THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-0 (A-E)
HOURS 0-96
CATALYST Bethlehem MS

FRESH FEED				WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED								
					At Wt. Balance							CONDENSATE								
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*				
CO 28.010	37.075	15.340	429.67	6.756	0.870	24.37	2.720	18.060	3.590	-14.470	-405.30						CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY,%	gal/hr
H_2 2.016	59.906	24.787	49.97	36.381	4.684	9.44	14.645	39.432	19.329	-20.103	-40.53				83.17	400 EP	78.80	8.118	98.0	7.956
CO_2 44.010	2.345	0.970	42.69	32.187	4.144	182.38	12.957	13.927	17.101	3.174	139.69	9.173			9.46	400-550	11.92	1.228	91.4	1.122
N_2 28.016	0.268	0.111	3.11	1.682	0.217	6.08	0.677	0.788	0.894						7.37	550 +	9.28	0.956	114.6	1.096
CH_4 16.042	0.406	0.168	2.70	10.525	1.355	21.74	4.237	4.405	5.592	1.187	19.04	1.250								
C_2H_4 28.052				2.524	0.325	9.12	1.016	1.016	1.341	0.325	9.12	0.599					RECOVERY %	#/hr	gal/hr	
C_3H_6 30.068				1.890	0.243	7.31	0.761	0.761	1.004	0.243	7.31	0.480				PROPYLENE	45.8	8.02		
C_1+C_2											35.47	2.329				C_3 POLY GASO.	87.5	7.02	1.174	
C_3H_8 42.078				3.231	0.416	17.50	1.301	1.301	1.717	0.416	17.50	1.149	4.32	4.051	0.266	C_3 POLY TAR	12.5	1.00	0.133	
C_3H_8 44.094				0.295	0.038	1.68	0.119	0.119	0.157	0.038	1.68	0.110	4.24	0.396	0.026					
C_4H_8 56.104				2.836	0.288	16.16	0.900	0.900	1.188	0.288	16.16	1.062	5.00	3.232	0.212		#/gal	#/hr	gal/hr	RVP
C_4H_{10} 58.120				0.746	0.096	5.58	0.300	0.300	0.396	0.096	5.58	0.366	4.88	1.148	0.075	C_4H_8	5.00	0.24	0.048	68.0
C_5H_{10} 70.130				0.994	0.128	8.98	0.400	0.400	0.528	0.128	8.98	0.590	5.45	1.648	0.108	C_4 POLY GASO.	5.98	13.93	2.329	1.5
C_5H_{12} 72.146				0.264	0.034	2.45	0.106	0.106	0.140	0.034	2.45	0.161	5.28	0.467	0.031	C_4H_{10}	4.86	5.58	1.148	68.0
C_6H_{12} 84.158				0.289	0.037	3.11	0.116	0.116	0.153	0.037	3.11	0.204	5.64	0.561	0.037	C_4 FREE GASO.			11.806	5.8
C_5-C_6											55.46	3.642		11.503	0.755	C_4 POLY TAR	7.58	1.99	0.264	
TOTAL		41.376	528.14		12.875	315.90	40.254	81.630	61.041											
H_2+CO	96.981	40.127	15,228 SCFH		5.554		17.365	57.492	22.919	-34.573							gal/hr	gal/MCF	Bbl/Day	
H_2/CO		1.62	Factor 656685		5.38		5.38	2.18	5.38	1.39						10 # RVP 400 EP GASOLINE	15.331	1.0068	5458	
Weight Recovery, % 90.45			Catalyst Age, hrs. 48			Space Velocity, vhv 1118			RECOVERED OIL	0.472	66.17	4.345		10.302	0.677	GAS OIL	1.122	0.0737	400	
Pressure, psig 414			Inlet Velocity, Ft/sec 0.96			Catalyst 13.62			TOTAL OIL		121.63	7.987		21.805	1.432	FUEL OIL	1.096	0.0720	390	
Temperature, °F 655			Bed Depth, Ft 20.64			Weight, # 2111			WATER SOLUBLE CHEMICALS Acids	0.344	12.66 5.57	0.831 0.366	7.815	1.620 0.713	0.153	POLY TAR	0.396	0.0261	142	
Recycle Ratio 0.97			Bed Density, #/CF 155			Effluent $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ shift Ratio = 13.0			TOTAL LIQUID PRODUCTS C_4+		139.86	9.184		24.138	1.585	TOTAL	17.946	1.1786	6390	
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY		NET WATER	7.096	127.84	8.394		15.347	1.008	W. S. CHEM.	1.620 0.713	1.064 0.468	577 254	
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_2+/C_1+		GROSS WATER		146.07	9.592		17.680	1.161	TOTAL	20.279	1.3318	7221	
68.88	94.33	81.10	86.16	80.12	50.98	60.14	79.77		HYDROCARBON TOTAL—C_1+		175.33	11.514								

Form ML—11

g/NCM = 16.91 × #/MCF *0488 MCPH H_2+CO, Bbl/Day = 5421.6 × gal/MCF

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-1 (F-J)
HOURS 96-216
CATALYST Bethlehem MS

FRESH FEED				WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED								
					At Wt. Balance							CONDENSATE								
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*				
CO 28.010	37.358	15.774	441.83	7.691	1.063	29.77	3.114	18.888	4.177	-14.711	-412.06						CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY,%	gal/hr
H_2 2.016	60.271	25.449	51.31	37.427	5.176	10.43	15.153	40.602	20.329	-20.273	-40.88				86.99	400 EP	82.88	7.344	98.0	7.197
CO_2 44.010	2.061	0.870	38.29	31.151	4.307	189.55	12.613	13.483	16.920	3.437	151.26	9.669			8.17	400-550	10.76	0.953	91.4	0.871
N_2 28.016	0.196	0.083	2.33	1.709	0.236	6.61	0.692	0.774	0.928						4.84	550 +	6.36	0.564	114.6	0.646
CH_4 16.042	0.114	0.048	0.77	9.630	1.332	21.37	3.899	3.947	5.231	1.284	20.60	1.317								
C_2H_4 28.052				2.596	0.359	10.07	1.051	1.051	1.410	0.359	10.07	0.644					RECOVERY %	#/hr	gal/hr	
C_3H_6 30.068				1.860	0.257	7.73	0.753	0.753	1.010	0.257	7.73	0.494				PROPYLENE	43.4	8.25		
C_1+C_2											38.40	2.455				C_3 POLY GASO.	87.5	7.22	1.207	
C_3H_8 42.078				3.269	0.452	19.02	1.324	1.324	1.776	0.452	19.02	1.216	4.32	4.403	0.281	C_3 POLY TAR	12.5	1.03	0.137	
C_3H_8 44.094				0.292	0.040	1.76	0.118	0.118	0.158	0.040	1.76	0.113	4.24	0.415	0.027					
C_4H_8 56.104				2.201	0.304	17.06	0.891	0.891	1.195	0.304	17.06	1.091	5.00	3.412	0.218		#/gal	#/hr	gal/hr	RVP
C_4H_{10} 58.120				0.671	0.093	5.41	0.272	0.272	0.365	0.093	5.41	0.346	4.88	1.113	0.071	C_4H_8	5.00	0.29	0.058	68.0
C_5H_{10} 70.130				0.985	0.136	9.54	0.399	0.399	0.535	0.136	9.54	0.610	5.45	1.750	0.112	C_4 POLY GASO.	5.98	14.67	2.454	1.5
C_5H_{12} 72.146				0.217	0.030	2.16	0.088	0.088	0.118	0.030	2.16	0.138	5.28	0.411	0.026	C_4H_{10}	4.86	5.41	1.113	68.0
C_6H_{12} 84.158				0.301	0.042	3.53	0.122	0.122	0.164	0.042	3.53	0.226	5.84	0.637	0.041	C_4 FREE GASO.			11.202	5.8
C_5-C_6											58.48	3.740		12.141	0.776	C_4 POLY TAR	7.58	2.10	0.279	
TOTAL		42.224	534.53		13.827	334.01	40.489	82.713	61.926											
H_2+CO	97.629	41.223	15644 SCFH		6.239		18.267	59.490	24.506	34.984							gal/hr	gal/MCF	Bbl/Day	
H_2/CO		1.61	Factor 639222		4.87		4.87	2.15	4.87	1.38						10 # RVP 400 EP GASOLINE	14.827	0.9478	5139	
Weight Recovery, % 92.28			Catalyst Age, hrs. 156			Space Velocity, vhv 1152			RECOVERED OIL	0.405	56.82	3.632		8.861	0.566	GAS OIL	0.871	0.0557	302	
Pressure, psig 413			Inlet Velocity, Ft/sec 0.98			Catalyst 13.58			TOTAL OIL		115.30	7.372		21.002	1.342	FUEL OIL	0.646	0.0413	224	
Temperature, °F 657			Bed Depth, Ft 20.57			Weight, # 2091			WATER SOLUBLE CHEMICALS	0.400	21.21	1.356	7.919	2.678	0.171	POLY TAR	0.416	0.0266	144	
Recycle Ratio 0.96			Bed Density, #/CF 154			Effluent $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ shift Ratio = 12.1			TOTAL LIQUID PRODUCTS C_4+		136.51	8.728		23.680	1.513	TOTAL	16.760	1.0714	5809	
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY		NET WATER	6.805	122.60	7.837		14.718	0.941	W. S. CHEM.	2.678	0.1712	928	
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_2+/C_1+		GROSS WATER		143.81	9.193		17.396	1.112	TOTAL	19.438	1.2426	6737	
67.25	93.26	79.66	84.87	77.89	49.93	58.81	78.05		HYDROCARBON TOTAL—C_1+		174.91	11.181								

Form ML—11

g/NCM = 16.91 × #/MCF *0488 MCPH H_2+CO. Bbl/Day = 5421.6 × gal/MCF

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-2 (K-O)
HOURS 216-336
CATALYST Bethlehem MS

