAS	303.65	339.65
OIL	70.58	70.58
WATER	138.63	138.63
TOTAL	512.84	548.86
FRESH FEED	548.86	548.86
WEIGHT BALANCE	93.44	
WET GAS FACTOR		1.118631
INDICATED LOSS—S C F H		635

GAS FLOW RATES		VR	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
FRESH FEED	79.31	6.653	399.21 / 20.3535	75 / 0.9859	15493	1.4682	40.868
WET GAS	158.44	7.202	1.96 / 4.0853	71 / 0.9890	5352	1.1602	14.118
RECYCLE	115.14	8.500	401.17 / 20.3936	117 / 0.9493	21982	1.1602	57.985
BLEED	5.02	9.510	401.17 / 20.3936	117 / 0.9493	1072	1.1602	2.828
NATURAL GAS	28.43	8.659	418.8 / 20.8214	207 / 0.8850	23054		60.813
OXYGEN	27.07	7.17	432 / 21.1359	75 / 0.9859	5529	1.2219	14.585
STEAM	215.7	5.13	35.1 / 0.3108		4044		10.667
					343.9#/hr		

LIQUID PRODUCT RATES HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL/HR
OIL	7'3½	386.41	68	0.9981	384.90	49.9 6.494	2499.5	
	3'1	165.75	60	1.000	165.75	49.8 6.489	1077.0	
					219.15		1422.5	
	1'½	54.14	59	1.0005	54.17	49.9		
	0'3	13.28	58	1.0010	13.29	6.494		70.58
					40.88		265.5	10.873
					+0.92 41.80		1694.0	
WATER	7'11	419.14	72	0.9987	418.60	10.5		138.63
	0'4	17.70	60	1.0000	17.70	8.299		16.704
					400.90		3327.07	

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 U
HOURS 437-461

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	35.190	15.024	421.26	16.273	2.580	72.26	10.126	25.169	12.708	-12.463	349.10
H_2 2.016	60.716	25.956	52.33	44.549	7.061	14.23	27.720	53.676	34.781	-18.895	38.10
CO_2 44.010	2.657	1.136	50.00	22.896	3.630	159.74	14.247	15.383	17.877	2.494	109.74
N_2 28.016	1.070	0.457	12.80	2.343	0.371	10.39	1.458	1.915	1.829		
CH_4 16.042	0.367	0.157	2.52	6.270	0.994	15.95	3.901	4.058	4.895	0.837	13.43
C_2H_4 28.052				2.056	0.326	9.14	1.279	1.279	1.605	0.326	9.14
C_2H_6 30.068				0.826	0.131	3.94	0.514	0.514	0.645	0.131	3.94
C_1+C_2											26.51
C_3H_6 42.078				2.193	0.348	14.64	1.365	1.365	1.713	0.348	14.64
C_3H_8 44.094				0.290	0.046	2.03	0.180	0.180	0.226	0.046	2.03
C_4H_8 56.104				1.273	0.202	11.33	0.792	0.792	0.994	0.202	11.33
C_4H_{10} 58.120				0.296	0.047	2.73	0.184	0.184	0.231	0.047	2.73
C_5H_{10} 70.130				0.566	0.090	6.31	0.352	0.352	0.442	0.090	6.31
C_5H_{12} 72.146				0.076	0.012	0.87	0.048	0.048	0.060	0.012	0.87
C_6H_{12} 84.156				0.093	0.015	1.26	0.058	0.058	0.073	0.015	1.26
C_3-C_6											39.17
TOTAL		42.749	539.01		15.853	324.82	62.224	104.973			
H_2+CO		40.999	15,543 S.C.F.H.					79.845	47.487	-31.358	
H_2/CO			643376								

	YIELD BASIS H_2+CO FED — CONDENSATE #/MCF	#/gal	gal/hr	gal/MCF	POLYMER #/hr	#/MCF	#/gal	gal/hr	gal/MCF	% Unsats.
CO					Distribution of					
H_2					Recovered Oil					
CO_2	7.060					400 EP			0.497	
N_2						400-550			0.115	
CH_4	0.864					550+			0.073	
C_2H_4	0.588									71.3
C_2H_6	0.253									
C_1+C_2	1.706									
C_3H_6	0.941	4.32	3.389	0.218	13.18	0.847	6.25	2.109	0.135	88.3
C_3H_8	0.131	4.24	0.479	0.031						
C_4H_8	0.729	5.00	2.267	0.146	10.76	0.693	6.10	1.764	0.113	81.1
C_4H_{10}	0.176	4.86	0.562	0.036	2.73	0.176	4.86	0.562	0.036	
C_5H_{10}	0.406	5.45	1.158	0.074	6.31	0.406	5.45	1.158	0.075	89.6
C_5H_{12}	0.056	5.25	0.166	0.011	0.87	0.056	5.25	0.166	0.011	
C_6H_{12}	0.081	5.54	0.227	0.015	1.26	0.081	5.54	0.227	0.015	
C_3-C_6	2.520		8.248	0.531	35.11	2.259		5.986	0.385	

CUMULATIVE TOTALS

	H_2+CO.MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT										
RECOVERED OIL		69.81	4.491		10.726	0.690	69.81	4.491		10.726	0.690
TOTAL OIL		108.98	7.012		18.974	1.221	104.92	6.750		16.712	1.075
WATER SOLUBLE CHEMICALS		14.70	0.946	8.046	1.827	0.118	14.70	0.946		1.827	0.118
TOTAL LIQUID PRODUCTS C_3+		123.68	7.957		20.801	1.338	119.62	7.696		18.539	1.193
NET WATER	7.198	129.68	8.343	8.328	15.571	1.002					
GROSS WATER		144.36	9.289		17.398	1.119					
HYDROCARBON TOTAL—C_1+		150.19	9.663								

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 6.8

FRESH FEED CONVERSION — % Contraction	CO	H_2	H_2+CO	TOTAL FEED CONVERSION — % CO	H_2	CO+H_2	SELECTIVITY C_3+/C_1+
62.92	82.85	72.80	76.48	49.52	35.20	40.53	82.35

g/M3 = 16.91 × #/MCF
cc/M3 = 141.3 × gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	433	Fresh Feed	16206
Natural Gas	419	Recycle	23589
Generator Outlet	413	Combined Feed	39795
Reactor Inlet	400	Wet Gas—Measured	5569
Condenser Inlet		Adjusted	6010
Product Accumulator	375	Loss	441
TEMPERATURES—°F.		Recycle/Fresh Feed	1.456
Oxygen	421	Inlet Velocity—ft/sec.	1.414
Natural Gas	710	Fresh Feed Rate—S.C.F.H.	15543
Generator		per Cu. Ft. Dense Bed	1252
Quench Accumulator	151	per Lb. Catalyst	11.07
Reactor Inlet	355		
Condenser Inlet			
Product Accumulator	73	Heat Transfer Calculations	
Catalyst No. Height"		Steam Rate = 354.7 #/hr	
1 12.0	698	@ 828 psia & 522°F	
2 43.2	646	= 1196 BTU/#	
3 74.4	663	Water in @ 180°F = 148 BTU/#	
4 105.6		Heat Transferred/lb. steam	
5 136.8	656	= 1048 BTU	
6 168.0	654	(1048)(354.7) = 370000 BTU/hr	
7 199.2	644	Ave. Bed Temperature	
8 230.4	637	= 660°F	
9 261.6	634	dT = 660-522 = 138°F	
10 292.8	637	Tube Area = 30.9 ft²	
12 342.0	639	K = 370000 / (138)(30.9) = 86.9	

PRODUCT TESTS

	OIL	WATER
°API	49.5	10.5
Neut. No.	41.5	41.3
Sap. No.	50.2	45.0
Hydrox. No.		
Bromine No.	87.1	
Pour °F.		
Chemicals, % by K_2CO_3		10.5
HEMPEL. DIST. %		°API
205 °F.		
400	72.0	55.1
400-550	16.6	36.1
550+	11.4	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	100	
10%	138	
50%	235	
90%	352	
EP	401	
	98.0	

CATALYST DATA

INVENTORY DATA		
In Reactor at Start of Period	1901	
Fresh Catalyst Added 52#	78	
Total	1979	
Catalyst Recovered	55	
In Reactor at End of Period	1924	
REACTOR d-p, Inches H_2O		
No. Height "		
1 12 - 43.2	56	
2 43.2 - 74.4	56	
3 74.4 - 105.6	55	
4 105.6 - 342.0	220	
(Calc) 0-12"	22	
total	409	
CALCULATED FROM dp		
Density, Lbs./Cu.Ft.	112	
Inventory, Lbs.	1404	
Bed Depth, Ft.	18.80	
Volume, Cu Ft	12.41	

PARTICLE SIZE

Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	10.7	80+	
100	150	69.5	40—80	
150	105	11.3	20—40	
200	74	5.2	10—20	
250	62	1.6	0—20	
325	44	1.0		
<325		0.6		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	139
Settled	140
Compacted	153
Particle Density, gm. cc.	4.2
NH_3 Value, ml. gm.	17.30
N_2 Surface, m². gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
$Fe_{20}C_9$	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR	0500	2100	1300	AVERAGE
FRESH FEED				
CO 28.010	36.51	36.09	32.97	35.190
H_2 2.016	59.52	59.63	63.00	60.716
CO_2 44.010	2.80	2.86	2.31	2.657
N_2 28.016	1.00	1.24	0.97	1.070
CH_4 16.042	0.17	0.18	0.75	0.367
			M. W.	12.6088
			H_2O 18.016	
			BALANCE	
WET GAS				
CO 28.010	17.11	15.65	16.06	16.273
H_2 2.016	45.17	44.50	43.98	44.549
CO_2 44.010	22.60	23.92	22.17	22.896
N_2 28.016	2.14	2.52	2.37	2.343
CH_4 16.042	5.48	5.61	7.72	6.270
C_2H_4 28.052	2.05	2.11	2.01	2.056
C_2H_6 30.068	0.78	0.81	0.89	0.826
C_3H_6 42.078	2.11	2.25	2.22	2.193
C_3H_8 44.094	0.25	0.29	0.33	0.290
C_4H_8 56.104	1.23	1.31	1.28	1.273
C_4H_{10} 58.120	0.32	0.29	0.28	0.296
C_5H_{10} 70.130	0.57	0.58	0.55	0.566
C_5H_{12} 72.146	0.08	0.08	0.07	0.076
C_6H_{12} 84.156	0.11	0.10	0.07	0.093
			M. W.	20.4900

GENERATOR BALANCE

	M/HR	C	H	O
FRESH FEED				
CO 28.010	15.043	15.043		15.043
H_2 2.016	25.955		51.910	
CO_2 44.010	1.136	1.136		2.272
N_2 28.016	0.457			
CH_4 16.042	0.157	0.157	0.628	
			9.066	4.533
		16.336	61.604	21.848
		95.99	100.94	98.71

	Mol %	M/Hr	C	H	O
O_2 32.000	0.70	0.102 10.667			21.538
CO 28.010					
H_2 2.016					
CO_2 44.010	2.04	0.298	0.298		0.596
N_2 28.016	2.96	0.433			
CH_4 16.042	79.99	11.702	11.702	46.808	
C_2H_6 30.068	8.85	1.295	2.590	7.770	
C_3H_8 44.094	5.29	0.774	2.322	6.192	
C_4H_{10} 58.120	0.13 0.04	0.019 0.005	0.076 0.030	0.19 0.072	
TOTAL			17.018	61.032	22.134

WEIGHT BALANCE

	# hr Measured	At. Wt. Balance
WET GAS	301.00	324.82
OIL	69.81	69.81
WATER	144.38	144.38
TOTAL	515.19	539.01
FRESH FEED	539.01	539.01
WEIGHT BALANCE	95.58	
WET GAS FACTOR		1.079136
INDICATED LOSS—S C F H		441

GAS FLOW RATES

	√h	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
FRESH FEED		400.04	74			
	6.71	20.366	0.9868	16206	1.51526	42.749
WET GAS		2.00	73			
158.44	7.32	4.0902	0.9877	5569	1.18864	14.690
RECYCLE		400.83	118			
115.14	8.50	20.385	0.9485	22493	1.18864	59.333
BLEED		400.83	118			
5.02	9.50	20.385	0.9485	1096	1.18864	2.891
NATURAL GAS		418.88	199	23589		62.224
28.43	8.74	20.823	0.8885	5546	1.20664	14.689
OXYGEN		432.63	76			
27.07	7.17	21.151	0.9850	4044		10.667
STEAM		34.5				
215.7	5.33	0.3085		354.7#/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL	5'10½	312.21	64	0.9980	311.59			
	1'7	54.14	59	1.0005	54.17	49.5 6.509		
					257.42		1675.55	69.81
								10.726
WATER	7'5	384.23	77	0.9980	383.46			
	3"	13.28	59	1.0001	13.28	10.5 8.299		
					370.18			
	1'2	60.66	70	0.9990	60.60			
	3"	13.28	82	0.9973	13.24			144.38
					47.36			17.398
					417.54		3465.16	