FRESH FEED				WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED								
					At Wt. Balance							CONDENSATE								
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF	YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*				
CO 28.010	36.981	15.751	441.19	9.255	1.475	41.31	3.900	19.651	5.375	-14.276	-399.88						CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY,%	gal/hr
H_2 2.016	60.683	25.847	52.11	41.937	6.684	13.47	17.672	43.519	24.356	-19.163	-38.64				89.03	400 EP	84.56	6.232	98.0	6.107
CO_2 44.010	1.850	0.788	34.68	27.338	4.357	191.75	11.521	12.309	15.878	3.569	157.07	9.950			7.39	400-550	10.40	0.766	91.4	0.700
N_2 28.016	0.217	0.092	2.58	1.394	0.222	6.22	0.587	0.679	0.809						3.58	550 +	5.04	0.371	114.6	0.425
CH_4 16.042	0.269	0.115	1.84	8.871	1.414	22.68	3.738	3.853	5.152	1.299	20.84	1.320								
C_2H_4 28.052				2.407	0.384	10.77	1.014	1.014	1.398	0.384	10.77	0.682					RECOVERY %	#/hr	gal/hr	
C_3H_6 30.068				1.723	0.275	8.27	0.726	0.726	1.001	0.275	8.27	0.524				PROPYLENE	37.6	7.12		
C_1+C_2											39.88	2.526				C_3 POLY GASO.	87.5	6.23	1.042	
C_3H_8 42.078				2.823	0.450	18.94	1.190	1.190	1.640	0.450	18.94	1.200	4.32	4.384	0.278	C_3 POLY TAR	12.5	0.89	0.118	
C_3H_8 44.094				0.298	0.047	2.07	0.126	0.126	0.173	0.047	2.07	0.131	4.84	0.488	0.031					
C_4H_8 56.104				1.929	0.307	17.22	0.813	0.813	1.120	0.307	17.22	1.091	5.00	3.444	0.218		#/gal	#/hr	gal/hr	RVP
C_4H_{10} 58.120				0.631	0.101	5.87	0.266	0.266	0.367	0.101	5.87	0.373	4.88	1.208	0.077	C_4H_8	5.00	--	--	68.0
C_5H_{10} 70.130				0.894	0.142	9.96	0.377	0.377	0.519	0.142	9.96	0.631	5.45	1.828	0.116	C_4 POLY GASO.	5.98	15.07	2.520	1.5
C_5H_{12} 72.146				0.213	0.034	2.45	0.090	0.090	0.124	0.034	2.45	0.155	5.28	0.467	0.030	C_4H_{10}	4.86	(5.87) 5.36	(1.208) 1.103	68.0
C_6H_{12} 84.158				0.287	0.046	3.87	0.121	0.121	0.167	0.046	3.87	0.245	5.84	0.699	0.044	C_4 FREE GASO.			10.143	5.8
C_5-C_6											60.38	3.825		12.518	0.794	C_4 POLY TAR	7.58	2.15	0.286	
TOTAL		42.593	532.40		15.938	354.85	42.141	84.734	64.902											
H_2+CO	97.664	41.598	15786 SCFH		8.159		21.572	63.170	29.731	-33.439							gal/hr	gal/MCF	Bbl/Day	
H_2/CO		1.64	Factor 633472		4.53		4.53	2.21	4.53	1.34						10 # RVP 400 EP GASOLINE	13.766	0.8720	4728	
Weight Recovery, % 91.88			Catalyst Age, hrs. 276			Space Velocity, vhv 1237			RECOVERED OIL	0.338	47.42	3.004		7.369	0.467	GAS OIL	0.700	0.0443	240	
Pressure, psig 406			Inlet Velocity, Ft/sec 1.02			Catalyst 12.76			TOTAL OIL		107.80	6.829		19.887	1.261	FUEL OIL	0.485	0.0269	146	
Temperature, °F 660			Bed Depth, Ft 19.33			Weight, # 1876			WATER SOLUBLE CHEMICALS	0.388	20.58	1.304	7.899	2.605	0.165	POLY TAR	0.404	0.0256	139	
Recycle Ratio 0.99			Bed Density, #/CF 147			Effluent $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ shift Ratio = 11.8			TOTAL LIQUID PRODUCTS C_4+		128.38	8.133		22.492	1.426	TOTAL	15.295	0.9688	5253	
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY		NET WATER	6.097	109.85	6.959		13.187	0.835	W. S. CHEM.	2.605	0.1650	895	
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_2+/C_1+		GROSS WATER		130.43	8.262		15.792	1.000	TOTAL	17.900	1.1338	6148	
62.58	90.64	74.14	80.39	72.65	44.03	52.93	76.30		HYDROCARBON TOTAL—C_1+		168.26	10.659								

Form ML—11

g/NCM = 16.91 × #/MCF *0488 MCPH H_2+CO, Bbl/Day = 5421.6 × gal/MCF

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-A
HOURS 0-17
CATALYST Mill Scale Red. at Brownsville

	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
CO 28.010	37.805	15.213	426.12	6.885	0.858	24.03	2.740	17.953	3.598	-14.355	-402.09				
H_2 2.016	59.020	23.751	47.88	36.305	4.524	9.12	14.448	38.199	18.972	-19.227	-38.76				
CO_2 44.010	2.780	1.119	49.25	34.820	4.339	190.96	13.857	14.976	18.196	3.220	141.71	9.583			
N_2 28.016	0.345	0.139	3.89	1.625	0.203	5.69	0.647	0.786	0.850						
CH_4 16.042	0.050	0.020	0.32	9.100	1.134	18.19	3.621	3.641	4.755	1.114	17.87	1.208			
C_2H_4 28.052				2.355	0.293	8.22	0.937	0.937	1.230	0.293	8.22	0.556			
C_2H_6 30.068				1.540	0.192	5.77	0.613	0.613	0.805	0.192	5.77	0.390			
C_1+C_2											31.86	2.154			
C_3H_6 42.078				2.815	0.351	14.77	1.120	1.120	1.471	0.351	14.77	0.999	4.32	3.419	0.231
C_3H_8 44.094				0.255	0.032	1.41	0.101	0.101	0.133	0.032	1.41	0.095	4.24	0.333	0.023
C_4H_8 56.104				2.055	0.256	14.36	0.818	0.818	1.074	0.256	14.36	0.971	5.00	2.872	0.194
C_4H_{10} 58.120				0.700	0.087	'5.06	0.279	0.279	0.366	0.087	5.06	0.342	4.86	1.041	0.070
C_5H_{10} 70.130				0.935	0.117	8.21	0.372	0.372	0.489	0.117	8.21	0.555	5.45	1.506	0.102
C_5H_{12} 72.146				0.310	0.039	2.81	0.123	0.123	0.162	0.039	2.81	0.190	5.25	0.535	0.036
C_6H_{12} 84.156				0.300	0.037	3.11	0.119	0.119	0.156	0.037	3.11	0.210	5.54	0.561	0.038
C_3-C_6											49.73	3.362		10.267	0.694
TOTAL		40.242	527.46		12.462	311.71	39.795	80.037	60.425						
H_2+CO	96.825	38.964	14787	SCFH	5.382		17.188	56.152	22.570	-33.582					
H_2/CO		1.56	Factor 676269		5.27		5.27	2.13	5.27	1.34					

					NET CHANGE m/hr	NET CHANGE #/hr	#/MCF	#/gal	gal/hr	gal/MCF
Weight Recovery, % 88.58	Catalyst Age, hrs. 17		Space Velocity, vhv 1039	RECOVERED OIL	0.507**	71.09	4.808		10.995	0.744
Pressure, psig 415	Inlet Velocity, Ft/sec 0.94		Catalyst Vol.,CF 14.23	TOTAL OIL		120.82	8.170		21.262	1.438
Temperature, °F 653	Bed Depth, Ft 21.56		Weight, # 2191	WATER SOLUBLE CHEMICALS	0.190**	10.07	0.681		1.310	0.089
Recycle Ratio 0.99	Bed Density, #/CF 154		Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ = 12.84	TOTAL LIQUID PRODUCTS C_3+		130.89	8.851		22.572	1.527
FRESH FEED CONVERSION — %	TOTAL FEED CONVERSION — %		SELECTIVITY	NET WATER	7.471**	134.59	9.102		16.157	1.093
Contraction / CO / H_2 / H_2+CO	CO / H_2 / $CO+H_2$		C_3+/C_1+	GROSS WATER		144.66	9.783		17.467	1.182
69.03 / 94.36 / 80.95 / 86.19	79.96 / 50.33 / 59.81		80.42	HYDROCARBON TOTAL—C_1+		162.75	11.006			

YIELD BASIS H_2+CO FED — YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY,%	gal/hr
400 EP	77	8.466	98.0	8.297
400-550	14	1.539	91.4	1.407
550 +	9	0.990	114.6	1.135
	RECOVERY %	#/hr	gal/hr	
PROPYLENE	46.0	6.79		
C_3 POLY GASO.	87.5	5.94	0.993	
C_3 POLY TAR	12.5	0.85	0.113	
	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	0.58	0.116	68.0
C_4 POLY GASO.	5.98	12.06	2.016	1.5
C_4H_{10}	4.86	5.06	1.041	68.0
C_4-FREE GASO.			11.892	5.8
C_4 POLY TAR	7.53	1.72	0.228	
	gal/hr	gal/MCF	Bbl/Day	
10 # RVP 400 EP GASOLINE	15.065	1.0188	5524	
GAS OIL	1.407	0.0952	516	
FUEL OIL	1.135	0.0768	416	
POLY TAR	0.341	0.0231	125	
TOTAL	17.948	1.2139	6581	
W. S. CHEM.	1.310	0.0886	481	
TOTAL	19.258	1.3025	7062	

Form ML—11 **Included in Reactor Effluent Total g/NCM = 16.91×#/MCF *9488 MCFH H_2 + CO, Bbl/Day = 5421.6×gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	439	Fresh Feed	15,272
Natural Gas	435	Recycle	15,102
Generator Outlet	417	Combined Feed	30,374
Reactor Inlet	415	Wet Gas—Measured	3,815
Condenser Inlet		Adjusted	4,729
Product Accumulator	360	Loss	914
TEMPERATURES—°F.		Recycle/Fresh Feed	0.99
Oxygen	419	Inlet Velocity—ft./sec.	0.94
Natural Gas	761	Fresh Feed Rate—S.C.F.H.	14787
Generator		per Cu.Ft. Dense Bed	1039
Quench Accumulator	154	per Lb. Catalyst	6.75
Reactor Inlet	381	per Sq. Ft.	22405
Condenser Inlet	578		
Product Accumulator	89	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 221 #/hr.	
1 0'0"	626	@707 psia & 505°F	
2 0'9"	654	= 1201 Btu/#	
3 1'9"	648	Water in @60°F = 28 Btu/#	
4 4'5"	657	= 1173 Btu	
5 7'0"	662	(1173)(221) = 259,233 Btu/hr.	
6 12'3"	660	Ave. Bed Temp. = 653°F	
7 17'5"	650	dT = 653-505 = 148°F	
8 20'0"	642	Tube Area = 37.8 sq. ft.	
9 22'7"	635	$K = \frac{259,233}{(37.8)(148)} = 46.3$ Btu/°F/sq. ft.	
10 25'2"	631		
11 26'11"	516		

PRODUCT TESTS

	OIL	WATER
°API	50.7	10.8
Neut. No.	39.7	32.5
Sap. No.	46.8	36.7
Hydrox. No.		
Bromine No.	75	
Pour °F.		
Chemicals, % by K_2CO_3		7.5
HEMPEL, DIST. %		°API
205 °F.		
400	76	55.4
400-550	14	34.7
550+	10	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	96	
10%	137	
50%	226	
90%	380	
EP	396	
Rec.	96	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	58
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 0-21 3/8	-
1 21 3/8-52 3/4	75
2 52 3/4-84	76
3 84-115 3/8	83
4 115 3/8-353 1/8	375
Total	609
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	154
Inventory, Lbs.	2191
Bed Depth, Ft.	21.56
Vol., Cu. Ft.	14.23

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
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 / GENERATOR BALANCE

HOUR	2200	0600		AVERAGE	M/HR	C	H	O		Mol %	M/Hr	C	H	O
FRESH FEED									O_2 32.000	0.18	10.735 0.023			21.516
CO 28.010	37.37	38.24		37.805	15.213	15.213		15.213	CO_2 44.010	1.40	0.183	0.183		0.366
H_2 2.016	59.37	58.67		59.020	23.751		47.502		N_2 28.016	1.25	0.163			
CO_2 44.010	2.85	2.71		2.780	1.119	1.119		2.238	CH_4 16.042	82.63	10.773	10.773	43.092	
N_2 28.016	0.36	0.33		0.345	0.139				C_2H_6 30.068	6.73	0.877	1.754	5.262	
CH_4 16.042	0.05	0.05		0.050	0.020	0.020	0.080		C_3H_8 44.094	5.40	0.704	2.112	5.632	
			M. W	13.107178					C_4H_{10} 58.120	1.67	0.218	0.872	2.180	
			H_2O 18.016				9.305	4.653	C_5H_{12} 72.146	0.74	0.097	0.485	1.164	
						16.352	56.887	22.104	MW = 20.1885814					
			BALANCE			101.07	99.23	101.01	TOTAL			16.179	57.330	21.882

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	251.45	311.71
OIL	71.09	71.09
WATER	144.66	144.66
TOTAL	467.20	527.46
FRESH FEED	527.46	
WEIGHT BALANCE	88.58	
WET GAS FACTOR	1239650	
INDICATED LOSS—S C F H	914	

WET GAS	2200	0600		AVERAGE
CO 28.010	6.70	7.07		6.885
H_2 2.016	36.93	35.68		36.305
CO_2 44.010	35.15	34.49		34.820
N_2 28.016	1.58	1.67		1.625
CH_4 16.042	9.00	9.20		9.100
C_2H_4 28.052	2.23	2.48		2.355
C_2H_6 30.068	1.50	1.58		1.540
C_3H_6 42.078	2.60	3.03		2.815
C_3H_8 44.094	0.22	0.29		0.255
C_4H_8 56.104	1.91	2.20		2.055
C_4H_{10} 58.120	0.65	0.75		0.700
C_5H_{10} 70.130	0.88	0.99		0.935
C_5H_{12} 72.146	0.36	0.26		0.310
C_6H_{12} 84.156	0.29	0.3[illegible]		0.300
			M. W.	25.01198

GAS FLOW RATES

	√R	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.294	414.8 / 20.724	67 / 0.9933	2208713 / 1.4862	15,272	40.242
WET GAS 158.44	5.589	1.49 / 4.024	65 / 0.9952	1157445 / 1.0758	3,815	10.053
RECYCLE 79.31	8.483	413.3 / 20.688	122 / 0.9452	1.0758	14,153	37.294
BLEED 5.02	8.494	20.688	1.0000	1.0758	949	2.501
NATURAL GAS 28.43	7.706	435.4 / 21.216	198 / 0.8890	1433978 / 1.1975	4,948	13.038
OXYGEN 27.07	7.128	438.8 / 21.296	69 / 0.9915		4,074	10.735
STEAM 215.7	3.489	30.6 / 4.7 / 35.3 / 0.2940		221 #/hr.		

LIQUID PRODUCT RATES Basis 15 hours

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	5'6"	292.57	57	1.0015	293.01	50.7 6.466	1894.60	
	2'5½"	130.04	65	0.9975	129.71		838.70	
					+1.62		+10.50	71.09
					164.92		1066.40	10.995
WATER	7'3-3/4	387.50	74	0.99846	386.90	10.8 8.282	3204.31	
	5'7½"	299.12	74	0.99846	298.66		2473.50	
	4'2-3/4	226.01	71	0.99883	225.75		1869.66	
	1'0"	52.00	64	0.99963	51.98		430.50	144.66
					262.01		2169.97	17.467

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-B
HOURS 17-28
CATALYST Mill Scale Red. at Brownsville

	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	#/gal	gal/hr	gal/MCF
CO 28.010	36.88	15.343	429.76	6.81	0.898	25.15	2.782	18.125	3.680	-14.445	-404.61				
H_2 2.016	60.25	25.065	50.53	37.44	4.939	9.96	15.294	40.359	20.233	-20.126	-40.57				
CO_2 44.010	2.08	0.865	38.07	31.19	4.115	181.12	12.742	13.607	16.857	3.250	143.05	9.328			
N_2 28.016	0.31	0.129	3.61	1.51	0.199	5.58	0.617	0.746	0.816						
CH_4 16.042	0.48	0.200	3.21	11.18	1.475	23.66	4.567	4.767	6.042	1.275	20.45	1.334			
C_2H_4 28.052				2.46	0.324	9.09	1.005	1.005	1.329	0.324	9.09	0.593			
C_2H_6 30.068				1.70	0.224	6.74	0.695	0.695	0.919	0.224	6.74	0.440			
C_1+C_2											36.28	2.367			
C_3H_6 42.078				2.89	0.381	16.03	1.181	1.181	1.562	0.381	16.03	1.045	4.32	3.711	0.242
C_3H_8 44.094				0.26	0.034	1.50	0.106	0.106	0.140	0.034	1.50	0.098	4.24	0.354	0.023
C_4H_8 56.104				2.17	0.286	16.05	0.887	0.887	1.173	0.286	16.05	1.047	5.00	3.210	0.209
C_4H_{10} 58.120				0.76	0.100	5.81	0.310	0.310	0.410	0.100	5.81	0.379	4.86	1.195	0.078
C_5H_{10} 70.130				1.01	0.133	9.33	0.413	0.413	0.546	0.133	9.33	0.608	5.45	1.712	0.112
C_5H_{12} 72.146				0.31	0.041	2.96	0.127	0.127	0.168	0.041	2.96	0.193	5.25	0.564	0.037
C_6H_{12} 84.156				0.31	0.041	3.45	0.127	0.127	0.168	0.041	3.45	0.225	5.54	0.623	0.041
C_3-C_6											55.13	3.595		11.369	0.742
TOTAL		41.602	525.18		13.190	316.43	40.853	82.455	62.031						
H_2+CO	97.13	40.408	15335	SCFH	5.837		18.076	58.484	23.913	-34.571					
H_2/CO		1.63	Factor 652103		5.50		5.50	2.23	5.50	1.39					

Weight Recovery, %	87.62	Catalyst Age, hrs.	28	Space Velocity, vhv	1079
Pressure, psig	414	Inlet Velocity, Ft/sec	0.97	Catalyst Vol., CF	14.21
Temperature, °F	656	Bed Depth, Ft	21.53	Weight, #	2217
Recycle Ratio	0.98	Bed Density, #/CF	156	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 12.65

FRESH FEED CONVERSION — % Contraction	CO	H_2	H_2+CO	TOTAL FEED CONVERSION — % CO	H_2	CO+H_2	SELECTIVITY C_3+/C_1+
68.29	94.15	80.30	85.55	79.70	49.87	59.11	78.43

	NET CHANGE m/hr	NET CHANGE #/hr	#/MCF	#/gal	gal/hr	gal/MCF
RECOVERED OIL	0.477**	66.92	4.364		10.349	0.675
TOTAL OIL		122.05	7.959		21.718	1.417
WATER SOLUBLE CHEMICALS	0.186**	9.87	0.644		1.284	0.084
TOTAL LIQUID PRODUCTS C_3+		131.92	8.603		23.002	1.501
NET WATER	7.325**	131.96	8.605		15.841	1.033
GROSS WATER		141.83	9.249		17.125	1.117
HYDROCARBON TOTAL—C_1+		168.20	10.970			

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	77	7.969	98.0	7.810
400-550	14	1.449	91.4	1.324
550 +	9	0.931	114.6	1.067

	RECOVERY %	#/hr	gal/hr
PROPYLENE	44.9	7.20	
C_3 POLY GASO.	87.5	6.30	1.054
C_3 POLY TAR	12.5	0.90	0.120

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	14.04	2.348	1.5
C_4H_{10}	4.86	5.81	1.195	68.0
C_4-FREE GASO.			11.763	5.8
C_4 POLY TAR	7.53	2.01	0.267	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	15.306	0.9981	5411
GAS OIL	1.324	0.0863	468
FUEL OIL	1.067	0.0696	377
POLY TAR	0.387	0.0252	137
TOTAL	18.084	1.1792	6393
W. S. CHEM.	1.284	0.0837	454
TOTAL	19.368	1.2629	6847

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91×#/MCF

*9488 MCFH H_2 + CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	440	Fresh Feed	15,788
Natural Gas	437	Recycle	15,504
Generator Outlet	416	Combined Feed	31,292
Reactor Inlet	414	Wet Gas—Measured	3,977
Condenser Inlet		Adjusted	5,006
Product Accumulator	360	Loss	1,029
TEMPERATURES—°F.		Recycle/Fresh Feed	0.98
Oxygen	494	Inlet Velocity—ft./sec.	0.97
Natural Gas	775	Fresh Feed Rate—S.C.F.H. H_2 + CO	15,335
Generator	2212	per Cu.Ft. Dense Bed	1079
Quench Accumulator	145	per Lb. Catalyst	6.92
Reactor Inlet	399	per Sq. Ft.	23235
Condenser Inlet	579		
Product Accumulator	94	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 229 #/hr.	
1 See Period A	590	@706 psia & 506°F.=	
2	662	= 1201 Btu/#	
3	652	Water in @71.8°F = 40 Btu/#	
4	660	Net Heat Transferred/# steam =	
5	666	= 1161 Btu	
6	662	(1161)(229) = 265,869 Btu/hr.	
7	649	Ave. Bed Temp. = 656°F	
8	641	dT = 656-506 = 150°F	
9	634	Tube Area = 37.8 sq. ft.	
10	629	K = $\frac{265,869}{(150)(37.8)}$ =	
11	515	= 46.9 Btu/°F/sq. ft.	

PRODUCT TESTS

	OIL	WATER
°API	50.7	10.8
Neut. No.	39.7	32.5
Sap. No.	46.8	36.7
Hydrox. No.		
Bromine No.	75	
Pour °F.		
Chemicals, % by K_2CO_3		7.5
HEMPEL, DIST. %		°API
205 °F.		
400	76	55.4
400-550	14	34.7
550+	10	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	96	
10%	137	
50%	226	
90%	380	
EP	396	
Rec.	96	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	36
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	-
1	73
2	85
3	78
4	380
Total	616
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	156
Inventory, Lbs.	2217
Bed Depth, Ft.	21.53
Vol., Cu. Ft.	14.21

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
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 / GENERATOR BALANCE

HOUR	1400			AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	36.88			36.88	15.343	15.343		15.343
H_2 2.016	60.25			60.25	25.065		50.130	
CO_2 44.010	2.08			2.08	0.865	0.865		1.730
N_2 28.016	0.31			0.31	0.129			
CH_4 16.042	0.48			0.48	0.200	0.200	0.800	
			M. W	12.62399				
			H_2O 18.016				7.020	3.510
						16.408	57.950	20.583
			BALANCE			101.39	101.06	98.55

	Mol %	M/Hr	C	H	O
O_2 32.000	0.18	10.237 0.023			20.520
CO_2 44.010	1.40	0.183	0.183		0.366
N_2 28.016	1.25	0.163			
CH_4 16.042	82.63	10.775	10.775	43.100	
C_2H_6 30.068	6.73	0.878	1.756	5.268	
C_3H_8 44.094	5.40	0.704	2.112	5.632	
C_4H_{10} 58.120	1.67	0.218	0.872	2.180	
C_5H_{12} 72.146	0.74	0.097	0.485	1.164	
MW =	20.1885814				
TOTAL			16.183	57.344	20.886

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	251.41	316.43
OIL	66.92	66.92
WATER	141.83	141.83
TOTAL	460.16	525.18
FRESH FEED	525.18	
WEIGHT BALANCE	87.62	
WET GAS FACTOR	1258621	
INDICATED LOSS—S C F H	1028	

WET GAS

WET GAS				
CO 28.010	6.81			6.81
H_2 2.016	37.44			37.44
CO_2 44.010	31.19			31.19
N_2 28.016	1.51			1.51
CH_4 16.042	11.18			11.18
C_2H_4 28.052	2.46			2.46
C_2H_6 30.068	1.70			1.70
C_3H_6 42.078	2.89			2.89
C_3H_8 44.094	0.26			0.26
C_4H_8 56.104	2.17			2.17
C_4H_{10} 58.120	0.76			0.76
C_5H_{10} 70.130	1.01			1.01
C_5H_{12} 72.146	0.31			0.31
C_6H_{12} 84.156	0.31			0.31
			M. W.	23.98948

GAS FLOW RATES

	√h	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.470	414 / 20.705	80 / 0.9813	2293252 / 1.514	15,788	41.602
WET GAS 158.44	5.750	1.50 / 4.025	73.6 / 0.9874	1206779 / 1.0985	3,977	10.480
RECYCLE 79.31	8.530	413 / 20.681	128 / 0.9404	1.0985	14,453	38.084
BLEED 5.02	9.220	20.681	1.0000	1.0985	1,051	2.769
NATURAL GAS 28.43	7.700	437 / 21.253	199 / 0.8883	1433978 / 1.1975	4,949	13.041
OXYGEN 27.07	6.890	440 / 21.324	85 / 0.9768		3,885	10.237
STEAM 215.7	3.540	32.3 + 4.7 = 37.0 / 0.3004		229 #/hr.		