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 Y
HOURS 461-473

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr	YIELD BASIS H_2+CO FED CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO 28.010	36.497	15.536	435.17	16.610	2.687	75.26	10.302	25.838	12.989	-12.849	359.90					Distribution of				
H_2 2.016	59.573	25.360	51.13	45.136	7.303	14.72	27.995	53.353	35.296	-18.057	36.40					Recovered Oil				
CO_2 44.010	2.657	1.131	49.78	22.938	3.711	163.32	14.226	15.357	17.937	2.580	113.54	7.323				400 EP			0.518	
N_2 28.016	0.890	0.379	10.62	2.320	0.375	10.51	1.439	1.818	1.814							400-550			0.138	
CH_4 16.042	0.383	0.163	2.61	5.633	0.911	14.61	3.494	3.657	4.405	0.748	12.00	0.774				550+			0.071	
C_2H_4 28.052				2.023	0.327	9.17	1.255	1.255	1.582	0.327	9.17	0.591								71.2
C_2H_6 30.068				0.817	0.132	3.97	0.507	0.507	0.639	0.132	3.97	0.256								
C_1+C_2											25.14	1.622								
C_3H_6 42.078				2.033	0.330	13.88	1.261	1.261	1.591	0.330	13.88	0.895	4.32	3.213	0.207	12.49	0.805	6.25	1.992	0.129	89.7
C_3H_8 44.094				0.233	0.038	1.68	0.145	0.145	0.183	0.038	1.68	0.108	4.24	0.396	0.025					
C_4H_8 56.104				1.190	0.192	10.77	0.738	0.738	0.930	0.192	10.77	0.695	5.00	2.154	0.139	10.23	0.660	6.10	1.677	0.108	75.3
C_4H_{10} 58.120				0.387	0.063	3.66	0.240	0.240	0.303	0.063	3.66	0.236	4.86	0.753	0.049	3.66	0.236	4.86	0.753	0.049	
C_5H_{10} 70.130				0.460	0.074	5.19	0.285	0.285	0.359	0.074	5.19	0.335	5.45	0.952	0.061	5.19	0.335	5.45	0.952	0.061	85.1
C_5H_{12} 72.146				0.083	0.013	0.94	0.051	0.051	0.064	0.013	0.94	0.061	5.28	0.179	0.012	0.94	0.061	5.28	0.179	0.012	
C_6H_{12} 84.156				0.137	0.022	1.85	0.095	0.095	0.107	0.022	1.85	0.119	5.54	0.334	0.022	1.85	0.119	5.54	0.334	0.022	
C_3-C_6											37.97	2.449		7.981	0.515	34.36	2.216		5.894	0.380	
TOTAL		42.569	549.31		16.180	329.64	62.021													
H_2+CO		40.896	15,504 S.C.F.H.			339.53	38.295	79.191	48.285	-30.906										
H_2/CO		1.63	644994		2.72			2.06		1.41										

CUMULATIVE TOTALS	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT								
RECOVERED OIL		73.31	4.728		11.270	0.727	73.31	4.728		11.270	0.727
TOTAL OIL		111.28	7.177		19.251	1.242	107.67	6.945		17.164	1.107
WATER SOLUBLE CHEMICALS		14.18	0.915	8.039	1.764	0.114	14.18	0.915		1.764	0.114
TOTAL LIQUID PRODUCTS C_3+		125.46	8.092		21.015	1.355	121.85	7.859		18.928	1.221
NET WATER	7.337	132.19	8.526	8.328	15.873	1.024					
GROSS WATER		146.37	9.441		17.637	1.138					
HYDROCARBON TOTAL—C_1+		150.60	9.714								

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 6.6

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
61.99	82.70	71.20	75.57	49.73	33.84	39.03	83.30

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	444	Fresh Feed	16138
Natural Gas	425	Recycle	23512
Generator Outlet	413	Combined Feed	39650
Reactor Inlet	399	Wet Gas—Measured	5022
Condenser Inlet		Adjusted	6542
Product Accumulator	372	Loss	1520
TEMPERATURES—°F.		Recycle/Fresh Feed	1.457
Oxygen	371	Inlet Velocity—ft./sec.	1.405
Natural Gas	744	Fresh Feed Rate—S.C.F.H.	15504
Generator		per Cu. Ft. Dense Bed	1185
Quench Accumulator	158	per Lb. Catalyst	10.38
Reactor Inlet	346		
Condenser Inlet			
Product Accumulator	64	**Heat Transfer Calculations**	
Catalyst No. Height "		**Steam Rate = 339.6 #/hr**	
1 12.0	695	**@ 850 psia & 525°F**	
2 43.2	644	**= 1195 BTU/#**	
3 74.4	654	**Water in @ 175°F = 143 BTU/#**	
4 105.6		**Heat Transferred/lb. steam**	
5 136.8	653	**= 1052 BTU**	
6 168.0	656	**(1052)(339.6) = 357000 BTU/hr**	
7 199.2	649	**Ave. Bed Temperature**	
8 230.4	645	**= 658°F**	
9 261.6	639	**dT = 658-525 = 133°F**	
10 292.8	639	**Tube Area = 30.9 ft²**	
12 342.0	639	**K = 357000 / (133)(30.9) = 87.1**	

PRODUCT TESTS

	OIL	WATER
°API	49.6	10.5
Neut. No.	42.5	44.3
Sap. No.	51.4	44.4
Hydrox. No.		
Bromine No.	80.9	
Pour °F.		
Chemicals, % by K_2CO_3		10.0
HEMPEL, DIST. %		°API
205 °F.		
400	71.3	55.3
400-550	19.0	36.9
550+	9.7	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	103	
10%	139	
50%	235	
90%	351	
EP	399	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	1924
Fresh Catalyst Added 50#	76
Total	2000
Catalyst Recovered	65
In Reactor at End of Period	1975
REACTOR d-p. Inches H_2O	
No. Height "	
1 12 - 43.2	58
2 43.2 - 74.4	55
3 74.4 - 105.6	60
4 105.6 - 342.0	240
(Calc) 0-12"	22
total	435
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	113
Inventory, Lbs.	1493
Bed Depth, Ft.	19.82
Volume, Cu Ft	13.08

PARTICLE SIZE				
Screen Analysis			Sedimentation	
Mesh	Microns	%	Microns	%
On 40	419+	11.5	80+	
100	150	66.5	40—80	
150	105	11.0	20—40	
200	74	5.9	10—20	
250	62	2.0	0—20	
325	44	1.2		
<325		1.8		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	129
Settled	131
Compacted	149
Particle Density, gm./cc.	4.2
NH_3 Value, mL/gm.	4.08
N_2 Surface, m²/gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
$Fe_{20}C_9$	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR	1300	2100	0500	AVERAGE
FRESH FEED				
CO 28.010	36.68	36.32	36.49	36.497
H_2 2.016	59.16	59.71	59.85	59.573
CO_2 44.010	2.54	2.90	2.53	2.657
N_2 28.016	0.81	0.98	0.88	0.890
CH_4 16.042	0.81	0.09	0.25	0.383
			M. W.	12.9039
			H_2O 18.016	
			BALANCE	
WET GAS	0100	2100	0500	
CO 28.010	16.91	16.55	16.38	16.610
H_2 2.016	44.57	45.44	45.41	45.136
CO_2 44.010	23.42	23.13	22.27	22.938
N_2 28.016	2.26	2.28	2.42	2.320
CH_4 16.042	5.36	5.43	6.11	5.633
C_2H_4 28.052	2.08	2.02	1.97	2.023
C_2H_6 30.068	0.82	0.82	0.81	0.817
C_3H_6 42.078	2.10	1.91	2.09	2.033
C_3H_8 44.094	0.26	0.24	0.17	0.233
C_4H_8 56.104	1.22	1.11	1.24	1.190
C_4H_{10} 58.120	0.37	0.35	0.44	0.387
C_5H_{10} 70.130	0.46	0.44	0.48	0.460
C_5H_{12} 72.146	0.06	0.13	0.06	0.083
C_6H_{12} 84.156	0.11	0.15	0.15	0.137
			M. W.	20.3787

GENERATOR BALANCE

	M/HR	C	H	O
FRESH FEED				
CO	15.536	15.536		15.536
H_2	25.360		50.720	
CO_2	1.131	1.131		2.262
N_2	0.379			
CH_4	0.163	0.163	0.652	
			8.957	4.469
		16.830	60.309	22.267
		99.96	99.07	101.29

	Mol %	M/Hr	C	H	O
O_2 32.000	0.46	0.067 / 10.657			21.448
CO 28.010					
H_2 2.016					
CO_2 44.010	1.84	0.268	0.268		0.536
N_2 28.016	2.52	0.367			
CH_4 16.042	81.81	11.921	11.921	47.684	
C_2H_6 30.068	8.40	1.224	2.448	7.344	
C_3H_8 44.094	4.85	0.707	2.121	5.656	
C_4H_{10} 58.120	0.08	0.012	0.048	0.12	
	0.04	0.006	0.030	0.07	
TOTAL			16.836	60.874	21.984

WEIGHT BALANCE

	# hr Measured	At. Wt. Balance	
WET GAS	*500 CF 269.88	296.75	329.63
OIL	66.00	66.00	73.31
WATER	131.77	131.77	146.37
TOTAL	467.65	494.52	549.31
FRESH FEED	549.31		
WEIGHT BALANCE	85.13		
WET GAS FACTOR			1.302578
INDICATED LOSS—S C F H	Assumed at 500 SCFH		

GAS FLOW RATES

	$\sqrt{h}$	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
FRESH FEED	6.712	398.9 / 20.3378	65.0 / 0.9952	16138	1.4978	42.569
WET GAS	6.579	1.732 / 4.0573	64.3 / 0.9962	5022	1.19207	13.247
RECYCLE	8.443	399.8 / 20.3600	117.1 / 0.9493	22398	1.19207	59.082
BLEED	9.628	399.8 / 20.3600	117.1 / 0.9493	1114	1.19207	2.939
NATURAL GAS	8.622	424.5 / 20.9576	207.1 / 0.9830	23512	1.21778	62.021
OXYGEN	7.063	445.8 / 21.4133	73.5 / 0.9966	4040		10.657
STEAM	5.45	89.3 / 0.2989		339.6#/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL. HR
OIL	7'8¾	382.05	69	0.9956	380.37			
	6'4⅝	339.49	70	0.9951	337.83	49.6	792.05	66.004
					42.54	6.505		
	1'10½	98.28	65	0.9975	98.03			10.147
	4½"	18.81	60	1.0000	18.81			
					79.22			
					42.54			
					121.76			
WATER	5'7	296.94	70	0.99896	296.63			131.77
	2'1½	106.35	79	0.99775	106.11	10.5	1581.2	
					190.53	8.299		15.878

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 W
HOURS 473-497

57

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	36.590	15.509	434.41	15.777	2.667	74.70	10.346	25.855	13.013	-12.842	359.70
H_2 2.016	59.350	25.157	50.72	44.327	7.047	14.21	27.333	52.490	34.380	-18.110	36.51
CO_2 44.010	2.623	1.112	48.94	22.983	3.654	160.81	14.172	15.283	17.826	2.542	111.87
N_2 28.016	1.020	0.432	12.10	2.283	0.363	10.17	1.408	1.840	1.771		
CH_4 16.042	0.417	0.177	2.84	6.180	0.982	15.75	3.811	3.988	4.793	0.805	12.91
C_2H_4 28.052				2.067	0.329	9.23	1.275	1.275	1.604	0.329	9.23
C_2H_6 30.068				0.817	0.130	3.91	0.504	0.504	0.634	0.130	3.91
C_1+C_2											26.05
C_3H_6 42.078				2.107	0.335	14.10	1.300	1.300	1.635	0.335	14.10
C_3H_8 44.094				0.273	0.043	1.90	0.168	0.168	0.211	0.043	1.90
C_4H_8 56.104				1.153	0.183	10.27	0.711	0.711	0.894	0.183	10.27
C_4H_{10} 58.120				0.393	0.062	3.60	0.242	0.242	0.304	0.062	3.60
C_5H_{10} 70.130				0.460	0.073	5.12	0.284	0.284	0.357	0.073	5.12
C_5H_{12} 72.146				0.067	0.011	0.79	0.041	0.041	0.052	0.011	0.79
C_6H_{12} 84.156				0.113	0.018	1.51	0.070	0.070	0.088	0.018	1.51
C_3-C_6											37.29
TOTAL		42.387	549.01		15.898	326.10	61.665	104.052			
H_2+CO		40.666	15,417 S.C.F.H.		9.714		37.679	78.345	47.393	30.952	
H_2/CO		1.62	648634		2.64			2.03		1.41	

YIELD BASIS H_2+CO FED	CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO					Distribution of					
H_2					Recovered Oil					
CO_2	7.256					400 EP			0.516	
N_2						400-550			0.154	
CH_4	0.837					550+			0.044	
C_2H_4	0.599									71.7
C_2H_6	0.254									
C_1+C_2	1.690									
C_3H_6	0.915	4.32	3.264	0.212	12.69	0.823	6.25	2.030	0.132	88.6
C_3H_8	0.123	4.24	0.448	0.029						
C_4H_8	0.666	5.00	2.054	0.133	9.75	0.632	6.10	1.598	0.104	74.7
C_4H_{10}	0.234	4.86	0.741	0.048	3.60	0.234	4.86	0.741	0.048	
C_5H_{10}	0.332	5.45	0.939	0.062	5.12	0.332	5.45	0.939	0.062	86.9
C_5H_{12}	0.051	5.25	0.150	0.010	0.79	0.051	5.25	0.150	0.010	
C_6H_{12}	0.098	5.54	0.273	0.018	1.51	0.098	5.54	0.273	0.018	
C_3-C_6	2.419		7.869	0.510	33.46	2.170		5.731	0.372	
TOTAL										
H_2+CO										
H_2/CO										

CUMULATIVE TOTALS	H_2+CO MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT								
RECOVERED OIL		71.73	4.653		11.010	0.714	71.73	4.653	11.010	0.714
TOTAL OIL		109.02	7.071		18.879	1.225	105.19	6.823	16.741	1.086
WATER SOLUBLE CHEMICALS		14.54	0.943	7.976	1.823	0.118	14.54	0.943	1.823	0.118
TOTAL LIQUID PRODUCTS C_3+		123.56	8.015		20.702	1.343	119.73	7.766	18.564	1.204
WET WATER	7.584	136.64	8.863	8.328	16.407	1.064				
GROSS WATER		151.18	9.806		18.230	1.182				
HYDROCARBON TOTAL—C_1+		149.61	9.704							

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 6.2

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
62.49	82.80	71.99	76.11	49.67	34.50	39.51	82.59

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	445	Fresh Feed	16069
Natural Gas	424	Recycle	23377
Generator Outlet	412	Combined Feed	39446
Reactor Inlet	398	Wet Gas—Measured	4989
Condenser Inlet		Adjusted	6395
Product Accumulator	371	Loss	1406
TEMPERATURES—°F.		Recycle/Fresh Feed	1.455
Oxygen	425	Inlet Velocity—ft./sec.	1.393
Natural Gas	698	Fresh Feed Rate—S.C.F.H.	15417
Generator		per Cu.Ft. Dense Bed	1219
Quench Accumulator	142	per Lb. Catalyst	10.67
Reactor Inlet	373		
Condenser Inlet			
Product Accumulator	72		

Catalyst No.	Height "	
1	12.0	690
2	43.2	647
3	74.4	653
4	105.6	
5	136.8	655
6	168.0	654
7	199.2	648
8	230.4	644
9	261.6	639
10	292.8	638
12	342.0	642

Heat Transfer Calculations

Steam Rate = 351.6 #/hr
@ 851 psia & 525°F
= 1195 BTU/#
Water in @ 168°F = 136 BTU/#
Heat Transferred/lb. steam
= 1059 BTU
(1059)(351.6) = 372000 BTU/hr
Ave. Bed Temperature
= 658°F
dT = 658-525 = 133°F
Tube Area = 30.9 ft²
K = 372000 / (133)(30.9) = 90.8

PRODUCT TESTS

	OIL	WATER
°API	49.3	10.6
Neut. No.	40.4	41.2
Sap. No.	48.3	42.2
Hydrox. No.		
Bromine No.	78.5	
Pour °F.		
Chemicals, % by K_2CO_3		10.0
HEMPEL, DIST. %		°API
205 °F.		
400	72.3	55.8
400-550	21.6	35.7
550+	6.1	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	104	
10%	140	
50%	238	
90%	352	
EP	402	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	1975
Fresh Catalyst Added 60=	91
Total	2066
Catalyst Recovered	86
In Reactor at End of Period	1980
REACTOR d-p, Inches H_2O	
No. Height "	
1 12 - 43.2	58
2 43.2 - 74.4	55
3 74.4 - 105.6	58
4 105.6 - 342.0	228
(Calc) 0-12"	22
total	421
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	113
Inventory, Lbs.	1445
Bed Depth, Ft.	19.18
Volume, Cu Ft	12.65

PARTICLE SIZE — Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	5.2	80+	
100	150	71.6	40—80	
150	105	14.6	20—40	
200	74	6.0	10—20	
250	62	1.6	0—20	
325	44	0.6		
<325		0.4		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	145
Settled	147
Compacted	158
Particle Density, gm./cc.	4.2
NH_3 Value, ml./gm.	20.76
N_2 Surface, m²/gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
Fe_5C_2	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR	1300	2100	0500	AVERAGE
FRESH FEED				
CO 28.010	37.53	35.74	36.50	36.590
H_2 2.016	58.52	60.10	59.43	59.350
CO_2 44.010	2.69	2.69	2.49	2.623
N_2 28.016	0.78	1.39	0.89	1.020
CH_4 16.042	0.48	0.08	0.69	0.417
			M. W.	12.9524
			H_2O 18.016	
			BALANCE	
WET GAS				
CO 28.010	16.36	16.38	17.59	16.777
H_2 2.016	44.81	44.82	43.35	44.327
CO_2 44.010	22.67	23.35	22.93	22.983
N_2 28.016	1.97	2.60	2.28	2.283
CH_4 16.042	6.68	5.43	6.43	6.180
C_2H_4 28.052	2.11	2.06	2.03	2.067
C_2H_6 30.068	0.85	0.73	0.87	0.817
C_3H_6 42.078	2.15	2.16	2.01	2.107
C_3H_8 44.094	0.26	0.28	0.28	0.273
C_4H_8 56.104	1.17	1.16	1.13	1.153
C_4H_{10} 58.120	0.35	0.39	0.44	0.393
C_5H_{10} 70.130	0.45	0.49	0.44	0.460
C_5H_{12} 72.146	0.06	0.06	0.08	0.067
C_6H_{12} 84.156	0.11	0.09	0.14	0.113
			M. W.	20.5125

GENERATOR BALANCE

	M/HR	C	H	O
FRESH FEED				
CO	15.509	15.509		15.509
H_2	25.157		50.314	
CO_2	1.112	1.112		2.224
N_2	0.432			
CH_4	0.177	0.177	0.708	
M. W.				
H_2O			9.359	4.6795
		16.798	60.381	22.413
BALANCE		99.85	98.70	101.81

	Mol %	M/Hr	C	H	O
O_2 32.000	0.52	0.076 10.646			21.444
CO 28.010					
H_2 2.016					
CO_2 44.010	1.94	0.285	0.285		0.570
N_2 28.016	2.02	0.297			
CH_4 16.042	82.86	12.190	12.190	48.760	
C_2H_6 30.068	8.49	1.249	2.498	7.494	
C_3H_8 44.094	4.06	0.597	1.791	4.776	
C_4H_{10} 58.120	0.07 0.03	0.010 0.004	0.040 0.020	0.10 0.048	
TOTAL			16.824	61.178	22.014

WEIGHT BALANCE

	#/hr Measured	At. Wt. Balance	
WET GAS	269.94	296.99	326.10
OIL	65.33	65.33	71.73
WATER	137.68	137.68	151.18
TOTAL	472.95	500.00	549.01
FRESH FEED	549.01		549.01
WEIGHT BALANCE	86.15		
WET GAS FACTOR			1.281766
INDICATED LOSS—S C F H		500	

GAS FLOW RATES

	VR	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
FRESH FEED		398.0	74.3			
	6.76	20.3157	0.9868	16069	1.49503	42.387
WET GAS		1.969	72.3			
	6.56	4.0864	0.9887	4989	1.18900	13.160
RECYCLE		399.5	120.0			
	8.45	20.3526	0.9469	22275	1.187995	58.758
BLEED		399.5	120.0			
	9.59	20.3526	0.9469	1102	1.187995	2.907
NATURAL GAS		399.5	120.0	23577		61.665
	8.65	20.9506	0.8836	5577	1.22515	14.711
OXYGEN		444.6	73.9			
	7.06	21.4319	0.9869	4036		10.646
STEAM		39.1				
	5.44	0.2996		351.6#/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL	°F	FACTOR	GAL AT 60	API° #/GAL.	#	#/HR GAL. HR.
OIL	5'4½	338.40	62	0.9990	338.062	49.3	1568.022	65.501
	1'10½	98.28	65	0.9975	98.034	6.516	44.00	
					240.642		1572.022	10.058
WATER	7'4	388.59	76	0.99819	387.887	10.6	3304.470	137.686
	5'7	296.94	70	0.99896	296.631	8.293		
					91.256			
	5'11½	316.58	75	0.99832	316.048			16.603
	2"	8.85	72	0.99872	8.839			
					307.209			
					91.256			
					398.465			

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 49 X
HOURS 497-521

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr	CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO 28.010	37.837	10.558	295.70	13.927	1.176	32.94	4.130	14.688	5.306	- 9.382	262.76					Distribution of					
H_2 2.016	58.133	16.220	32.70	39.994	3.376	6.81	11.860	28.080	15.236	-12.844	25.89					Recovered Oil					
CO_2 44.010	2.733	0.763	33.58	27.070	2.286	100.69	8.027	8.790	10.313	1.523	67.31	6.833				400 EP				0.701	
N_2 28.016	1.010	0.282	7.90	2.233	0.189	5.30	0.662	0.944	0.851							400-550				0.174	
CH_4 16.042	0.287	0.080	1.28	7.333	0.619	9.93	2.175	0.256	2.794	0.539	8.65					550+				0.080	
C_2H_4 28.052				2.330	0.197	5.53	0.691	0.691	0.888	0.197	5.53										67.7
C_2H_6 30.068				1.113	0.094	2.83	0.330	0.330	0.424	0.094	2.83										
C_1+C_2											17.01	1.676									
C_3H_6 42.078				2.760	0.233	9.80	0.818	0.818	1.051	0.233	9.80	0.966	4.32	2.269	0.224	8.82	0.869	6.25	1.411	0.139	83.2
C_3H_8 44.094				0.557	0.047	2.07	0.165	0.165	0.212	0.047	2.07	0.204	4.24	0.488	0.048						
C_4H_8 56.104				1.610	0.136	7.63	0.477	0.477	0.613	0.136	7.63	0.752	5.00	1.526	0.150	7.25	0.714	6.10	1.189	0.117	80.2
C_4H_{10} 58.120				0.397	0.034	1.98	0.118	0.118	0.152	0.034	1.98	0.195	4.86	0.407	0.040	1.98	0.195	4.86	0.407	0.040	
C_5H_{10} 70.130				0.513	0.043	3.02	0.152	0.152	0.195	0.043	3.02	0.297	5.45	0.554	0.055	3.02	0.297	5.45	0.554	0.055	88.0
C_5H_{12} 72.146				0.070	0.006	0.43	0.021	0.021	0.027	0.006	0.43	0.042	5.23	0.082	0.008	0.43	0.042	5.23	0.082	0.008	
C_6H_{12} 84.156				0.093	0.008	0.67	0.028	0.028	0.036	0.008	0.67	0.066	5.54	0.121	0.012	0.67	0.066	5.54	0.121	0.012	
C_3-C_6											25.60	2.522		5.447	0.537	22.17	2.183		3.764	0.371	
TOTAL		27.903	371.16		8.444	189.82	29.654	57.557													
H_2+CO		26.778	10,152 S.C.F.H.		4.552			42.768	20.542	-22.226											
H_2/CO		1.54	985027		2.87			1.91	2.87	1.37											

CUMULATIVE TOTALS	H_2+CO,MCF	Catalyst #/	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT								
RECOVERED OIL		61.16	6.024		9.490	0.935	61.16	6.024		9.490	0.935	
TOTAL OIL		86.76	8.546		14.937	1.471	83.33	8.208		13.254	1.306	
WATER SOLUBLE CHEMICALS		12.77	1.258	8.011	1.594	0.157	12.77	1.258		1.594	0.157	
TOTAL LIQUID PRODUCTS C_3+		99.53	9.804		16.531	1.628	96.10	9.466		14.848	1.463	
NET WATER	5.962	107.41	10.580	8.328	12.897	1.270						
GROSS WATER		120.18	11.838		14.491	1.427						
HYDROCARBON TOTAL—C_1+		116.54	11.480									