LIQUID PRODUCT RATES Basis 11 hours

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'1-3/4	378.77	71	0.9956	377.10	50.7	2438.33	
	5'6"	292.57	57	1.0015	293.01	6.466	1894.60	
	2'4-3/4	127.74	72	0.9941	126.99		821.12	
	1'10½"	98.28	72	0.9941	97.70		631.73	
					+0.46		+3.00	66.92
					113.84		736.12	10.349
WATER	6'11-3/4"	370.04	79	0.99775	369.21	10.8	3057.80	
	4'2-3/4"	226.01	71	0.99883	225.75	8.282	1869.66	
	1'2½"	62.73	83	0.99709	62.55		518.04	
	0'4"	17.70	86	0.99656	17.64		146.09	141.83
					188.37		1560.09	17.125

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-C
HOURS 28-48
CATALYST Mill Scale Red. at Brownsville

	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	#/gal	gal/hr	gal/MCF
CO 28.010	37.043	15.338	429.61	6.387	0.834	23.36	2.535	17.873	3.369	-14.504	-406.25				
H_2 2.016	59.197	24.512	49.42	35.937	4.695	9.47	14.264	38.776	18.959	-19.817	-39.95				
CO_2 44.010	2.373	0.983	43.26	32.304	4.221	185.77	12.823	13.806	17.044	3.238	142.51	9.423			
N_2 28.016	0.220	0.091	2.55	1.513	0.198	5.55	0.601	0.692	0.799						
CH_4 16.042	1.167	0.483	7.75	10.923	1.427	22.89	4.336	4.819	5.763	0.944	15.14	1.001			
C_2H_4 28.052				2.633	0.344	9.65	1.045	1.045	1.389	0.344	9.65	0.638			
C_2H_6 30.068				1.937	0.253	7.61	0.769	0.769	1.022	0.253	7.61	0.503			
C_1+C_2											32.40	2.142			
C_3H_6 42.078				3.273	0.428	18.01	1.299	1.299	1.727	0.428	18.01	1.191	4.32	4.169	0.276
C_3H_8 44.094				0.353	0.046	2.03	0.140	0.140	0.186	0.046	2.03	0.134	4.24	0.479	0.032
C_4H_8 56.104				2.320	0.303	17.00	0.921	0.921	1.224	0.303	17.00	1.124	5.00	3.400	0.225
C_4H_{10} 58.120				0.757	0.099	5.75	0.300	0.300	0.399	0.099	5.75	0.380	4.86	1.183	0.078
C_5H_{10} 70.130				1.093	0.143	10.03	0.434	0.434	0.577	0.143	10.03	0.663	5.45	1.840	0.122
C_5H_{12} 72.146				0.223	0.029	2.09	0.089	0.089	0.118	0.029	2.09	0.138	5.25	0.398	0.026
C_6H_{12} 84.156				0.347	0.045	3.79	0.138	0.138	0.183	0.045	3.79	0.251	5.54	0.684	0.045
C_3-C_6											58.70	3.881		12.153	0.804
TOTAL		41.407	532.59		13.065	323.00	39.694	81.101	60.792						
H_2+CO	96.240	39.350	15123	SCFH	5.529		16.799	56.649	22.328	-34.321					
H_2/CO		1.60	Factor 661244		5.63		5.63	2.17	5.63	1.37					

							NET CHANGE m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF
Weight Recovery, %	88.83	Catalyst Age, hrs.	48	Space Velocity, vhv	1085	RECOVERED OIL	0.456**	63.91	4.226		9.966	0.659
Pressure, psig	412	Inlet Velocity, Ft/sec	0.96	Catalyst Vol., CF	13.94	TOTAL OIL		122.61	8.107		22.119	1.463
Temperature, °F	655	Bed Depth, Ft	21.12	Weight, #	2133	WATER SOLUBLE CHEMICALS	0.262**	13.89	0.918		1.758	0.116
Recycle Ratio	0.96	Bed Density, #/CF	153	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 13.11	TOTAL LIQUID PRODUCTS C_3+		136.50	9.025		23.877	1.579

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY							
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+	NET WATER	7.315**	131.79	8.715		15.821	1.046
								GROSS WATER		145.68	9.633		17.579	1.162
68.45	94.56	80.85	86.13	81.15	51.11	60.59	80.82	HYDROCARBON TOTAL—C_1+		168.90	11.168			

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL %	gal/hr	TREATING RECOVERY %	gal/hr
400 EP	79	7.873	98.0	7.716
400-550	10	0.997	91.4	0.911
550 +	11	1.096	114.6	1.256
	RECOVERY %	#/hr	gal/hr	
PROPYLENE	45.1	8.12		
C_3 POLY GASO.	87.5	7.10	1.187	
C_3 POLY TAR	12.5	1.02	0.135	
	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	0.17	0.034	68.0
C_4 POLY GASO.	5.98	14.73	2.463	1.5
C_4H_{10}	4.86	5.75	1.183	68.0
C_4-FREE GASO.			11.825	5.8
C_4 POLY TAR	7.53	2.10	0.279	
	gal/hr	gal/MCF	Bbl/Day	
10 # RVP 400 EP GASOLINE	15.505	1.0253	5559	
GAS OIL	0.911	0.0602	326	
FUEL OIL	1.256	0.0831	451	
POLY TAR	0.414	0.0274	149	
TOTAL	18.086	1.1960	6485	
W. S. CHEM.	1.758	0.1162	630	
TOTAL	19.844	1.3122	7115	

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91 × #/MCF

*9488 MCFH H_2 + CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	439	Fresh Feed	15,714
Natural Gas	442	Recycle	15,064
Generator Outlet	417	Combined Feed	30,778
Reactor Inlet	412	Wet Gas—Measured	4,045
Condenser Inlet		Adjusted	4,958
Product Accumulator	361	Loss	913
TEMPERATURES—°F.		Recycle/Fresh Feed	0.96
Oxygen	478	Inlet Velocity—ft./sec.	0.96
Natural Gas	747	Fresh Feed Rate—S.C.F.H. H_2 + CO	15123
Generator	2068	per Cu. Ft. Dense Bed	1085
Quench Accumulator	151	per Lb. Catalyst	7.09
Reactor Inlet	357	per Sq. Ft.	22914
Condenser Inlet	577		
Product Accumulator	92	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 237 #/hr.	
1 See Period A	565	@705 psia & 506°F =	
2	658	1201 Btu/#	
3	651	Water in @63°F = 31 Btu/#	
4	660	Net Heat Trans./# steam =	
5	664	1170 Btu	
6	662	(1170)(237) = 277,290 Btu	
7	650	Ave. Bed Temp. = 655°F	
8	641	dT = 655-506 = 149°F	
9	634	Tube Area = 37.6 sq. ft.	
10	629	$K = \frac{277,290}{(37.6)(149)} = 49.5$ Btu/°F/sq.ft.	
11			

PRODUCT TESTS

	OIL	WATER
°API	52.2	10.7
Neut. No.	40.0	31.9
Sap. No.	47.7	35.0
Hydrox. No.		
Bromine No.	82	
Pour °F.		
Chemicals, % by K_2CO_3		10.0
HEMPEL, DIST. %		°API
205 °F.		
400	78	55.2
400-550	10	30.2
550+	12	
A. S. T. M. DIST. ON Naphtha °F.		
IBP	107	
10%	134	
50%	221	
90%	350	
EP	411	
Rec.		

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	33
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	-
1	76
2	75
3	81
4	360
Total	592
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	153
Inventory, Lbs.	2133
Bed Depth, Ft.	21.12
Vol., Cu. Ft.	13.94

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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 / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	37.02	36.15	37.96	37.043	15.338	15.338		15.338
H_2 2.016	60.08	58.38	59.13	59.197	24.512		49.024	
CO_2 44.010	2.05	2.41	2.66	2.373	0.983	0.983		1.966
N_2 28.016	0.19	0.27	0.20	0.220	0.091			
CH_4 16.042	0.66	2.79	0.05	1.167	0.483	0.483	1.932	
			M. W.	12.862358				
			H_2O 18.016				6.926	3.463
						16.804	57.882	20.767
			BALANCE			103.23	100.07	99.90
WET GAS								
CO 28.010	6.31	6.17	6.68	6.387				
H_2 2.016	36.55	35.82	35.44	35.937				
CO_2 44.010	29.71	33.33	33.87	32.304				
N_2 28.016	1.42	1.63	1.49	1.513				
CH_4 16.042	12.40	10.25	10.12	10.923				
C_2H_4 28.052	2.79	2.52	2.59	2.633				
C_2H_6 30.068	1.96	1.93	1.92	1.937				
C_3H_6 42.078	3.45	3.12	3.25	3.273				
C_3H_8 44.094	0.41	0.28	0.37	0.353				
C_4H_8 56.104	2.49	2.30	2.17	2.320				
C_4H_{10} 58.120	0.72	0.89	0.66	0.757				
C_5H_{10} 70.130	1.18	1.12	0.98	1.093				
C_5H_{12} 72.146	0.26	0.25	0.16	0.223				
C_6H_{12} 84.156	0.35	0.39	0.30	0.347				
			M. W.	24.72153				

GENERATOR BALANCE	Mol %	M/Hr	C	H	O
O_2 32.000	0.23	10.364 0.030			20.788
CO_2 44.010	1.42	0.186	0.186		0.372
N_2 28.016	0.42	0.055			
CH_4 16.042	83.32	10.914	10.914	43.656	
C_2H_6 30.068	7.13	0.934	1.868	5.604	
C_3H_8 44.094	5.29	0.693	2.079	5.544	
C_4H_{10} 58.120	1.56	0.204	0.816	2.040	
C_5H_{12} 72.146	0.63	0.083	0.415	0.996	
MW =	20.02002				
TOTAL			16.278	57.840	20.788

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	263.51	323.00
OIL	63.91	63.91
WATER	145.68	145.68
TOTAL	473.10	532.59
FRESH FEED	532.59	
WEIGHT BALANCE	88.83	
WET GAS FACTOR	1225759	
INDICATED LOSS—S C F H	913	

GAS FLOW RATES

		√H	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED	79.31	6.464	412.3 / 20.664	72 / 0.9887	2250753 / 1.5003	15,714	41.407
WET GAS	158.44	5.895	1.50 / 4.025	66 / 0.9943	1171044 / 1.0821	4,045	10.659
RECYCLE	79.31	8.482	411.6 / 20.647	127 / 0.9412	1.0821	14,146	37.275
BLEED	5.02	8.182	20.647	1.0000	1.0821	918	2.419
NATURAL GAS	28.43	7.668	442.3 / 21.378	201 / 0.8870	1446052 / 1.2025	4,971	13.099
OXYGEN	27.07	6.909	438.7 / 21.293	73 / 0.9877		3,933	10.364
STEAM	215.7	3.759	30.0 + 4.7 = 34.7 / 0.2917		237 #/hr.		