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 5.0

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
69.74	88.86	79.19	83.00	63.88	45.74	51.97	85.40

g/M3 = 16.91 × #/MCF
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	430	Fresh Feed	10578
Natural Gas	412	Recycle	11242
Generator Outlet	411	Combined Feed	21820
Reactor Inlet	400	Wet Gas—Measured	2052
Condenser Inlet		Adjusted	3832
Product Accumulator	386	Loss	1780
TEMPERATURES—°F.		Recycle/Fresh Feed	1.063
Oxygen	454	Inlet Velocity—ft./sec.	0.785
Natural Gas	743	Fresh Feed Rate—S.C.F.H.	10152
Generator		per Cu.Ft. Dense Bed	894
Quench Accumulator	118	per Lb. Catalyst	7.32
Reactor Inlet	445		
Condenser Inlet			
Product Accumulator	66	Heat Transfer Calculations	
Catalyst No. Height "		Steam Rate = 328.1 #/hr	
1	12.0 744	@ 766 psia & 513°F	
2	43.2 648	= 1198 BTU/#	
3	74.4 654	Water in @ 173°F = 141 BTU/#	
4	105.6	Heat Transferred/lb. steam	
5	136.8 643	= 1057 BTU	
6	168.0 633	(1057)(328.1) = 346000 BTU/hr	
7	199.2 603	Ave. Bed Temperature	
8	230.4 598	= 654°F	
9	261.6 596	dT = 654-513 = 141°F	
10	292.8 594	Tube Area = 30.4 ft²	
12	342.0 565	$K = \frac{346000}{(141)(30.4)} = 81.1$	

PRODUCT TESTS

	OIL	WATER
°API	51.5	10.7
Neut. No.	38.8	38.9
Sap. No.	45.3	41.0
Hydrox. No.		
Bromine No.	85.6	
Pour °F.		
Chemicals, % by K_2CO_3		11.0
HEMPEL, DIST. %		°API
205 °F.		
400	75.0	57.1
400-550	18.6	36.6
550+	6.4	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	102	
10%	134	
50%	226	
90%	346	
EP	399	
	97.5	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	1778
Fresh Catalyst Added 67=	101
Total	1879
Catalyst Recovered	15
In Reactor at End of Period	1864
REACTOR d-p, Inches H_2O	
No. Height "	
1 12 - 43.2	58
2 43.2 - 74.4	62
3 74.4 - 105.6	61
4 105.6 - 342.0	200
(Calc) 0-12"	23
total	404
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	121
Inventory, Lbs.	1367
Bed Depth, Ft.	17.19
Volume, Cu Ft	11.35

PARTICLE SIZE

Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	14.1	80+	
100	150	66.6	40—80	
150	105	10.9	20—40	
200	74	4.6	10—20	
250	62	1.4	0—20	
325	44	1.0		
<325		1.2		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	122
Settled	123
Compacted	145
Particle Density, gm./cc.	3.8
NH_3 Value, ml./gm.	15.03
N_2 Surface, m²/gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
$Fe_{20}C_9$	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR	1300	2100	0500	AVERAGE
FRESH FEED				
CO 28.010	38.72	37.66	37.13	37.837
H_2 2.016	57.02	58.27	59.11	58.133
CO_2 44.010	2.54	3.09	2.57	2.733
N_2 28.016	1.10	0.90	1.03	1.010
CH_4 16.042	0.62	0.08	0.16	0.287
			M. W.	13.3019
			H_2O 18.016	
			BALANCE	
WET GAS				
CO 28.010	14.28	13.96	13.54	13.927
H_2 2.016	41.63	39.50	39.05	39.994
CO_2 44.010	25.43	27.82	27.89	27.070
N_2 28.016	1.92	2.31	2.47	2.233
CH_4 16.042	7.88	6.89	7.23	7.333
C_2H_4 28.052	2.03	2.56	2.60	2.330
C_2H_6 30.068	1.12	1.09	1.13	1.113
C_3H_6 42.078	2.50	2.80	2.98	2.760
C_3H_8 44.094	0.65	0.62	0.40	0.557
C_4H_8 56.104	1.53	1.69	1.61	1.610
C_4H_{10} 58.120	0.38	0.39	0.42	0.397
C_5H_{10} 70.130	0.49	0.53	0.52	0.513
C_5H_{12} 72.146	0.07	0.08	0.06	0.070
C_6H_{12} 84.156	0.09	0.09	0.10	0.092
			M. W.	23.4405

GENERATOR BALANCE

	M/HR	C	H	O
FRESH FEED				
CO	10.558	10.558		10.558
H_2	16.221		32.442	
CO_2	0.763	0.763		1.526
N_2	0.282			
CH_4	0.080	0.080	0.320	
C_2H_4				
C_2H_6				
C_3H_6				
C_3H_8				
C_4H_8				
C_4H_{10}				
C_5H_{10}				
C_5H_{12}				
C_6H_{12}				
H_2O			6.970	3.485
		11.401	39.732	15.569
BALANCE		101.85	97.88	102.85

	Mol %	M/Hr	C	H	O
O_2 32.000	0.47	7.362			14.814
CO 28.010					
H_2 2.016					
CO_2 44.010	1.88	0.162	0.162		0.324
N_2 28.016	2.15	0.208			
CH_4 16.042	82.10	7.931	7.931	31.724	
C_2H_6 30.068	8.85	0.855	1.710	5.130	
C_3H_8 44.094	4.65	0.449	1.347	3.632	
C_4H_{10} 58.120	0.05 0.04	0.006 0.004	0.024 0.020	0.06 0.048	
TOTAL			11.194	40.594	15.138

WEIGHT BALANCE

	#/hr Measured	At. Wt. Balance	
WET GAS	121.47	151.07	189.82
OIL	48.67	48.67	61.16
WATER	95.64	95.64	120.18
TOTAL	265.78	295.38	371.16
FRESH FEED	371.16		371.16
WEIGHT BALANCE	71.61		
WET GAS FACTOR			
INDICATED LOSS—S C F H		500	

GAS FLOW RATES

		√H	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
FRESH FEED			399.8	74.5			
	79.31	4.504	20.3600	0.9859	10578	1.47525	27.903
WET GAS			1.345	66.1			
	50.54	8.961	4.0093	0.9943	2052	1.13671	5.413
RECYCLE			401.0	119.7			
	115.14	4.050	20.3894	0.9469	10234	1.13671	26.995
BLEED			401.0	119.7			
	5.02	9.153	20.3894	0.9469	1008	1.13671	2.659
NATURAL GAS			412.0	192.0	11242		29.654
	28.43	5.720	20.6574	0.8931	3662	1.22065	9.660
OXYGEN			429.5	74.8			
	27.07	4.962	21.0767	0.9859	2791		7.362
STEAM			33.3				
	215.7	5.00	0.3042		328.1#/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL	7'1	375.50	66	0.9970	374.37	42.3		
	6'4½	338.40	62	0.9990	338.06	6.516	236.60	
					36.31			
	2'11	156.54	58	1.0010	156.70	51.3		
	0'3	13.28	64	0.9980	13.25	6.445	924.54	48.67
					143.45			
					41.09		7.00	7.535
					180.85		1168.14	
WATER	7'0	371.14	74	0.9985	370.58	10.6		
	5'11½	316.58	75	0.9983	316.04	8.293		
					54.54		452.30	
	4'5½	238.01	66	0.9994	237.87	10.7		
	0'3½	15.49	68	0.9992	15.48	8.287	1842.95	95.64
					292.39			11.539
							2295.25	

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 42 Y
HOURS 521-528

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr	YIELD BASIS H_2+CO FED — CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO 28.010	37.71	10.626	297.62	13.30	1.117	31.29	3.722	14.348	4.839	- 9.509	266.33					Distribution of					
H_2 2.016	58.35	16.441	33.15	40.78	3.427	6.91	11.411	27.852	14.838	-13.014	26.24					Recovered Oil					
CO_2 44.010	2.48	0.699	30.76	26.38	2.216	97.51	7.382	8.081	9.598	1.517	66.75	6.505					400 EP			0.625	
N_2 28.016	1.18	0.332	9.30	2.17	0.182	5.10	0.607	0.939	0.789								400-550			0.158	
CH_4 16.042	0.28	0.079	1.27	7.38	0.620	9.95	2.065	2.144	2.685	0.541	8.68						550+			0.078	
C_2H_4 28.052				2.45	0.206	5.78	0.686	0.686	0.892	0.206	5.78										69.1
C_2H_6 30.068				1.10	0.092	2.77	0.308	0.308	0.400	0.092	2.77										
C_1+C_2											17.23	1.68									
C_3H_6 42.078				2.92	0.245	10.31	0.817	0.817	1.062	0.245	10.31	1.004	4.32	2.387	0.232	9.28	0.905	6.25	1.485	0.145	87.2
C_3H_8 44.094				0.43	0.036	1.59	0.120	0.120	0.156	0.036	1.59	0.155	4.24	0.375	0.037						
C_4H_8 56.104				1.73	0.145	8.14	0.484	0.484	0.624	0.145	8.14	0.793	5.00	1.628	0.159	7.73	0.753	6.10	1.267	0.123	79.4
C_4H_{10} 58.120				0.45	0.038	2.21	0.126	0.126	0.164	0.038	2.21	0.215	4.86	0.455	0.044	2.21	0.215	4.86	0.455	0.044	
C_5H_{10} 70.130				0.63	0.053	3.72	0.176	0.176	0.229	0.053	3.72	0.363	5.45	0.683	0.067	3.72	0.363	5.45	0.683	0.067	82.9
C_5H_{12} 72.146				0.13	0.011	0.79	0.036	0.036	0.047	0.011	0.79	0.077	5.25	0.150	0.015	0.79	0.077	5.25	0.150	0.015	
C_6H_{12} 84.156				0.15	0.013	1.09	0.042	0.042	0.055	0.013	1.09	0.106	5.54	0.197	0.019	1.09	0.106	5.54	0.197	0.019	
C_3-C_6											27.85	2.714		5.875	0.573	24.82	2.419		4.237	0.413	
TOTAL		28.177	372.10		8.401	187.16	27.982	56.159													
H_2+CO	96.06	27.076	10,261 S.C.F.H.		4.544			42.200	19.677	-22.523											
H_2/CO	1.55	1.55	974563		3.07			1.94	3.07	1.37											

CUMULATIVE TOTALS	H_2+CO MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT									
SHIFT RATIO	RECOVERED OIL		56.80	5.536		8.834	0.861	56.80	5.536		8.834	0.861	
	TOTAL OIL		84.65	8.250		14.709	1.433	81.62	7.954		13.071	1.274	
$\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 4.6	WATER SOLUBLE CHEMICALS		13.53	1.319	7.954	1.701	0.166	13.53	1.319		1.701	0.166	
	TOTAL LIQUID PRODUCTS C_3+		98.18	9.568		16.410	1.599	95.15	9.273		14.772	1.440	
	NET WATER	6.362	114.61	11.169	6.326	13.762	1.341						
	GROSS WATER		128.14	12.488		15.463	1.507						
	HYDROCARBON TOTAL—C_1+		115.41	11.247									

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
70.18	89.49	79.16	83.18	66.27	46.73	53.37	85.07

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

OPERATING CONDITIONS

PRESSURES PSIG	
Oxygen	434
Natural Gas	415
Generator Outlet	415
Reactor Inlet	402
Condenser Inlet	
Product Accumulator	388
TEMPERATURES—°F.	
Oxygen	495
Natural Gas	786
Generator	
Quench Accumulator	122
Reactor Inlet	455
Condenser Inlet	
Product Accumulator	72

Catalyst No.	Height"	
1	12.0	756
2	43.2	650
3	74.4	662
4	105.6	
5	136.8	647
6	168.0	657
7	199.2	608
8	230.4	598
9	261.6	597
10	292.8	593
12	342.0	564

RATES S.C.F.H.	
Fresh Feed	10682
Recycle	10608
Combined Feed	21290
Wet Gas—Measured	1991
Adjusted	3872
Loss	1881
Recycle/Fresh Feed	0.99
Inlet Velocity—ft./sec.	0.766
Fresh Feed Rate—S.C.F.H.	10261
per Cu. Ft. Dense Bed	856
per Lb. Catalyst	6.89

Heat Transfer Calculations

Steam Rate = 340.6 #/hr
@ 769 psia & 514°F
= 1198 BTU/#

Heat Transferred/lb. steam
= 1050 BTU

(1050)(340.6) = 358500 BTU/hr

Ave. Bed Temperature
= 660°F

dT = 660-514 = 146°F

Tube Area = 31.9 ft²

K = 358500 / (146)(31.9) = 77.1

PRODUCT TESTS

	OIL	WATER
°API	51.7	
Neut. No.	24.0	water
Sap. No.	31.8	sample
Hydrox. No.		contaminated
Bromine No.	95.8	with
Pour °F.		condenser
Chemicals, % by K_2CO_3		water
HEMPEL, DIST. %		°API
205 °F.		
400	72.6	57.8
400-550	18.3	35.7
550+	9.1	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	108	
10%	150	
50%	240	
90%	358	
EP	402	
	98.0	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	1864
Fresh Catalyst Added 50#	76
Total	1940
Catalyst Recovered	3
In Reactor at End of Period	1937
REACTOR d-p, Inches H_2O	
No. Height "	
1 12 - 43.2	58
2 43.2 - 74.4	63
3 74.4 - 105.6	64
4 105.6 - 342.0	225
(Calc) 0-12"	24
total	434
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	123
Inventory, Lbs.	1489
Bed Depth, Ft.	18.16
Volume, Cu Ft	11.99