LIQUID PRODUCT RATES

Basis 19 hours

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL	6'0½"	320.94	54	1.0030	321.90	52.2	2064.34	
	2'6½"	135.80	68	0.9961	135.27	6.413	867.49	
					+2.73		+17.50	63.91
					189.36		1214.35	9.966
WATER	7'3"	384.23	74	0.99846	383.64	10.7	3179.22	
	1'11½"	102.89	73	0.99858	102.74	8.287	851.41	
	2'6"	133.50	66	0.99942	133.42		1105.65	
	1'6½"	80.37	68	0.99920	80.31		665.53	145.68
					334.01		2767.93	17.579

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-D
HOURS 48-72
CATALYST Mill Scale Red. at Brownsville

	FRESH FEED			WET GAS	At Wt. Balance		RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		CONDENSATE			
	%	m/hr	#/hr	%	m/hr	#/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF
CO 28.010	37.043	15.511	434.47	6.530	0.858	24.03	2.657	18.168	3.515	-14.653	-410.44				
H_2 2.016	60.237	25.224	50.85	36.277	4.765	9.60	14.759	39.983	19.524	-20.459	-41.25				
CO_2 44.010	2.300	0.963	42.38	30.750	4.037	177.65	12.511	13.474	16.548	3.074	135.27	8.750			
N_2 28.016	0.243	0.102	2.86	1.520	0.200	5.60	0.618	0.720	0.818						
CH_4 16.042	0.177	0.074	1.19	11.500	1.511	24.24	4.679	4.753	6.190	1.437	23.05	1.491			
C_2H_4 28.052				2.667	0.350	9.82	1.085	1.085	1.435	0.350	9.82	0.635			
C_2H_6 30.068				2.173	0.285	8.57	0.884	0.884	1.169	0.285	8.57	0.554			
C_1+C_2											41.44	2.680			
C_3H_6 42.078				3.690	0.485	20.41	1.501	1.501	1.986	0.485	20.41	1.320	4.32	4.725	0.306
C_3H_8 44.094				0.320	0.042	1.85	0.130	0.130	0.172	0.042	1.85	0.120	4.24	0.436	0.028
C_4H_8 56.104				2.373	0.312	17.50	0.965	0.965	1.277	0.312	17.50	1.132	5.00	3.500	0.226
C_4H_{10} 58.120				0.720	0.095	5.52	0.293	0.293	0.388	0.095	5.52	0.357	4.86	1.136	0.073
C_5H_{10} 70.130				0.987	0.130	9.12	0.402	0.402	0.532	0.130	9.12	0.590	5.45	1.673	0.108
C_5H_{12} 72.146				0.243	0.032	2.31	0.099	0.099	0.131	0.032	2.31	0.149	5.25	0.440	0.028
C_6H_{12} 84.156				0.250	0.033	2.78	0.102	0.102	0.135	0.033	2.78	0.180	5.54	0.502	0.032
C_3-C_6											59.49	3.848		12.412	0.801
TOTAL		41.874	531.74		13.135	319.00	40.685	82.559	62.031						
H_2+CO	97.280	40.735	15459	SCFH	5.623		17.416	58.151	23.039	-35.112					
H_2/CO		1.63	Factor	646872	5.55		5.55	2.20	5.55	1.40					

Weight Recovery, %	92.82	Catalyst Age, hrs.	72	Space Velocity, vhv	1096			RECOVERED OIL	0.460**	64.52	4.174	10.094	0.653
Pressure, psig	415	Inlet Velocity, Ft/sec	0.97	Catalyst Vol.CF	14.10			TOTAL OIL		124.01	8.022	22.506	1.454
Temperature, °F	655	Bed Depth, Ft	21.37	Weight, #	2228			WATER SOLUBLE CHEMICALS	0.245**	13.01	0.842	1.665	0.108
Recycle Ratio	0.97	Bed Density, #/CF	158	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 12.25			TOTAL LIQUID PRODUCTS C_3+		137.02	8.864	24.171	1.562
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY	NET WATER	7.506**	135.22	8.747	16.233	1.050
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+	GROSS WATER		148.23	9.589	17.898	1.158
68.63	94.47	81.11	86.20	80.65	51.17	60.38	76.78	HYDROCARBON TOTAL—C_1+		178.46	11.544		

YIELD BASIS H_2 + CO FED — YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL %	gal/hr	TREATING RECOVERY %	gal/hr
400 EP	80.0	8.075	98.0	7.914
400-550	10.4	1.050	91.4	0.960
550 +	9.6	0.969	114.6	1.110
	RECOVERY %	#/hr	gal/hr	
PROPYLENE	45.4	9.27		
C_3 POLY GASO.	87.5	8.11	1.356	
C_3 POLY TAR	12.5	1.16	0.154	
	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	0.45	0.090	68.0
C_4 POLY GASO.	5.98	14.92	2.495	1.5
C_4H_{10}	4.86	5.52	1.136	68.0
C_4-FREE GASO.			11.885	5.8
C_4 POLY TAR	7.53	2.13	0.283	
	gal/hr	gal/MCF	Bbl/Day	
10 # RVP 400 EP GASOLINE	15.606	1.0095	5473	
GAS OIL	0.960	0.0621	337	
FUEL OIL	1.110	0.0718	389	
POLY TAR	0.437	0.0283	153	
TOTAL	18.113	1.1717	6352	
W. S. CHEM.	1.665	0.1077	584	
TOTAL	19.778	1.2794	6936	

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91×#/MCF

*9488 MCFH H_2 + CO, Bbl/Day = 5421.6× gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	443	Fresh Feed	15,891
Natural Gas	445	Recycle	15,440
Generator Outlet	420	Combined Feed	31,331
Reactor Inlet	415	Wet Gas—Measured	4,388
Condenser Inlet		Adjusted	4,984
Product Accumulator	364	Loss	596
TEMPERATURES—°F.		Recycle/Fresh Feed	0.97
Oxygen	503	Inlet Velocity—ft./sec.	0.97
Natural Gas	796	Fresh Feed Rate—S.C.F.H. H_2 + CO	15459
Generator	2267	per Cu.Ft. Dense Bed	1096
Quench Accumulator	153	per Lb. Catalyst	6.94
Reactor Inlet	338	per Sq. Ft.	23423
Condenser Inlet	577		
Product Accumulator	91		
Catalyst No. Height			
1 See Period A	557		
2	659		
3	653		
4	659		
5	663		
6	660		
7	649		
8	642		
9	636		
10	631		
11	516		

PRODUCT TESTS

	OIL	WATER
°API	52.8	10.8
Neut. No.	44.0	33.0
Sap. No.	55.0	36.3
Hydrox. No.		
Bromine No.	88	
Pour °F.		
Chemicals, % by K_2CO_3		9.3
HEMPEL, DIST. %		°API
205 °F.		
400	79.0	55.8
400-550	10.4	36.0
550+	10.6	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	93	
10%	120	
50%	200	
90%	324	
EP	348	
Rec.	98	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	49
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	-
1	76
2	81
3	82
4	380
Total	619
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	158
Inventory, Lbs.	2228
Bed Depth, Ft.	21.37
Vol., Cu. Ft.	14.10

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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 — GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	36.94	37.02	37.17	37.043	15.511	15.511		15.511
H_2 2.016	60.19	60.37	60.15	60.237	25.224		50.448	
CO_2 44.010	2.27	2.29	2.34	2.300	0.963	0.963		1.926
N_2 28.016	0.25	0.21	0.27	0.243	0.102			
CH_4 16.042	0.35	0.11	0.07	0.177	0.074	0.074	0.296	
			M. W	12.698825				
			H_2O 18.016				7.525	3.763
						16.548	58.269	21.200
			BALANCE			101.92	100.98	98.69

	Mol %	M/Hr	C	H	O
O_2 32.000	0.21	10.522 0.028			21.100
CO_2 44.010	1.44	0.191	0.191		0.382
N_2 28.016	1.79	0.237			
CH_4 16.042	82.33	10.918	10.918	43.672	
C_2H_6 30.068	6.80	0.902	1.804	5.412	
C_3H_8 44.094	5.28	0.700	2.100	5.600	
C_4H_{10} 58.120	1.55	0.206	0.824	2.060	
C_5H_{12} 72.146	0.60	0.080	0.400	0.960	
MW =	20.116332				
TOTAL			16.237	57.704	21.482

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	280.83	319.00
OIL	64.52	64.52
WATER	148.23	148.23
TOTAL	493.58	531.75
FRESH FEED	531.75	
WEIGHT BALANCE	92.82	
WET GAS FACTOR	1135918	
INDICATED LOSS—S C F H	596	

WET GAS				
CO 28.010	6.48	6.29	6.82	6.530
H_2 2.016	36.04	35.26	37.53	36.277
CO_2 44.010	32.01	32.91	27.33	30.750
N_2 28.016	1.49	1.29	1.78	1.520
CH_4 16.042	11.65	11.04	11.81	11.500
C_2H_4 28.052	2.55	2.73	2.72	2.667
C_2H_6 30.068	1.99	2.15	2.38	2.173
C_3H_6 42.078	3.57	3.57	3.93	3.690
C_3H_8 44.094	0.41	0.27	0.28	0.320
C_4H_8 56.104	2.12	2.30	2.70	2.373
C_4H_{10} 58.120	0.55	0.66	0.95	0.720
C_5H_{10} 70.130	0.79	1.00	1.17	0.987
C_5H_{12} 72.146	0.18	0.26	0.29	0.243
C_6H_{12} 84.156	0.17	0.27	0.31	0.250
			M. W.	24.28715

GAS FLOW RATES

	√H	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.463	415 20.729	70 0.9905	2279738 1.5099	15,891	41.874
WET GAS 158.44	6.325	1.51 4.026	64 0.9962	1191988 1.0918	4,388	11.563
RECYCLE 79.31	8.479	415.3 20.736	118 0.9485	1.0918	14,440	38.050
BLEED 5.02	8.800	20.736	1.0000	1.0918	1,000	2.635
NATURAL GAS 28.43	7.700	445 21.441	191 0.8938	1439129 1.1996	5,033	13.262
OXYGEN 27.07	6.963	442.6 21.385	70 0.9905		3,993	10.522
STEAM 215.7	3.354	30.1 4.7 34.8 0.2920		211 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'3½"	386.41	65	0.9975	385.44	52.8	2463.73	
	6'0½"	320.94	54	1.0030	321.90	6.392	2057.58	
	4'4"	231.47	53	1.0035	232.28		1484.73	
	1'1¼"	57.39	72	0.9941	57.05		364.66	
					+3.48		+22.25	64.52
					242.25		1548.47	10.094
WATER	7'7"	401.69	76	0.99819	400.96	10.8	3320.75	
	2'6"	133.50	66	0.99942	133.42	8.282	1104.98	
	4'5½"	238.01	66	0.99942	237.87		1970.04	
	1'5½"	75.97	74	0.99846	75.85		628.19	148.23
					429.56		3557.62	17.898

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-E
HOURS 72-96
CATALYST Mill Scale Red. at Brownsville