PARTICLE SIZE — Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	13.6	80+	
100	150	72.1	40—80	
150	105	9.7	20—40	
200	74	3.6	10—20	
250	62	0.4	0—20	
325	44	0.4		
<325		0.2		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	144
Settled	146
Compacted	157
Particle Density, gm./cc.	4.1
NH_3 Value, ml./gm.	25.33
N_2 Surface, m²/gm.	
CHEMICAL ANALYSIS	
Fe	
C	
O	
H	
K_2O, W+, % basis Fe	
X-Ray Analysis—	
$Fe_{20}C_9$	
Fe_3O_4	
Fe	

GAS ANALYSES

HOUR	0900			AVERAGE
FRESH FEED				
CO 28.010	37.71			
H_2 2.016	58.35			
CO_2 44.010	2.48			
N_2 28.016	1.18			
CH_4 16.042	0.28			
			M. W.	13.2059
			H_2O 18.016	
			BALANCE	

GENERATOR BALANCE

	M/HR	C	H	O
CO	10.626	10.626		10.626
H_2	16.441		32.882	
CO_2	0.699	0.699		1.398
N_2	0.332			
CH_4	0.079	0.079	0.316	
		11.404	33.715	15.283
		103.19	99.20	101.06

	Mol %	M/Hr	C	H	O
O_2 32.000	0.47	0.045 / 7.356			14.802
CO 28.010					
H_2 2.016					
CO_2 44.010	1.68	0.160	0.160		0.320
N_2 28.014	2.15	0.205			
CH_4 16.042	82.11	7.830	7.830	31.320	
C_2H_6 30.068	8.85	0.844	1.688	5.064	
C_3H_8 44.094	4.65	0.443	1.329	3.544	
C_4H_{10} 58.120	0.05 / 0.04	0.005 / 0.004	0.024 / 0.020	0.06 / 0.048	
TOTAL			11.051	40.036	15.122

WEIGHT BALANCE

	#/hr Measured	At. Wt. Balance	
WET GAS	117.01	146.39	187.16
OIL	44.30	44.30	56.80
WATER	100.23	100.23	128.14
TOTAL	261.54	290.92	372.10
FRESH FEED	372.10	372.10	372.10
WEIGHT BALANCE	70.29		
WET GAS FACTOR			
INDICATED LOSS—S C F H		500	

WET GAS

CO 28.010	13.30
H_2 2.016	40.78
CO_2 44.010	26.38
N_2 28.016	2.17
CH_4 16.042	7.38
C_2H_4 28.052	2.45
C_2H_6 30.068	1.10
C_3H_6 42.078	2.92
C_3H_8 44.094	0.43
C_4H_8 56.104	1.73
C_4H_{10} 58.120	0.45
C_5H_{10} 70.130	0.63
C_5H_{12} 72.146	0.13
C_6H_{12} 84.156	0.15
M. W.	22.2794

GAS FLOW RATES

	$\sqrt{h}$	PRESSURE	TEMP.	S. C. F. H.	M. W.	M/HR
		402.2	91.7			
FRESH FEED 79.31	4.590	20.4188	0.9706	10682	1.4806	28.177
		1.292	72.2			
WET GAS 50.54	8.78	4.0027	0.9887	1991	1.1340	5.252
		402.3	126.7			
RECYCLE 115.14	3.844	20.4213	0.9412	9647	1.1340	25.447
		402.3	126.7			
BLEED 5.02	8.786	20.4213	0.9412	961	1.1340	2.535
		414.8	201.7	2966		27.982
NATURAL GAS 28.43	5.679	20.7251	0.8863	3615	1.2188	9.536
		433.8	88.8			
OXYGEN 27.07	5.001	21.1785	0.9732	2790		7.356
		33.0				
STEAM 215.7	5.20	0.3029		340.6#/hr		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL	3'10¼	206.37	74	0.9930	204.925	51.7		
	2'11	156.54	58	1.0010	156.697	6.430	310.11	44.30
					48.228			
								6.890
WATER	6'1	323.12	76	0.99819	322.535	10.7		
	4'5½	238.01	66	0.99942	237.872	8.287	701.60	100.23
					84.663			12.095

THE TEXAS COMPANY — MONTEBELLO LABORATORY

YIELD CALCULATIONS

RUN NO. 22-G

HOURS 144-168

	FRESH FEED			WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED									
					At. Wt. Balance							CONDENSATE				POLYMER					%
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	Unsats.
CO 28.010	34.5	5.598	156.74	2.63	0.101	2.84	0.600	6.198	0.701	- 5.497						%	gph	#/hr	%	gph	
H_2 2.016	59.5	9.656	19.31	40.63	1.565	3.12	9.273	18.929	10.838	- 8.091					400	70.3	4.158		98.0	4.075	
CO_2 44.010	2.4	0.389	17.12	21.00	0.809	35.59	4.793	5.182	5.602	0.420	18.47	3.195			400/550	17.0	1.005		91.4	0.919	
N_2 28.016	2.9	0.146	4.09	3.70	0.142	3.98	0.844	0.990	0.986						550+	12.7	0.751		114.6	0.861	
CH_4 16.042	2.7	0.438	7.01	15.81	0.608	9.73	3.606	4.044	4.214	0.230	2.72	0.470									
C_2H_4 28.052				5.30	0.204	5.70	1.210	1.210	1.414	0.204	5.70	0.986			C_3	59.1		4.37			
C_2H_6 30.068				2.39	0.092	2.76	0.545	0.545	0.637	0.092	2.76	0.477			C3Poly			3.82		0.639	
C_1+C_2											11.18	1.934			Tar			0.55		0.073	
C_3H_6 42.078				4.59	0.176	7.40	1.048	1.048	1.224	0.176	7.40	1.280	4.32	1.713	0.296			6.25			
C_3H_8 44.094				0.71	0.027	1.21	0.162	0.162	0.189	0.027	1.21	0.209	4.24	0.285	0.049	C_4H_8			0.246	68.0	
C_4H_8 56.104				2.31	0.089	4.98	0.527	0.527	0.616	0.089	4.98	0.861	5.00	0.996	0.172	C4Poly		6.10	0.549	1.5	
C_4H_{10} 58.120				0.43	0.016	0.94	0.098	0.098	0.114	0.016	0.94	0.162	4.86	0.193	0.033	C4H10		4.86	0.193	68.0	
C_5H_{10} 70.130				0.50	0.019	1.30	0.114	0.114	0.133	0.019	1.30	0.225	5.45	0.239	0.041	C4Free	Gaso	5.45	4.953	5.8	
C_5H_{12} 72.146													5.25			C4Poly	Tar	5.25	0.062		
C_6H_{12} 84.156													5.54					5.54			
C_3-C_6											15.83	2.738		3.426	0.593						
TOTAL		16.227	204.27		3.848	79.55	22.823	39.075	31.470								gal/hr.		gal/MCF	BPD	
H_2+CO		15.254	5781.3 C.F.H.		1.666		9.873	25.127	11.539	-13.588						Gasoline	5.941		1.0276	5571	
H_2/CO		1.72	1729715		15.5		15.5	3.05	15.5	1.47						Diesel	0.919		0.1590	862	
							EFFLUENT		RECOVERED OIL	0.273*	38.30	6.625	6.476	5.914	1.023	Waxy Btms	0.861		0.1489	807	
							SHIFT RATIO		TOTAL OIL		54.13	9.363		9.340	1.616	Poly Tar	0.135		0.0234	127	
							20.1 $(H_2)(CO_2)$ $(H_2O)(CO)$		WATER SOLUBLE CHEMICALS	0.225*	11.92	2.062		1.515	0.262	Total	7.856		1.3589	7367	
									TOTAL LIQUID PRODUCTS C_3+		66.03	11.421		10.855	1.878	WSChem	1.515		0.2620	1420	
									NET WATER	4.301	77.48	13.402	8.328	9.303							
									GROSS WATER		89.40	15.464	8.264	10.818							
									HYDROCARBON TOTAL—C_1+		77.21	13.355									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
76.29	98.20	83.79	89.08	88.69	42.74	54.08	85.52

Form ML-11

*Included in Reactor Effluent Total

g/M3 = 16.91 × #/MCF.

cc/M3 = 141.3 × gal/MCF.

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 46-1 / 46 F/I
HOURS 108-204 / 168

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	35.796	15.680	439.20	20.763	4.924	137.92	10.238	25.918	15.162	10.756	
H_2 2.016	60.159	26.353	53.13	53.055	12.584	25.37	26.162	52.515	38.746	13.769	
CO_2 44.010	2.360	1.034	45.51	16.328	3.873	170.45	8.052	9.086	11.925	2.839	124.94
N_2 28.016	0.491	0.215	6.02	0.800	0.190	5.32	0.394	0.609	0.584		
CH_4 16.042	1.194	0.523	8.39	5.003	1.187	19.04	2.467	2.990	3.654	0.664	10.65
C_2H_4 28.052				0.922	0.219	6.14	0.455	0.455	0.674	0.219	6.14
C_2H_6 30.068				0.428	0.102	3.07	0.211	0.211	0.313	0.102	3.07
C_1+C_2											19.86
C_3H_6 42.078				1.145	0.272	11.44	0.565	0.565	0.837	0.272	11.44
C_3H_8 44.094				0.275	0.065	2.87	0.136	0.136	0.201	0.065	2.87
C_4H_8 56.104				0.708	0.168	9.43	0.349	0.349	0.517	0.168	9.43
C_4H_{10} 58.120				0.195	0.046	2.67	0.096	0.096	0.142	0.046	2.67
C_5H_{10} 70.130				0.305	0.072	5.05	0.150	0.150	0.222	0.072	5.05
C_5H_{12} 72.146											
C_6H_{12} 84.156				0.073	0.017	1.43	0.036	0.036	0.043	0.017	1.43
C_3-C_6											32.89
TOTAL		43.805	552.25		23.718	400.20	49.311	93.116	78.853		
H_2+CO		42.033	15930.5 S.C.F.H.	73.818	17.508		36.400	78.433	53.908	24.525	
H_2/CO		1.68	627727		2.56			2.03		1.28	

	YIELD BASIS H_2+CO FED — CONDENSATE #/MCF	#/gal	gal/hr	gal/MCF	POLYMER #/hr	#/MCF	#/gal	gal/hr	gal/MCF	% Unsats.
CO					%	gph	#/hr.	%	gph	#/hr.
H_2				400	67.6	4.933		98.0	4.834	
CO_2	7.843			400/550	16.0	1.168		91.4	1.068	
N_2				550+	16.4	1.197		114.6	1.372	
CH_4	0.669					7.298				
C_2H_4	0.385			C_3			11.44	26.0		2.97
C_2H_6	0.193			Poly Gaso	87.5				0.435	2.60
C_1+C_2	1.247			Poly Tar	12.5				0.049	0.37
C_3H_6	0.718	4.32	2.648	0.166		Balance for 10# RVP	6.25			
C_3H_8	0.180	4.24	0.677	0.042	C_4H_8			0.108	68.0	7.344
C_4H_8	0.592	5.00	1.886	0.118	C_4 Poly		6.10	1.301	1.5	1.951
C_4H_{10}	0.168	4.86	0.549	0.034	C_4H_{10}		4.86	0.549	68.0	37.332
C_5H_{10}	0.317	5.45	0.927	0.058	C_4 Free Gaso		5.45	6.454	5.8	37.433
C_5H_{12}		5.25					5.25	8.412		84.060
C_6H_{12}	0.090	5.54	0.258	0.016	C_4 Poly Tar		5.54	0.147		
C_3-C_6	2.065		6.945	0.436						
TOTAL						gal/hr.		gal/MCF	#Bbl/Day	
H_2+CO					Gasoline		8.412	0.5281	2863	
H_2/CO					Diesel		1.068	0.0670	363	
EFFLUENT — RECOVERED OIL	2.964	6.470	7.298	0.458	Waxy Bottoms		1.372	0.0861	467	
TOTAL OIL	5.029		14.243	0.894	Poly Tar		0.196	0.0123	67	
WATER SOLUBLE CHEMICALS	0.731	8.484	1.372	0.086	Total		11.048	0.6935	3760	
TOTAL LIQUID PRODUCTS C_3+	5.759		15.615	0.980	Water Soluble Chemicals		1.372	0.0861	467	
NET WATER	5.958	8.321	11.406		Total		12.420	0.7796	4227	
GROSS WATER	6.688		12.778							
HYDROCARBON TOTAL—C_1+	7.194									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

SHIFT RATIO $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 5.78

FRESH FEED CONVERSION — % Contraction	CO	H_2	H_2+CO	TOTAL FEED CONVERSION — % CO	H_2	CO+H_2	SELECTIVITY C_3+/C_1+
45.86	68.60	54.31	58.35	41.50	26.22	31.27	80.05

Form ML-11

#9488 MCFH H_2 + CO

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

HOURS 108-204 / 168

DATA SUMMARY

OPERATING CONDITIONS			
PRESSURES PSIG		RATES S.C.F.H.	
Oxygen		Fresh Feed	16602
Natural Gas		Recycle	18689
Generator Outlet	428	Combined Feed	35291
Reactor Inlet	420	Wet Gas—Measured	
Condenser Inlet		Adjusted	8989
Product Accumulator		Loss	
TEMPERATURES—°F.		Recycle/Fresh Feed	1.12
Oxygen		Inlet Velocity—ft./sec.	1.07
Natural Gas		Fresh Feed Rate—S.C.F.H. H_2+CO	15931
Generator		per Cu. Ft. Dense Bed	2825
Quench Accumulator		per Lb. Catalyst	23.12
Reactor Inlet	252	per square foot	24138
Condenser Inlet			
Product Accumulator	70		
Catalyst No. Height			
1	631		
2	631		
3	656		
4	660		
5			
6			

PRODUCT TESTS	OIL	WATER
°API	50.6	10.7
Neut. No.	37.7	39.5
Sap. No.	42.3	42.4
Hydrox. No.		
Bromine No.	83	
Pour °F.		
Chemicals, % by K_2CO_3		10.88
HEMPEL, DIST. %		
205 °F.		
400	66.6	°API 56.5
400-550	16.0	41.7
550+	17.4	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	107	
10%	148	
50%	249	
90%	358	
EP	402	
Rec.	97.5	

CATALYST DATA	
INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	122
Inventory, Lbs.	689
Bed Depth, Ft.	8.55
Volume, Cu. Ft.	5.64

PARTICLE SIZE — Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	16.5	80+	
100	150	65.8	40—80	
150	105	8.5	20—40	
200	74	4.0	10—20	
250	62	1.0	0—20	
325	44	0.6		
<325		3.6		

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	141
Settled	143
Compacted	
Particle Density, gm./cc.	4.1
NH_3 Value, ml./gm.	6.3
N_2 Surface, m^2/gm.	
CHEMICAL ANALYSIS	
Fe	65.5
C	9.77
O	
H	0.63
K_2O, W+, % basis Fe	0.18
X-Ray Analysis—	
$Fe_{20}C_9$	30
Fe_3O_4	65
Fe	5

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 46-2 46 J/P
HOURS 204-369 183

	FRESH FEED			WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED									
					At. Wt. Balance							CONDENSATE				POLYMER					%
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	Unsats.
CO 28.010	35.806	15.964	447.15	17.968	3.945	110.50	8.377	24.341	12.322	12.019	336.65					%	gph	#/hr.	%	gph	
H_2 2.016	59.508	26.531	53.49	50.509	11.089	22.36	23.547	50.078	34.636	15.442	31.13				400	71.2	6.145		98.0	6.022	
CO_2 44.010	2.228	0.993	43.70	18.258	4.008	176.39	8.512	9.505	12.518	3.015	132.69	8.239			400/550	16.9	1.458		91.4	1.333	
N_2 28.016	0.353	0.157	4.40	0.844	0.185	5.18	0.393	0.550	0.578						550+	11.9	1.027		114.6	1.177	
CH_4 16.042	2.105	0.939	15.06	7.560	1.660	26.63	3.524	4.463	5.184	0.721	11.57	0.718					8.630				
C_2H_4 28.052				1.257	0.276	7.74	0.586	0.586	0.862	0.276	7.74	0.481			C_3	29.0		3.56			72.6
C_2H_6 30.068				0.474	0.104	3.13	0.221	0.221	0.325	0.104	3.13	0.194			Poly Gasc			3.12		0.521	
C_1+C_2											22.44	1.393			Poly Tar			0.44		0.058	
C_3H_6 42.078				1.328	0.292	12.29	0.619	0.619	0.911	0.292	12.29	0.763	4.32	2.845	0.177			6.25		RVP	81.4
C_3H_8 44.094				0.303	0.066	2.91	0.141	0.141	0.207	0.066	2.91	0.181	4.24	0.686	0.043	C_4H_8			0.240	68.0	
C_4H_8 56.104				0.840	0.184	10.32	0.392	0.392	0.576	0.184	10.32	0.641	5.00	2.064	0.128	C_4 Poly		6.10	1.334	1.5	80.8
C_4H_{10} 58.120				0.200	0.044	2.56	0.093	0.093	0.137	0.044	2.56	0.159	4.86	0.527	0.033	C_4H_{10}		4.86	0.527	68.0	
C_5H_{10} 70.130				0.353	0.078	5.47	0.164	0.164	0.242	0.078	5.47	0.340	5.45	1.004	0.062	C_4 Free Gaso		5.45	7.887	5.8	92.2
C_5H_{12} 72.146				0.030	0.006	0.43	0.014	0.014	0.020	0.006	0.43	0.027	5.25	0.082	0.005	C_4 Poly Tar		5.25	0.151		
C_6H_{12} 84.156				0.077	0.017	1.43	0.036	0.036	0.053	0.017	1.43	0.089	5.54	0.258	0.016			5.54			
C_3-C_6											35.41	2.199		7.466	0.464						
TOTAL		44.584	563.80		21.954	387.34	46.620	91.204	75.210								gal/hr.		gal/MCF	Bbl/D	
H_2+CO		42.495	16,105.6 S.C.F.H.	68.477	15.034		31.924	74.419	46.958	27.461						Gasoline	9.988		0.6201	3362	
H_2/CO		1.66	620902		2.81		2.81	2.06	2.81	1.28						Diesel	1.333		0.0828	449	
										0.400	56.08	3.482	6.498	8.630	0.536	Waxy Bottom	1.177		0.0731	396	
											91.49	5.681		16.096	0.999	Poly Tar	0.209		0.0130	71	
										0.236	12.54	0.779	8.00	1.567	0.097	Total	12.707		0.7890	4278	
											104.03	6.459		17.663	1.097	Water Soluble Chemicals	1.567		0.0973	527	
										6.000	108.09	6.711	8.328	12.979		Total	14.274		0.3863	4805	
											120.63	7.490	8.293	14.546							
											126.47	7.853									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT — RECOVERED OIL
SHIFT RATIO — TOTAL OIL
$\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ 5.86 — WATER SOLUBLE CHEMICALS
TOTAL LIQUID PRODUCTS C_3+
NET WATER
GROSS WATER
HYDROCARBON TOTAL—C_1+

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
50.76	75.29	58.20	64.62	49.38	30.84	36.90	82.26

Form ML-11

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

DATA SUMMARY

HOURS 204-369 183

OPERATING CONDITIONS			
PRESSURES PSIG		RATES S.C.F.H.	
Oxygen		Fresh Feed	16897
Natural Gas		Recycle	17669
Generator Outlet	431	Combined Feed	34566
Reactor Inlet		Wet Gas—Measured	
Condenser Inlet		Adjusted	8320
Product Accumulator		Loss	
TEMPERATURES—°F.		Recycle/Fresh Feed	1.04
Oxygen		Inlet Velocity—ft./sec.	1.05
Natural Gas		Fresh Feed Rate—S.C.F.H. H_2 + CO	16106
Generator		per Cu.Ft. Dense Bed	2314
Quench Accumulator		per Lb. Catalyst	17.6
Reactor Inlet	217	per square foot	24403
Condenser Inlet			
Product Accumulator	70		
Catalyst No. Height			
1	633		
2	633		
3	664		
4	651		
5			
6			

PRODUCT TESTS	OIL	WATER
°API	49.8	10.6
Neut. No.	42.3	41.9
Sap. No.	47.5	43.7
Hydrox. No.		
Bromine No.	86	
Pour °F.	-22	
Chemicals, % by K_2CO_3		10.43
HEMPEL, DIST. %		
205 °F.		
400	70.2	55.9
400-550	16.9	39.9
550+	12.9	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP		
10%		
50%		
90%		
EP		

CATALYST DATA									
INVENTORY DATA		PARTICLE SIZE							
		Screen Analysis			Sedimentation				
In Reactor at Start of Period		Mesh	Microns	%	Microns	%			
Fresh Catalyst Added	560	On 40	419+		80+				
Total		100	150		40—80				
Catalyst Recoyered		150	105		20—40				
In Reactor at End of Period		200	74		10—20				
		250	62		0—20				
REACTOR d-p, Inches H_2O		325	44						
No. Height		<325							
		CATALYST							
		Bulk Density, Lbs./Cu.Ft.							
		Aerated							
		Settled							
		Compacted							
		Particle Density, gm./cc.							
CALCULATED FROM dp		NH_3 Value, ml./gm.							
Density, Lbs./Cu.Ft.	131	N_2 Surface, m^2/gm.							
Inventory, Lbs.	915								
Bed Depth, Ft.	10.55	CHEMICAL ANALYSIS							
Volume, Cu. Ft.	6.96	Fe							
		C							
		Ext. O:1							
		H							
		K_2O, W+, % basis Fe							
		X-Ray Analysis—							
		$Fe_{20}C_9$							
		Fe_3O_4							
		Fe							

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 46-3 / 46 Q/W
HOURS 369-537 / 162

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	At. Wt. Balance m/hr	At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
CO 28.010	35.798	15.510	434.44	17.636	3.499	98.01	8.001	23.511	11.500	-12.011	-336.43
H_2 2.016	60.365	26.155	52.73	50.635	10.045	20.25	22.973	49.128	33.018	-16.110	- 32.48
CO_2 44.010	2.281	0.988	43.48	19.465	3.862	169.97	8.831	9.819	12.693	2.874	126.49
N_2 28.014	0.450	0.195	5.46	0.777	0.154	4.31	0.353	0.548	0.507		
CH_4 16.042	1.106	0.479	7.68	6.215	1.233	19.78	2.820	3.299	4.053	0.754	12.10
C_2H_4 28.052				1.424	0.282	7.91	0.646	0.646	0.928	0.282	7.91
C_2H_6 30.068				0.541	0.107	3.22	0.245	0.245	0.352	0.107	3.22
C_1+C_2											23.23
C_3H_6 42.078				1.459	0.290	12.20	0.662	0.662	0.952	0.290	12.20
C_3H_8 44.094				0.234	0.046	2.03	0.106	0.106	0.152	0.046	2.03
C_4H_8 56.104				0.912	0.181	10.15	0.414	0.414	0.595	0.181	10.15
C_4H_{10} 58.120				0.208	0.041	2.38	0.094	0.094	0.135	0.041	2.38
C_5H_{10} 70.130				0.379	0.075	5.26	0.172	0.172	0.247	0.075	5.26
C_5H_{12} 72.146				0.043	0.009	0.65	0.020	0.020	0.029	0.009	0.65
C_6H_{12} 84.156				0.072	0.014	1.18	0.033	0.033	0.047	0.014	1.18
C_3-C_6											33.85
TOTAL		43.327	543.79		19.838	357.30	45.370	88.697	72.215		
H_2+CO		41.665	15791 S.C.F.H.		13.544		30.974	72.639	44.518	28.121	
H_2/CO		1.69	6332721		2.87		2.87	2.09	2.87	1.34	

YIELD BASIS H_2+CO FED	CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
					%	gph	#/hr.	%	gph	#/hr
CO					73.3	6.591		98.0	6.459	
H_2				400	16.1	1.448		91.4	1.323	
CO_2	8.010			400/550	10.6	0.953		114.6	1.092	
N_2				550+		8.992				
CH_4	0.766									
C_2H_4	0.501			C3	31.3		3.82			
C_2H_6	0.204		Poly Gaso				3.34		0.559	
C_1+C_2	1.471		Poly Tar				0.48		0.064	
C_3H_6	0.773	4.32	2.824	0.179			6.25		RVP	86.2
C_3H_8	0.129	4.24	0.479	0.030	C4H8			0.298	58.0	
C_4H_8	0.643	5.00	2.030	0.129	C4 Poly		6.10	1.267	1.5	81.4
C_4H_{10}	0.151	4.86	0.490	0.031	C4H10		4.86	0.490	68.0	
C_5H_{10}	0.333	5.45	0.965	0.061	C4Free Gaso		5.45	8.320	5.8	89.8
C_5H_{12}	0.041	5.25	0.124	0.008	C4Poly Tar		5.25	0.143		
C_6H_{12}	0.075	5.54	0.213	0.013			5.54			
C_3-C_6	2.144		7.125	0.451						
TOTAL						gal/hr.		gal/MCF		BPD
H_2+CO					Gasoline		10.375	0.6570		3562
H_2/CO					Diesel		1.323	0.0838		454
EFFLUENT — RECOVERED OIL	3.700	6.498	8.992	0.569	Waxy Bottms		1.092	0.0692		375
EFFLUENT — TOTAL OIL	5.844		16.117	1.020	Poly Tar		0.207	0.0131		71
EFFLUENT — WATER SOLUBLE CHEMICALS	0.796	7.99	1.574	0.100	Total		12.997	0.8231		4462
EFFLUENT — TOTAL LIQUID PRODUCTS C_3+	6.640		17.691	1.120	WS Chem.		1.574	0.0997		541
EFFLUENT — NET WATER	7.248	8.328	13.743		Total		14.571	0.9228		5003
EFFLUENT — GROSS WATER	8.044	8.293	15.317							
EFFLUENT — HYDROCARBON TOTAL—C_1+	8.111									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

SHIFT RATIO: 5.74 $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
54.21	77.44	61.60	67.49	51.09	32.79	38.71	81.86

Form ML-11

*Included in Reactor Effluent Total

g/M3 = 16.91 × #./MCF.
cc/M3 = 141.3 × gal/MCF.