	FRESH FEED			WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		YIELD BASIS H_2+CO FED: CONDENSATE				YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*				
	%	m/hr	#/hr	%	At Wt. Balance m/hr	At Wt. Balance #/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF					
CO 28.010	36.603	15.284	428.08	7.167	0.897	25.12	2.884	18.168	3.781	-14.387	-402.96						CORRECTED HEMPEL. %	gal/hr	TREATING RECOVERY %	gal/hr
H_2 2.016	60.827	25.397	51.20	35.947	4.501	9.08	14.467	39.864	18.968	-20.896	-42.12					400 EP	81.0	8.187	98.0	8.023
CO_2 44.010	2.193	0.916	40.30	31.870	3.991	175.65	12.825	13.741	16.816	3.075	135.35	8.767				400-550	11.2	1.132	91.4	1.035
N_2 28.016	0.220	0.092	2.58	2.243	0.281	7.87	0.903	0.995	1.184							550 +	7.8	0.789	114.6	0,904
CH_4 16.042	0.157	0.066	1.06	9.924	1.243	19.94	3.994	4.060	5.237	1.177	18.88	1.223								
C_2H_4 28.052				2.503	0.313	8.78	1.007	1.007	1.320	0.313	8.78	0.569					RECOVERY %	#/hr	gal/hr	
C_2H_6 30.068				2.103	0.263	7.91	0.846	0.846	1.109	0.263	7.91	0.512				PROPYLENE	47.6	8.75		
C_1+C_2											35.57	2.304				C_3 POLY GASO.	87.5	7.66	1.281	
C_3H_6 42.078				3.487	0.437	18.39	1.403	1.403	1.840	0.437	18.39	1.191	4.32	4.257	0.276	C_3 POLY TAR	12.5	1.09	0.145	
C_3H_8 44.094				0.287	0.036	1.59	0.115	0.115	0.151	0.036	1.59	0.103	4.24	0.375	0.024					
C_4H_8 56.104				2.260	0.283	15.88	0.909	0.909	1.192	0.283	15.88	1.029	5.00	3.176	0.206		#/gal	#/hr	gal/hr	RVP
C_4H_{10} 58.120				0.793	0.099	5.75	0.319	0.319	0.418	0.099	5.75	0.372	4.86	1.183	0.077	C_4H_8	5.00	0.02	0.004	68.0
C_5H_{10} 70.130				0.943	0.118	8.28	0.379	0.379	0.497	0.118	8.28	0.536	5.45	1.519	0.098	C_4 POLY GASO.	5.98	13.88	2.321	1.5
C_5H_{12} 72.146				0.233	0.029	2.09	0.094	0.094	0.123	0.029	2.09	0.135	5.25	0.398	0.026	C_4H_{10}	4.86	5.75	1.183	68.0
C_6H_{12} 84.156				0.240	0.030	2.52	0.097	0.097	0.127	0.030	2.52	0.163	5.54	0.455	0.029	C_4-FREE GASO.			11.676	5.8
C_3-C_4											54.50	3.529		11.363	0.736	C_4 POLY TAR	7.53	1.98	0.263	
TOTAL		41.755	523.22		12.521	308.85	40.242	81.997	60.942											
H_2+CO	97.430	40.681	15439	SCFH	5.398		17.351	58.032	22.749	-35.283							gal/hr	gal/MCF	Bbl/Day	
H_2/CO		1.66	Factor 647710		5.02		5.02	2.19	5.02	1.45						10 # RVP 400 EP GASOLINE	15.184	0.9835	5332	

									m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF		gal/hr	gal/MCF	Bbl/Day	
Weight Recovery, %	94.39	Catalyst Age, hrs.	96	Space Velocity, vhv	1084			RECOVERED OIL	0.459**	64.40	4.171		10.108	0.655	GAS OIL	1.035	0.0670	363	
Pressure, psig	414	Inlet Velocity, Ft/sec	0.96	Catalyst Vol., CF	14.24			TOTAL OIL		118.90	7.700		21.471	1.391	FUEL OIL	0.904	0.0586	318	
Temperature, °F	656	Bed Depth, Ft	21.57	Weight, #	2221			WATER SOLUBLE CHEMICALS	0.310**	16.47	1.067		2.082	0.135	POLY TAR	0.408	0.0264	143	
Recycle Ratio	0.96	Bed Density, #/CF	156	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ =	11.38			TOTAL LIQUID PRODUCTS C_3+		135.37	8.767		23.553	1.526	TOTAL	17.531	1.1355	6156	
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY	NET WATER	7.410**	133.50	8.647		16.026	1.038	W. S. CHEM.	2.082	0.1349	731	
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3+/C_1+	GROSS WATER		149.97	9.714		18.108	1.173	TOTAL	19.613	1.2704	6887	
70.01	94.13	82.28	86.73	79.19	52.42	60.80	79.19	HYDROCARBON TOTAL—C_1+		170.94	11.071								

Form ML—11 **Included in Reactor Effluent Total g/NCM = 16.91×#/MCF *9488 MCFH H_2 + CO, Bbl/Day = 5421.6×gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	441	Fresh Feed	15,846
Natural Gas	445	Recycle	15,272
Generator Outlet	417	Combined Feed	31,118
Reactor Inlet	414	Wet Gas—Measured	4,300
Condenser Inlet		Adjusted	4,752
Product Accumulator	362	Loss	452
TEMPERATURES—°F.		Recycle/Fresh Feed	0.96
Oxygen	502	Inlet Velocity—ft./sec.	0.96
Natural Gas	792	Fresh Feed Rate—S.C.F.H. H_2+CO	15439
Generator	2259	per Cu. Ft. Dense Bed	1084
Quench Accumulator	137	per Lb. Catalyst	6.95
Reactor Inlet	331	per Sq. Ft.	23392
Condenser Inlet	578		
Product Accumulator	88		
Catalyst No. Height			
1	567		
2	659		
3	654		
4	659		
5	663		
6	661		
7	650		
8	643		
9	637		
10	632		
11	517		

PRODUCT TESTS

	OIL	WATER
°API	53.4	10.8
Neut. No.	43.0	33.2
Sap. No.	56.7	36.2
Hydrox. No.		
Bromine No.	96	
Pour °F.		
Chemicals, % by K_2CO_3		11.5
HEMPEL, DIST. %		°API
205 °F.		
400	80.0	55.8
400-550	11.2	35.4
550+	8.8	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	83	
10%	124	
50%	201	
90%	326	
EP	384	
Rec.	97.5	

CATALYST DATA

INVENTORY DATA		
In Reactor at Start of Period		
Fresh Catalyst Added		
Total		
Catalyst Recovered		42
In Reactor at End of Period		
REACTOR d-p, Inches H_2O		
No.	Height	
0	See Period A	-
1		75
2		79
3		83
4		380
Total		617
CALCULATED FROM dp		
Density, Lbs./Cu.Ft.		156
Inventory, Lbs.		2221
Bed Depth, Ft.		21.57
Vol., Cu. Ft.		14.24

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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 / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O		Mol %	M/Hr	C	H	O
FRESH FEED									O_2 32.000	0.29	10.495 0.038			21.066
CO 28.010	35.93	36.97	36.91	36.603	15.284	15.284		15.284	CO_2 44.010	1.24	0.164	0.164		0.328
H_2 2.016	61.19	60.69	60.60	60.827	25.397		50.794		N_2 28.016	1.98	0.262			
CO_2 44.010	2.38	2.02	2.18	2.193	0.916	0.916		1.832	CH_4 16.042	81.91	10.825	10.825	43.300	
N_2 28.016	0.29	0.16	0.21	0.220	0.092				C_2H_6 30.068	7.24	0.957	1.914	5.742	
CH_4 16.042	0.21	0.16	0.10	0.157	0.066	0.066	0.264		C_3H_8 44.094	5.51	0.728	2.184	5.824	
			M. W	12.53073					C_4H_{10} 58.120	1.35	0.178	0.712	1.780	
			H_2O 18.016				7.450	3.725	C_5H_{12} 72.146	0.48	0.063	0.315	0.756	
						16.266	58.508	20.841	MW = 20.070666					
			BALANCE			100.94	101.93	97.42	TOTAL			16.114	57.402	21.394

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	279.50	308.85
OIL	64.40	64.40
WATER	149.97	149.97
TOTAL	493.87	523.22
FRESH FEED	523.22	
WEIGHT BALANCE	94.39	
WET GAS FACTOR	1105008	
INDICATED LOSS—S C F H	452	

WET GAS	1400	2200	0600	AVERAGE
CO 28.010	6.66	7.16	7.68	7.167
H_2 2.016	36.64	35.68	35.52	35.947
CO_2 44.010	31.96	31.53	32.12	31.870
N_2 28.016	1.72	1.72	3.29	2.243
CH_4 16.042	10.76	10.25	8.76	9.924
C_2H_4 28.052	2.61	2.49	2.41	2.503
C_2H_6 30.068	2.09	2.13	2.09	2.103
C_3H_6 42.078	3.42	3.64	3.40	3.487
C_3H_8 44.094	0.30	0.28	0.28	0.287
C_4H_8 56.104	1.98	2.62	2.18	2.260
C_4H_{10} 58.120	0.61	0.85	0.92	0.793
C_5H_{10} 70.130	0.84	1.11	0.88	0.943
C_5H_{12} 72.146	0.16	0.26	0.28	0.233
C_6H_{12} 84.156	0.25	0.28	0.19	0.240
			M. W.	24.66709

GAS FLOW RATES

	√H	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED		414.0	63	2310319		
79.31	6.367	20.705	0.9971	1.5200	15,846	41.755
WET GAS		1.50	60	1173628		
158.44	6.225	4.025	1.0000	1.0833	4,300	11.331
RECYCLE		412.8	119			
79.31	8.483	20.676	0.9477	1.0833	14,281	37.631
BLEED						
5.02	8.813	20.676	1.0000	1.0833	991	2.611
NATURAL GAS		445.3	196	1442403		
28.43	7.692	21.447	0.8903	1.2010	5.015	13.215
OXYGEN		440.6	64			
27.07	6.921	21.338	0.9962		3,983	10.495
STEAM		29.9 4.7 34.6				
215.7	2.950	0.2913		185 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'3½"	386.41	58	1.0010	386.80	53.4	2464.30	
	4'4"	231.47	53	1.0035	232.28	6.371	1479.86	
	2'7"	138.11	49	1.0054	138.86		884.68	
	1'0"	52.00	52	1.0039	52.20		332.57	
					+1.41		+9.00	64.40
					242.59		1545.55	10.108
WATER	7'3"	384.23	74	0.99846	383.64	10.8	3177.31	
	4'5½"	238.01	66	0.99942	237.87	8.282	1970.04	
	6'2 5/8"	330.22	66	0.99942	330.03		2733.31	
	0'9½"	41.26	70	0.99896	41.22		341.38	149.97
					434.58		3599.20	18.108

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-F
HOURS 96-120
CATALYST Mill Scale Red. at Brownsville