HOURS 369-537 / 162

DATA SUMMARY

OPERATING CONDITIONS		RATES S.C.F.H.	
PRESSURES PSIG			
Oxygen		Fresh Feed	16421
Natural Gas		Recycle	17195
Generator Outlet		Combined Feed	33616
Reactor Inlet	417	Wet Gas—Measured	
Condenser Inlet		Adjusted	7519
Product Accumulator		Loss	
TEMPERATURES—°F.		Recycle/Fresh Feed	1.05
Oxygen		Inlet Velocity—ft./sec.	1.05
Natural Gas		Fresh Feed Rate—S.C.F.H. H_2 + CO	15791
Generator		per Cu. Ft. Dense Bed	2178
Quench Accumulator		per Lb. Catalyst	15.81
Reactor Inlet	212	per sq. ft.	23926
Condenser Inlet			
Product Accumulator			
Catalyst No. Height			
1	636		
2	632		
3	659		
4	640		
5			
6			

PRODUCT TESTS	OIL	WATER
°API	49.8	10.6
Neut. No.	44.9	43.5
Sap. No.	48.4	43.9
Hydrox. No.		
Bromine No.	85	
Pour °F.		
Chemicals, % by K_2CO_3		9.8
HEMPEL, DIST. %		°API
205 °F.		
400	72.3	56.0
400-550	16.1	38.7
550+	11.6	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	104	
10%	140	
50%	242	
90%	359	
EP	406	
Recovered	97.5	

CATALYST DATA	
INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	1152
Total	
Catalyst Recovered	
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	138
Inventory, Lbs.	999
Bed Depth, Ft.	10.99
Vol., cu. ft.	7.25

PARTICLE SIZE — Screen Analysis Mesh	Microns	%	Sedimentation Microns	%
On 40	419+	15.8	80+	
100	150	63.6	40—80	
150	105	11.5	20—40	
200	74	6.0	10—20	
250	62		0—20	
325	44			
<325				

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	149
Settled	151
Compacted	169
Particle Density, gm./cc.	4.6
NH_3 Value, ml./gm.	7.4
N_2 Surface, m^2/gm.	1
CHEMICAL ANALYSIS	
Fe	71.3
C	6.2
Ext. O: 1	0.9
H	0.3
K_2O, W+, % basis Fe	0.32
X-Ray Analysis—	
$Fe_{20}C_9$	
Fe_3O_4	
Fe	

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 48 E/H
HOURS 95-190
137

	FRESH FEED %	FRESH FEED m/hr	FRESH FEED #/hr	WET GAS %	WET GAS At. Wt. Balance m/hr	WET GAS At. Wt. Balance #/hr	RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr	YIELD BASIS H_2+CO FED CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF	POLYMER #/hr	POLYMER #/MCF	POLYMER #/gal	POLYMER gal/hr	POLYMER gal/MCF	% Unsats.
CO 28.010	35.970	15.678	439.14	15.133	2.977	83.39	6.884	22.562	9.861	-12.701	-355.75					%	gph	#/hr	%	gph	
H_2 2.016	60.385	26.318	53.06	50.405	9.915	19.99	22.930	49.248	32.845	-16.403	- 33.07				400	74.5	7.178		98.0	7.034	
CO_2 44.010	2.718	1.185	52.15	22.618	4.449	195.80	10.289	11.474	14.738	3.264	143.65	9.023			400/550	15.0	1.445		91.4	1.321	
N_2 28.016	0.725	0.316	8.85	1.332	0.262	7.34	0.606	0.922	0.868						550+	10.5	1.012		114.6	1.160	
CH_4 16.042	0.202	0.088	1.41	4.842	0.952	15.27	2.203	2.291	3.155	0.864	13.86	0.871					9.635				
C_2H_4 28.052				1.455	0.286	8.02	0.662	0.662	0.948	0.286	8.02	0.504			C_3	31.7		3.76			71.2
C_2H_6 30.068				0.588	0.116	3.49	0.267	0.267	0.383	0.116	3.49	0.219						3.29		0.550	
C_1+C_2											25.37	1.594						0.47		0.062	
C_3H_6 42.078				1.435	0.282	11.87	0.653	0.653	0.935	0.282	11.87	0.746	4.32	2.748	0.173			6.25			77.9
C_3H_8 44.094				0.408	0.080	3.53	0.186	0.186	0.266	0.080	3.53	0.222	4.24	0.833	0.052	C_4H_8			0.212	68.0	
C_4H_8 56.104				0.937	0.184	10.32	0.426	0.426	0.610	0.184	10.32	0.648	5.00	2.064	0.130	C_4 Poly		6.10	1.355	1.5	77.3
C_4H_{10} 58.120				0.275	0.054	3.14	0.125	0.125	0.179	0.054	3.14	0.197	4.86	0.646	0.040	C_4H_{10}		4.86	0.646	68.0	
C_5H_{10} 70.130				0.452	0.089	6.24	0.206	0.206	0.295	0.089	6.24	0.392	5.45	1.145	0.072	C_4Free Gaso		5.45	9.094	5.8	
C_5H_{12} 72.146													5.25			C_4Poly Tar		5.25	0.154		
C_6H_{12} 84.156				0.120	0.024	2.02	0.055	0.055	0.079	0.024	2.02	0.127	5.54	0.365	0.023			5.54			
C_3-C_6											37.12	2.332		7.801	0.490						
TOTAL		43.585	554.61		19.670	370.42	45.492	89.077	71.773									gal./hr.	gal/MCF		BPD
H_2+CO		41.996	15920 S.C.F.H.		12.892		29.814	71.810	42.706	-29.104						Gasoline		11.307	0.710		3849
H_2/CO		1.68			3.33		3.33	2.18	3.33	1.29						Diesel		1.321	0.083		450
									RECOVERED OIL	0.446*	62.50	3.926	6.487	9.635	0.605	Waxy Btms		1.160	0.073		396
									TOTAL OIL		99.62	6.257		17.436	1.095	Poly Tar		0.216	0.014		76
									WATER SOLUBLE CHEMICALS	0.236*	12.52	0.787		1.583	0.100	Total		14.004	0.880		4771
									TOTAL LIQUID PRODUCTS C_3+		112.14	7.044		19.019	1.195	WS Chem		1.583	0.099		537
									NET WATER	5.929*	106.82	6.710	8.328	12.827		Total		15.587	0.979		5308
									GROSS WATER		119.34	7.496	8.282	14.410							
									HYDROCARBON TOTAL—C_1+		137.51	8.637									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT SHIFT RATIO 8.39 $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION—%			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
54.87	81.01	62.33	69.30	56.29	33.31	40.53	81.55

Form ML-11

*Included in Reactor Effluent Total

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

HOURS 95-190
137

DATA SUMMARY

OPERATING CONDITIONS			
PRESSURES PSIG		RATES S.C.F.H.	
Oxygen		Fresh Feed	16523
Natural Gas		Recycle	17246
Generator Outlet		Combined Feed	33769
Reactor Inlet		Wet Gas—Measured	
Condenser Inlet		Adjusted	7457
Product Accumulator	375	Loss	
TEMPERATURES—°F.		Recycle/Fresh Feed	1.04
Oxygen		Inlet Velocity—ft./sec.	1.08
Natural Gas		Fresh Feed Rate—S.C.F.H. H_2 + CO	15921
Generator		per Cu.Ft. Dense Bed	2143
Quench Accumulator		per Lb. Catalyst	15.61
Reactor Inlet	177	per sq. ft.	24123
Condenser Inlet			
Product Accumulator			
Catalyst No. Height			
1	659		
2	646		
3	673		
4	638		
5	653		
6			

PRODUCT TESTS	OIL	WATER
°API	50.1	10.8
Neut. No.	37.1	37.0
Sap. No.	41.6	37.0
Hydrox. No.		
Bromine No.	82	
Pour °F.		
Chemicals, % by K_2CO_3		10.4
HEMPEL, DIST. %		
205 °F.		°API
400	73.5	55.2
400-550	15.0	37.4
550+	11.5	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	111	
10%	148	
50%	240	
90%	353	
EP	404	
Recovered	97.4	

CATALYST DATA						
INVENTORY DATA		PARTICLE SIZE				
In Reactor at Start of Period		Screen Analysis			Sedimentation	
Fresh Catalyst Added	80	Mesh	Microns	%	Microns	%
Total		On 40	419+	15.1	80+	
Catalyst Recovered		100	150	68.1	40—80	
In Reactor at End of Period		150	105	10.1	20—40	
		200	74	4.7	10—20	
REACTOR d-p, Inches H_2O		250	62	0.6	0—20	
No. Height		325	44	0.5		
		<325		0.9		
		CATALYST				
		Bulk Density, Lbs./Cu.Ft.				
		Aerated			147	
		Settled			149	
		Compacted			163	
		Particle Density, gm./cc.			4.39	
CALCULATED FROM dp		NH_3 Value, ml./gm.			5.7	
Density, Lbs./Cu.Ft.	137	N_2 Surface, m^2/gm.				
Inventory, Lbs.	1020					
Bed Depth, Ft.	11.25	CHEMICAL ANALYSIS				
Vol., cu. ft.	7.43	Fe				
		C				
		O				
		H				
		K_2O, W+, % basis Fe				
		X-Ray Analysis—				
		$Fe_{20}C_9$				
		Fe_3O_4				
		Fe				

49-1
RUN NO. 49 F/P
HOURS 104-341
192

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

	FRESH FEED			WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED									
					At. Wt. Balance							CONDENSATE				POLYMER					%
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	Unsats.
CO 28.010	36.751	14.950	418.75	13.691	2.060	57.70	5.659	20.609	7.719	-12.890	-361.05										
H_2 2.016	59.529	24.216	48.82	43.537	6.551	13.21	17.820	42.036	24.371	-17.665	- 35.61				400	74.3	7.874		98.0	7.717	
CO_2 44.010	2.677	1.089	47.93	25.926	3.901	171.68	10.608	11.697	14.509	2.812	123.76	8.326			400/550	17.8	1.887		91.4	1.725	
N_2 28.016	0.831	0.338	9.47	2.166	0.326	9.13	0.885	1.223	1.219						550+	7.9	0.837		114.6	0.959	
CH_4 16.042	0.212	0.086	1.38	6.327	0.952	15.27	2.655	2.741	3.607	0.866	13.89	0.934					10.598				
C_2H_4 28.052				2.186	0.329	9.23	0.895	0.895	1.224	0.329	9.23	0.621			C_3	38.5		5.20			72.8
C_2H_6 30.068				0.817	0.123	3.70	0.335	0.335	0.458	0.123	3.76	0.249			C_3Poly			4.55		0.761	
C_1+C_2											26.82	1.804			Tar			0.65		0.086	
C_3H_6 42.078				2.133	0.321	13.51	0.876	0.876	1.197	0.321	13.51	0.909	4.32	3.127	0.210			6.25			83.2
C_3H_8 44.094				0.432	0.065	2.87	0.161	0.161	0.226	0.065	2.87	0.193	4.24	0.677	0.046	C_4H_8			0.186	68.0	
C_4H_8 56.104				1.409	0.212	11.89	0.576	0.576	0.788	0.212	11.89	0.800	5.00	2.378	0.160	C_4Poly		6.10	1.604	1.5	76.0
C_4H_{10} 58.120				0.445	0.067	3.89	0.183	0.183	0.250	0.067	3.89	0.262	4.86	0.800	0.054	C_4H_{10}		4.86	0.800	68.0	
C_5H_{10} 70.130				0.651	0.098	6.87	0.268	0.268	0.366	0.098	6.87	0.462	5.45	1.261	0.085	C_4Free	Gaso	5.45	10.352	5.8	84.4
C_5H_{12} 72.146				0.120	0.018	1.30	0.048	0.048	0.066	0.018	1.30	0.087	5.25	0.248	0.017	C_4Poly	Tar	5.25	0.182		
C_6H_{12} 84.156				0.160	0.024	2.02	0.064	0.064	0.088	0.024	2.02	0.136	5.54	0.365	0.024			5.54			
C_3-C_6											42.35	2.849		8.856	0.596						
TOTAL		40.679	526.34		15.047	322.28	41.033	81.712	63.599								gal/hr.		gal/MCF	BPD	
H_2+CO		39.166	14863.5 S.C.F.H.		8.611		23.479	62.645	32.090	-30.555						Gasoline	12.942		0.871	4721	
H_2/CO		1.62			3.18		3.18	2.04	3.18	1.37						Diesel	1.725		0.116	629	
									RECOVERED OIL	0.493*	69.10	4.649	6.52	10.598	0.713	WaxyBtms	0.959		0.064	350	
									TOTAL OIL		111.45	7.498		19.454	1.309	Poly Tar	0.268		0.018	98	
									WATER SOLUBLE CHEMICALS	0.244*	12.94	0.871	8.03	1.612	0.108	Total	15.894		1.069	5797	
									TOTAL LIQUID PRODUCTS C_3+		124.39	8.369		21.066	1.357	WS Chem	1.612		0.109	588	
									NET WATER	6.782*	122.19	8.221				Total	17.506		1.178	6386	
									GROSS WATER		135.13	9.091									
									HYDROCARBON TOTAL—C_1+		151.21	10.173									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT SHIFT RATIO $\frac{6.75\,(H_2)(CO_2)}{(H_2O)(CO)}$

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
63.01	86.22	72.95	78.01	62.55	42.02	48.77	82.26

Form ML-11

*Included in Reactor Effluent Total

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

HOURS 104-341
192

DATA SUMMARY

OPERATING CONDITIONS					PRODUCT TESTS		
PRESSURES PSIG		RATES S.C.F.H.				OIL	WATER
Oxygen		Fresh Feed	15438		° API	49.6	10.6
Natural Gas		Recycle	15572		Neut. No.	39.7	38.1
Generator Outlet		Combined Feed	31010		Sap. No.	46.3	41.2
Reactor Inlet	381	Wet Gas—Measured			Hydrox. No.		
Condenser Inlet		Adjusted	5710		Bromine No.	86	
Product Accumulator	362	Loss			Pour °F.		
					Chemicals, % by K_2CO_3		9.9
TEMPERATURES—°F.		Recycle/Fresh Feed	1.01				
Oxygen		Inlet Velocity—ft./sec.	1.04				
Natural Gas		Fresh Feed Rate—S.C.F.H.	14864		HEMPEL, DIST. %		°API
Generator		per Cu. Ft. Dense Bed	1072		205 °F.		
Quench Accumulator		per Lb. Catalyst	8.75		400	73.3	55.4
Reactor Inlet	286				400-550	17.8	35.9
Condenser Inlet					550+	8.9	
Product Accumulator	70						
Catalyst No. Height					A. S. T. M. DIST. ON		
1 12"	721				Naphtha °F.		
2 43.2"	643				IBP	104	
3 74.4"	661				10%	140	
4					50%	235	
5 136.8"	657				90%	352	
6 168.0"	652				EP	404	
7 199.2"	643	Avg. Bed Temp., °F.	659		Recovered	97.5	
8 230.4"	637	dT, °F.	146				
9 261.6"	630	K, BTU/hr/sq.ft/°F.	83.0				
10 292.8"	629						
12 342.0"	620						

CATALYST DATA						
INVENTORY DATA		PARTICLE SIZE				
In Reactor at Start of Period		Screen Analysis			Sedimentation	
Fresh Catalyst Added	616	Mesh	Microns	%	Microns	%
Total		On 40	419+	13.8	80+	
Catalyst Recovered		100	150	66.3	40—80	
In Reactor at End of Period		150	105	9.6	20—40	
		200	74	5.0	10—20	
REACTOR d-p, Inches H_2O		250	62	1.2	0—20	
No. Height		325	44	1.3		
		<325		2.8		
		CATALYST				
		Bulk Density, Lbs./Cu.Ft.				
		Aerated				143
		Settled				145
		Compacted				161
		Particle Density, gm./cc.				4.3
CALCULATED FROM dp		NH_3 Value, ml./gm.				15.0
Density, Lbs./Cu.Ft.	121	N_2 Surface, m^2/gm.				1
Inventory, Lbs.	1698					
Bed Depth, Ft.	21.01	CHEMICAL ANALYSIS at 200 hrs.				
Vol., cu. ft.	13.87	Fe				66.6
		C				8.2
		O				
		H				0.5
		K_2O, W+, % basis Fe				0.50
		X-Ray Analysis—				
		$Fe_{20}C_9$				40
		Fe_3O_4				55
		Fe				5

49-2
RUN NO. 49 Q/W
HOURS 341-497
298

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

	FRESH FEED			WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED									
					At. Wt. Balance							CONDENSATE				POLYMER					%
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	Unsats.
CO 28.010	36.655	15.348	429.90	15.773	2.494	69.86	9.717	25.065	12.211	-12.854						%	gph	#/hr	%	gph	
H_2 2.016	59.331	24.843	50.08	44.220	6.992	14.10	27.257	52.100	34.249	-17.851					400	73.5	8.120		98.0	7.958	
CO_2 44.010	2.744	1.149	50.57	24.109	3.812	167.77	14.863	16.012	18.675	2.663	117.20	7.684			400/550	17.5	1.933		91.4	1.768	
N_2 28.016	0.967	0.405	11.35	2.326	0.367	10.28	1.430	1.835	1.797						550+	9.0	0.994		114.6	1.139	
CH_4 16.042	0.303	0.127	2.04	5.863	0.927	14.87	3.615	3.742	4.542	0.800	12.83	0.841					11.047				
C_2H_4 28.052				2.100	0.332	9.31	1.295	1.295	1.627	0.332	9.31	0.610			C3	38.0		5.36			72.0
C_2H_6 30.068				0.816	0.129	3.88	0.505	0.505	0.634	0.129	3.88	0.254			C3Poly			4.69		0.784	
C_1+C_2											26.02	1.706			Tar			0.67		0.089	
C_3H_6 42.078				2.119	0.335	14.10	1.306	1.306	1.641	0.335	14.10	0.924	4.32	3.264	0.214			6.25			88.2
C_3H_8 44.094				0.284	0.045	1.98	0.174	0.174	0.219	0.045	1.98	0.130	4.24	0.467	0.031	C_4H_8			0.254	68.0	
C_4H_8 56.104				1.252	0.198	11.11	0.772	0.772	0.970	0.198	11.11	0.728	5.00	2.222	0.146	C4Poly		6.10	1.440	1.5	77.0
C_4H_{10} 58.120				0.373	0.059	3.43	0.228	0.228	0.287	0.059	3.43	0.225	4.86	0.706	0.046	C_4H_{10}		4.86	0.706	68.0	
C_5H_{10} 70.130				0.557	0.088	6.17	0.343	0.343	0.431	0.088	6.17	0.405	5.45	1.132	0.074	C4Free Gaso		5.45	10.356	5.8	87.1
C_5H_{12} 72.146				0.082	0.013	0.94	0.051	0.051	0.064	0.013	0.94	0.062	5.25	0.179	0.012	C4Poly Tar		5.25	0.163		
C_6H_{12} 84.156				0.126	0.020	1.68	0.078	0.078	0.098	0.020	1.68	0.110	5.54	0.303	0.020			5.54			
C_3-C_6											39.41	2.584		8.273	0.543						
TOTAL		41.872	543.94		15.812	329.47	61.634	103.506	85.160								gal/hr.		gal/MCF	BPD	
H_2+CO		40.191	15252.5 S.C.F.H.		9.486		36.974	77.165	46.460	- 30.705						Gasoline	12.756		0.836	4534	
H_2/CO		1.62			2.80		2.80	2.08	2.80	1.39						Diesel	1.768		0.116	628	
									RECOVERED OIL	0.511*	71.74	4.703	6.494	11.047	0.724	WaxyBtms	1.139		0.075	405	
									TOTAL OIL		111.15	7.287		19.320	1.267	Poly Tar	0.252		0.016	90	
									WATER SOLUBLE CHEMICALS	0.265*	14.04	0.921	8.051	1.744	0.114	Total	15.915		1.043	5657	
									TOTAL LIQUID PRODUCTS C_3+		125.19	8.208		21.064	1.381	WS Chem	1.744		0.114	620	
									NET WATER	6.938*	124.99	8.195		15.252		Total	17.659		1.158	6277	
									GROSS WATER		139.03	9.116		16.996							
									HYDROCARBON TOTAL—C_1+		151.21	9.914									

CUMULATIVE TOTALS

	H_2+CO,MCF	Catalyst #	C_3+, gal	gal/MCF	gal/#
Previous Total					
Current Period					
New Total					

EFFLUENT SHIFT RATIO

7.55
$(H_2)(CO_2)$
$(H_2O)(CO)$

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION—%			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
62.24	83.75	71.86	76.40	51.28	34.26	39.79	82.79

Form ML-11

*Included in Reactor Effluent Total

g/M3 = 16.91 × #/MCF.
cc/M3 = 141.3 × gal/MCF.

HOURS 341-497
298

DATA SUMMARY

OPERATING CONDITIONS					PRODUCT TESTS			CATALYST DATA						
PRESSURES PSIG		RATES S.C.F.H.				OIL	WATER	INVENTORY DATA		PARTICLE SIZE				
Oxygen		Fresh Feed		15869	°API	49.8	10.5	In Reactor at Start of Period		Screen Analysis			Sedimentation	
Natural Gas		Recycle		23359	Neut. No.	43.0	41.9	Fresh Catalyst Added	361	Mesh	Microns	%	Microns	%
Generator Outlet		Combined Feed		39228	Sap. No.	48.5	45.3	Total		On 40	419+	11.2	80+	
Reactor Inlet	399	Wet Gas—Measured			Hydrox. No.			Catalyst Recovered		100	150	69.1	40—80	
Condenser Inlet		Adjusted		5993	Bromine No.	84		In Reactor at End of Period		150	105	11.0	20—40	
Product Accumulator	374	Loss			Pour °F.					200	74	5.3	10—20	
					Chemicals, % by K_2CO_3		10.14	REACTOR d-p, Inches H_2O		250	62	1.5	0—20	
								No. Height		325	44	1.1		
TEMPERATURES—°F.		Recycle/Fresh Feed		1.472						<325		0.8		
Oxygen		Inlet Velocity—ft./sec.		1.366						CATALYST				
Natural Gas		Fresh Feed Rate—S.C.F.H. H_2 + CO		15252	HEMPEL, DIST. %		°API			Bulk Density, Lbs./Cu.Ft.				
Generator		per Cu.Ft. Dense Bed		1215	205 °F.					Aerated			139	
Quench Accumulator		per Lb. Catalyst		10.48	400	72.5	55.7			Settled			141	
Reactor Inlet	341	per sq. ft.		23109	400-550	17.5	36.3			Compacted			156	
Condenser Inlet					550+	10.0				Particle Density, gm./cc.			4.1	
Product Accumulator	69							CALCULATED FROM dp		NH_3 Value, ml./gm.			15.8	
Catalyst No. Height					A. S. T. M. DIST. ON			Density, Lbs./Cu.Ft.	115	N_2 Surface, m^2/gm.				
1 12"	676				Naphtha °F.			Inventory, Lbs.	1456					
2 43.2"	641				IBP	102		Bed Depth, Ft.	19.02	CHEMICAL ANALYSIS				
3 74.4"	656				10%	136		Vol., cu. ft.	12.55	Fe				
4					50%	234				C				
5 136.8"	651				90%	352				O				
6 168.0"	653				EP	400				H				
7 199.2"	645				Recovered	97.5				K_2O, W+, % basis Fe				
8 230.4"	639	Avg. Bed Temp., °F.		653						X-Ray Analysis—				
9 261.6"	634	dT, °F.		131						Fe_2OC_2				
10 292.8"	635	K, BTU/hr/sq.ft/°F.		89.3						Fe_3O_4				
										Fe				

TABLE VIII

ANALYSES OF CATALYST SAMPLES FROM MONTEBELLO RUN NO. 49

Montebello Catalyst No.	Chemical Analyses, Per Cent by Weight				K_2O/Fe	Specific Surface, $m^2/g.$	X-Ray Analyses		
	K_2O	Fe	C	H			Fe_2OC_9	Fe_3O_4	Fe
49 Red	0.57	90.4	-	-	0.585	-			100
49-A	0.57	88.9	0.22	0.07	0.641	1.1			100
49-B	0.38	68.8	2.41	0.13	0.552	<1	40	55	5
49-D	0.33	66.1	-	-	0.499	-	30	65	5
49-G	0.35	67.8	-	-	0.516	-	40[a]	55	5
49-I	0.33	66.6	8.17	0.51	0.495	<1	40[a]	55	5
49-I (Carryover)	0.52	66.4	11.00	0.57	0.783	<1	35[a]	55	10

[a]The carbide present in these catalysts has an orthorhombic structure but it is unlike that observed in catalysts prepared at Beacon, HRI, and Stanolind.

HYDROXYL NUMBERS OF RECOVERED PRODUCT OIL

RUN 49

Period	Hydroxyl No.
49-B	37
49-C	34
49-D	37
49-E	38
49-F	38
49-G	31
49-H	38
49-I	41
49-L	38
49-M	35
49-O	30
49-P	36
49-R	38
49-S	40
49-T	35
49-U	36
49-W	35
49-X	34