	FRESH FEED			WET GAS			RECYCLE	COMBINED FEED	EFFLUENT	NET CHANGE		CONDENSATE (YIELD BASIS H_2+CO FED)			
	%	m/hr	#/hr	%	At Wt. Balance m/hr	At Wt. Balance #/hr	m/hr	m/hr	m/hr	m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF
CO 28.010	37.247	15.639	438.04	7.447	0.983	27.53	3.012	18.651	3.995	-14.656	-410.51				
H_2 2.016	60.526	25.413	51.23	36.844	4.861	9.80	14.899	40.312	19.760	-20.552	-41.43				
CO_2 44.010	1.917	0.805	35.43	31.634	4.174	183.67	12.793	13.598	16.967	3.369	148.24	9.515			
N_2 28.016	0.217	0.091	2.55	1.940	0.256	7.17	0.785	0.876	1.041						
CH_4 16.042	0.093	0.039	0.63	9.763	1.288	20.66	3.948	3.987	5.236	1.249	20.03	1.286			
C_2H_4 28.052				2.663	0.351	9.85	1.077	1.077	1.428	0.351	9.85	0.632			
C_2H_6 30.068				1.777	0.234	7.04	0.719	0.719	0.953	0.234	7.04	0.452			
C_1+C_2											36.92	2.370			
C_3H_6 42.078				3.420	0.451	18.98	1.383	1.383	1.834	0.451	18.98	1.218	4.32	4.394	0.282
C_3H_8 44.094				0.317	0.042	1.85	0.128	0.128	0.170	0.042	1.85	0.119	4.24	0.436	0.028
C_4H_8 56.104				2.143	0.283	15.88	0.867	0.867	1.150	0.283	15.88	1.019	5.00	3.176	0.204
C_4H_{10} 58.120				0.703	0.093	5.41	0.284	0.284	0.377	0.093	5.41	0.347	4.86	1.113	0.071
C_5H_{10} 70.130				0.893	0.118	8.28	0.361	0.361	0.479	0.118	8.28	0.531	5.45	1.519	0.098
C_5H_{12} 72.146				0.213	0.028	2.02	0.086	0.086	0.114	0.028	2.02	0.130	5.25	0.385	0.025
C_6H_{12} 84.156				0.243	0.032	2.69	0.098	0.098	0.130	0.032	2.69	0.173	5.54	0.486	0.031
C_3-C_6											55.11	3.537		11.509	0.739
TOTAL		41.987	527.88		13.194	320.83	40.440	82.427	61.606						
H_2+CO	97.773	41.052	15579	SCFH	5.844		17.911	58.963	23.755	-35.208					
H_2/CO		1.62	Factor 641889		4.95		4.95	2.16	4.95	1.40					

							m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF
Weight Recovery, %	92.80	Catalyst Age, hrs.	120	Space Velocity, vhv	1095	RECOVERED OIL	0.436**	61.17	3.926		9.596	0.616
Pressure, psig	413	Inlet Velocity, Ft/sec	0.97	Catalyst Vol.,CF	14.23	TOTAL OIL		116.28	7.463		21.105	1.355
Temperature, °F	656	Bed Depth, Ft	21.56	Weight, #	2191	WATER SOLUBLE CHEMICALS	0.288**	15.30	0.982		1.938	0.124
Recycle Ratio	0.96	Bed Density, #/CF	154	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 11.58	TOTAL LIQUID PRODUCTS C_3+		131.58	8.445		23.043	1.479
						NET WATER	7,248**	130.58	8.382		15.676	1.006
						GROSS WATER		145.88	9.364		17.614	1.130
						HYDROCARBON TOTAL—C_1+		168.50	10.816			

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3+/C_1+
68.58	93.71	80.87	85.76	78.58	50.98	59.71	78.09

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	82.2	7.887	98.0	7.729
400-550	9.6	0.921	91.4	0.842
550 +	8.2	0.788	114.6	0.903

	RECOVERY %	#/hr	gal/hr
PROPYLENE	45.3	8.60	
C_3 POLY GASO.	87.5	7.52	1.258
C_3 POLY TAR	12.5	1.08	0.143

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	0.23	0.046	68.0
C_4 POLY GASO.	5.98	13.69	2.290	1.5
C_4H_{10}	4.86	5.41	1.113	68.0
C_4-FREE GASO.			11.377	5.8
C_4 POLY TAR	7.53	1.96	0.260	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	14.826	0.9517	5160
GAS OIL	0.842	0.0540	293
FUEL OIL	0.903	0.0580	314
POLY TAR	0.403	0.0259	140
TOTAL	16.974	1.0896	5907
W. S. CHEM.	1.938	0.1244	674
TOTAL	18.912	1.2140	6581

Form ML—11 **Included in Reactor Effluent Total g/NCM = 16.91 × #/MCF *9488 MCFH H_2 + CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	441	Fresh Feed	15,934
Natural Gas	446	Recycle	15,347
Generator Outlet	416	Combined Feed	31,281
Reactor Inlet	413	Wet Gas—Measured	4,414
Condenser Inlet		Adjusted	5,007
Product Accumulator	362	Loss	593
TEMPERATURES—°F.		Recycle/Fresh Feed	0.96
Oxygen	478	Inlet Velocity—ft./sec.	0.97
Natural Gas	781	Fresh Feed Rate—S.C.F.H. H_2 + CO	15579
Generator	2282	per Cu.Ft. Dense Bed	1095
Quench Accumulator	153	per Lb. Catalyst	7.11
Reactor Inlet	318	per Sq. Ft.	23605
Condenser Inlet	582		
Product Accumulator	91	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 164 #/hr.	
1 See Period A	564	@705 psia & 506°F =	
2	657	= 1201 Btu/#	
3	650	Water in @54°F = 22 Btu/#	
4	657	Net Heat Trans./# steam =	
5	663	(1179)(164) = 193,356 Btu/hr.	
6	662	Ave. Bed Temp. = 656°F	
7	653	dT = 656-506 = 150°F	
8	647	Tube Area = 37.8 sq. ft.	
9	640	$K = \frac{193,356}{(37.8)(150)} = 34.1$ Btu/°F/sq.ft.	
10	636		
11	519		

PRODUCT TESTS

	OIL	WATER
°API	53.3	10.8
Neut. No.	41.8	34.5
Sap. No.	55.5	37.0
Hydrox. No.		
Bromine No.	95	
Pour °F.		
Chemicals, % by K_2CO_3		11.0
HEMPEL, DIST. %		°API
205 °F.		
400	81.2	56.1
400-550	9.6	35.2
550+	9.2	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	94	
10%	128	
50%	212	
90%	330	
EP	384	
Rec.	96.5	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	28
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	
1	74
2	80
3	80
4	375
Total	609
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	154
Inventory, Lbs.	2191
Bed Depth, Ft.	21.56
Vol., Cu. Ft.	14.23

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
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 / GENERATOR BALANCE

HOUR	1300	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	37.25	37.29	37.20	37.247	15.639	15.639		15.639
H_2 2.016	60.57	60.52	60.49	60.526	25.413		50.826	
CO_2 44.010	1.84	1.89	2.02	1.917	0.805			1.610
N_2 28.016	0.24	0.20	0.21	0.217	0.091			
CH_4 16.042	0.10	0.10	0.08	0.093	0.039	0.039	0.156	
			M. W	12.572474			6.888	4.279
			H_2O 18.016				7.723	3.862
						16.483	58.705	21.111
			BALANCE			101.40	101.44	98.06

	Mol %	M/Hr	C	H	O
O_2 32.000	0.20	10.551 / 0.026			21.154
CO_2 44.010	1.41	0.187	0.187		0.374
N_2 28.016	1.19	0.158			
CH_4 16.042	82.85	10.967	10.967	43.868	
C_2H_6 30.068	7.00	0.927	1.854	5.562	
C_3H_8 44.094	5.37	0.711	2.133	5.688	
C_4H_{10} 58.120	1.48	0.196	0.784	1.960	
C_5H_{12} 72.146	0.50	0.066	0.330	0.792	
MW=	20.00224				
TOTAL			16.255	57.870	21.528

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	282.82	320.83
OIL	61.17	61.17
WATER	145.88	145.88
TOTAL	489.87	527.88
FRESH FEED	527.88	
WEIGHT BALANCE	92.80	
WET GAS FACTOR	1134396	
INDICATED LOSS—S C F H	593	
	5007	

WET GAS	1300	2200	0600	AVERAGE
CO 28.010	7.60	7.22	7.52	7.447
H_2 2.016	36.44	37.14	36.95	36.844
CO_2 44.010	31.88	31.53	31.49	31.634
N_2 28.016	2.36	1.74	1.72	1.940
CH_4 16.042	9.25	10.10	9.94	9.763
C_2H_4 28.052	2.43	2.77	2.79	2.663
C_2H_6 30.068	1.87	1.65	1.81	1.777
C_3H_6 42.078	3.32	3.34	3.60	3.420
C_3H_8 44.094	0.31	0.31	0.33	0.317
C_4H_8 56.104	2.25	2.12	2.06	2.143
C_4H_{10} 58.120	0.83	0.71	0.57	0.703
C_5H_{10} 70.130	0.96	0.89	0.83	0.893
C_5H_{12} 72.146	0.25	0.24	0.15	0.213
C_6H_{12} 84.156	0.25	0.24	0.24	0.243
			M. W.	24.315996

GAS FLOW RATES

		√H	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
			413.0	65	2392649		
FRESH FEED	79.31	6.433	20.681	0.9952	1.5174	15,934	41.987
			1.53	62	1190574		
WET GAS	158.44	6.350	4.029	0.9981	1.0911	4,414	11.631
			412.5	122			
RECYCLE	79.31	8.508	20.669	0.9452	1.0911	14,383	37.900
BLEED	5.02	8.513	20.669	1.0000	1.0911	964	2.540
			445.7	198	1447337		
NATURAL GAS	28.43	7.700	21.457	0.8890	1.2031	5,024	13.238
			440.5	67			
OXYGEN	27.07	6.979	21.335	0.9933		4,004	10.551
			29.3 / 4.7				
STEAM	215.7	2.633	0.2889		164 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	6'10 1/8"	364.59	53	1.0035	365.87	53.3	2332.42	
	2'7"	138.11	49	1.0054	138.86	6.375	885.23	
					+3.29		+21.00	61.17
					230.30		1468.19	9.596
WATER	7'3"	384.23	67	0.99932	383.97	10.8		
	6'2 5/8"	330.22	66	0.99942	330.03	8.282		
	7'3 1/2"	385.32	68	0.99920	385.01			
	0'7"	30.98	72	0.99872	30.94			
	1'11 3/4"	104.04	62	0.99982	104.02			
	1'8 1/2"	89.24	53	1.00052	89.29			145.88
					492.74		3501.13	17.614

RUN NO. 63-G
HOURS 120-144
CATALYST Mill Scale Red. at Brownsville

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

	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
CO 28.010	37.203	15.777	441.89	7.810	1.052	29.47	3.137	18.914	4.189	-14.725	-412.42				
H_2 2.016	60.417	25.621	51.64	36.584	4.929	9.94	14.693	40.314	19.622	-20.692	-41.70				
CO_2 44.010	2.140	0.908	39.96	31.410	4.232	186.25	12.615	13.523	16.847	3.324	146.29	9.311			
N_2 28.016	0.160	0.068	1.91	1.710	0.230	6.44	0.687	0.755	0.917						
CH_4 16.042	0.080	0.034	0.55	9.640	1.299	20.84	3.872	3.906	5.171	1.265	20.29	1.291			
C_2H_4 28.052				2.553	0.344	0.65	1.025	1.025	1.369	0.344	9.65	0.614			
C_2H_6 30.068				1.973	0.266	8.00	0.792	0.792	1.058	0.266	8.00	0.509			
C_1+C_2											37.94	2.414			
C_3H_6 42.078				3.447	0.464	19.52	1.384	1.384	1.848	0.464	19.52	1.242	4.32	4.519	0.288
C_3H_8 44.094				0.313	0.042	1.85	0.126	0.126	0.168	0.042	1.85	0.118	4.24	0.436	0.028
C_4H_8 56.104				2.373	0.320	17.95	0.953	0.953	1.273	0.320	17.95	1.143	5.00	3.590	0.229
C_4H_{10} 58.120				0.613	0.083	4.82	0.246	0.246	0.329	0.083	4.82	0.307	4.86	0.992	0.063
C_5H_{10} 70.130				1.077	0.145	10.17	0.433	0.433	0.578	0.145	10.17	0.647	5.45	1.866	0.119
C_5H_{12} 72.146				0.187	0.025	1.80	0.075	0.075	0.100	0.025	1.80	0.115	5.25	0.343	0.022
C_6H_{12} 84.156				0.310	0.042	3.53	0.125	0.125	0.167	0.042	3.53	0.225	5.54	0.637	0.041
C_3-C_6											59.64	3.797		12.383	0.790
TOTAL		42.408	535.95		13.473	330.23	40.163	82.571	61.606						
H_2+CO	97.620	41.398	15711	SCFH	5.981		17.830	59.228	23.811	-35.417					
H_2/CO		1.62	Factor 636496		4.68		4.68	2.13	4.68	1.41					

Weight Recovery, %	92.47	Catalyst Age, hrs.	144	Space Velocity, vhv	1114	RECOVERED OIL	0.425**	59.61	3.794	9.316	0.593
Pressure, psig	416	Inlet Velocity, Ft/sec	0.97	Catalyst Vol, CF	14.10	TOTAL OIL		119.25	7.591	21.699	1.383
Temperature, °F	656	Bed Depth, Ft	21.37	Weight, #	2200	WATER SOLUBLE CHEMICALS	0.290**	15.40	0.980	1.939	0.123
Recycle Ratio	0.95	Bed Density, #/CF	156	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 10.88	TOTAL LIQUID PRODUCTS C_3+		134.65	8.571	23.638	1.506

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY						
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3+/C_1+	NET WATER	7.255**	130.71	8.320	15.692	0.999
								GROSS WATER		146.11	9.300	17.631	1.122
68.23	93.33	80.76	85.55	77.85	51.33	59.80	78.02	HYDROCARBON TOTAL—C_1+		172.59	10.985		

YIELD BASIS H_2+CO FED — YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	83.0	7.732	98.0	7.577
400-550	10.6	0.988	91.4	0.903
550 +	6.4	0.596	114.6	0.683

	RECOVERY %	#/hr	gal/hr
PROPYLENE	44.4	8.67	
C_3 POLY GASO.	87.5	7.59	1.269
C_3 POLY TAR	12.5	1.08	0.143

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	1.08	0.216	68.0
C_4 POLY GASO.	5.98	14.76	2.468	1.5
C_4H_{10}	4.86	4.82	0.992	68.0
C_4-FREE GASO.			11.692	5.8
C_4 POLY TAR	7.53	2.11	0.280	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	15.368	0.9782	5303
GAS OIL	0.903	0.0575	312
FUEL OIL	0.683	0.0435	236
POLY TAR	0.423	0.0269	146
TOTAL	17.377	1.1061	5997
W. S. CHEM.	1.939	0.1234	669
TOTAL	19.316	1.2295	6666

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91×#/MCF *9488 MCFH H_2 + CO, Bbl/Day = 5421.6×gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	445	Fresh Feed	16,094
Natural Gas	452	Recycle	15,242
Generator Outlet	422	Combined Feed	31,336
Reactor Inlet	416	Wet Gas—Measured	4,488
Condenser Inlet		Adjusted	5,113
Product Accumulator	367	Loss	625
TEMPERATURES—°F.		Recycle/Fresh Feed	0.95
Oxygen	469	Inlet Velocity—ft./sec.	0.97
Natural Gas	785	Fresh Feed Rate—S.C.F.H. H_2 + CO	15711
Generator	2293	per Cu.Ft. Dense Bed	1114
Quench Accumulator	152	per Lb. Catalyst	7.14
Reactor Inlet	326	per Sq. Ft.	23805
Condenser Inlet	584		
Product Accumulator	95	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 160#/hr.	
1 See Period A	-	@705 psia & 506°F. =	
2	655	1201 Btu/#	
3	651	Water in @60°F. = 28 Btu/#	
4	658	Net Heat Transferred/# steam =	
5	662	1173 Btu	
6	661	(1173)(160) = 187,680 Btu/hr.	
7	654	Ave. Bed Temp. = 656°F.	
8	649	dT = 656-506 = 150°F.	
9	641	Tube Area = 37.7 sq. ft.	
10	637	$K = \frac{187,680}{(37.7)(150)}$ 33.2 Btu/°F./sq. ft.	
11	523		

PRODUCT TESTS

	OIL	WATER
°API	52.6	10.7
Neut. No.	43.9	34.6
Sap. No.	55.0	36.6
Hydrox. No.		
Bromine No.	86	
Pour °F.		
Chemicals, % by K_2CO_3		11.0
HEMPEL. DIST. %		°API
205 °F.		
400	82.0	55.3
400-550	10.6	33.3
550+	7.4	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	98	
10%	128	
50%	213	
90%	343	
EP	386	
Rec.	97.0	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	38
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
See Period A	
1	76
2	80
3	80
4	375
Total	611
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	156
Inventory, Lbs.	2200
Bed Depth, Ft.	21.37
Vol., Cu. Ft.	14.10

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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	1400	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	37.17	37.23	37.21	37.203	15.777	15.777		15.777
H_2 2.016	60.51	60.47	60.27	60.417	25.621		51.242	
CO_2 44.010	2.04	2.10	2.28	2.140	0.908	0.908		1.816
N_2 28.016	0.14	0.15	0.19	0.160	0.068			
CH_4 16.042	0.14	0.05	0.05	0.080	0.034	0.034	0.136	
			M. W	12.63804				
			H_2O 18.016				7.571	3.836
						16.719	58.949	21.429
			BALANCE			101.88	101.14	98.71
WET GAS								
CO 28.010	7.46	8.12	7.85	7.810				
H_2 2.016	37.32	36.18	36.25	36.584				
CO_2 44.010	30.30	31.58	32.35	31.410				
N_2 28.016	1.35	1.91	1.87	1.710				
CH_4 16.042	10.69	9.08	9.15	9.640				
C_2H_4 28.052	2.66	2.43	2.57	2.553				
C_2H_6 30.068	2.02	1.94	1.96	1.973				
C_3H_6 42.078	3.56	3.31	3.47	3.447				
C_3H_8 44.094	0.32	0.30	0.32	0.313				
C_4H_8 56.104	2.35	2.57	2.20	2.373				
C_4H_{10} 58.120	0.46	0.80	0.58	0.613				
C_5H_{10} 70.130	1.05	1.21	0.97	1.077				
C_5H_{12} 72.146	0.16	0.24	0.16	0.187				
C_6H_{12} 84.156	0.30	0.33	0.30	0.310				
			M. W.	24.51075				

GENERATOR BALANCE

	Mol %	M/Hr	C	H	O
O_2 32.000	0.28	10.675 0.037			21.424
CO_2 44.010	1.08	0.143	0.143		0.286
N_2 28.016	1.44	0.191			
CH_4 16.042	82.30	10.902	10.902	43.608	
C_2H_6 30.068	7.09	0.939	1.878	5.634	
C_3H_8 44.094	5.55	0.735	2.205	5.880	
C_4H_{10} 58.120	1.60	0.212	0.848	2.120	
C_5H_{12} 72.146	0.66	0.087	0.435	1.044	
MW =	20.156026				
TOTAL			16.411	58.286	21.710

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	289.86	330.23
OIL	59.61	59.61
WATER	146.11	146.11
TOTAL	495.58	535.95
FRESH FEED	535.95	
WEIGHT BALANCE	92.47	
WET GAS FACTOR	1139274	
INDICATED LOSS—S C F H	625	

GAS FLOW RATES

	√R	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.504	416 / 20.753	67 / 0.9933	2290703 / 1.5135	16,094	42.408
WET GAS 158.44	6.513	1.50 / 4.025	66 / 0.9943	1181114 / 1.0868	4,488	11.826
RECYCLE 79.31	8.454	416.5 / 20.765	126 / 0.9420	1.0868	14,254	37.560
BLEED 5.02	8,721	20.765	1.0000	1.0868	988	2.603
NATURAL GAS 28.43	7.713	451.8 / 21.599	203 / 0.8856	1436295 / 1.1985	5,027	13.246
OXYGEN 27.07	7.046	446.0 / 21.464	71 / 0.9896		4,051	10.675
STEAM 215.7	2.579	29.0 + 4.7 = 33.7 / 0.2878		160 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'0½"	373.32	52	1.0039	374.78	52.6	2398.22	
	6'10½"	364.59	53	1.0035	365.87	6.399	2341.20	
	5'0"	266.38	52	1.0038	267.42		1711.22	
	1'1"	56.30	50	1.0049	56.58		362.06	
					+3.83		+24.50	59.61
					223.58		1430.68	9.316
WATER	7'3¾"	387.50	80	0.99759	386.57	10.7	3203.51	
	1'11¾"	104.04	62	0.99982	104.02	8.287	862.01	
	3'7⅜"	193.82	68	0.99920	193.66		1604.86	
	1'0½"	53.06	60	1.00000	53.06		439.71	146.11
					423.15		3506.65	17.631

RUN NO. 63-H
HOURS 144-168
CATALYST Mill Scale Reduced at Brownsville

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

FRESH FEED	%	m/hr	#/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	37.203	15.684	439.31	7.460	1.014	28.40		3.022	18.706	4.036	-14.670	-410.91
H_2 2.016	60.340	25.438	51.28	36.930	5.020	10.12		14.958	40.396	19.978	-20.418	-41.16
CO_2 44.010	2.147	0.905	39.83	31.484	4.280	188.37		12.753	13.658	17.033	3.375	148.54
N_2 28.016	0.187	0.079	2.21	1.650	0.224	6.28		0.668	0.747	0.892		
CH_4 16.042	0.123	0.052	0.84	10.020	1.362	21.85		4.059	4.111	5.421	1.310	21.01
C_2H_4 28.052				2.554	0.347	9.73		1.035	1.035	1.382	0.347	9.73
C_2H_6 30.068				1.920	0.261	7.85		0.778	0.778	1.039	0.261	7.85
C_1+C_2												38.59
C_3H_6 42.078				3.360	0.457	19.23		1.361	1.361	1.818	0.457	19.23
C_3H_8 44.094				0.293	0.040	1.76		0.119	0.119	0.159	0.040	1.76
C_4H_8 56.104				2.193	0.298	16.72		0.888	0.888	1.186	0.298	16.72
C_4H_{10} 58.120				0.717	0.097	5.64		0.290	0.290	0.387	0.097	5.64
C_5H_{10} 70.130				0.943	0.128	8.98		0.382	0.382	0.510	0.128	8.98
C_5H_{12} 72.146				0.213	0.029	2.09		0.086	0.086	0.115	0.029	2.09
C_6H_{12} 84.156				0.263	0.036	3.03		0.107	0.107	0.143	0.036	3.03
C_3+C_4												57.45
TOTAL		42.158	533.47		13.593	330.05		40.506	82.664	62.078		
H_2+CO	97.543	41.122	15606 SCFH		6.034			17.980	59.102	24.014	-35.088	
H_2/CO		1.62	Factor 640779		4.95			4.95	2.16	4.95	1.39	

Weight Recovery, %	93.29	Catalyst Age, hrs.	168	Space Velocity, vhv	1102	RECOVERED OIL	0.405** 56.76
Pressure, psig	415	Inlet Velocity, Ft/sec	0.97	Catalyst Vol., CF.	14.16	TOTAL OIL	114.21
Temperature, °F	657	Bed Depth, Ft	21.46	Weight, #	2166	WATER SOLUBLE CHEMICALS	0.291** 15.45
Recycle Ratio	0.96	Bed Density, #/CF	153	Effluent $(H_2)(CO_2)$ / Shift Ratio $(H_2O)(CO)$ =	11.58	TOTAL LIQUID PRODUCTS C_3+	129.66

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY	NET WATER	7.283** 131.21
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3^+/C_1^+	GROSS WATER	146.66
67.76	93.53	80.27	85.33	78.42	50.54	59.37	77.06	HYDROCARBON TOTAL—C_1+	168.25

YIELD BASIS H_2+CO FED	CONDENSATE #/MCF	CONDENSATE #/gal	CONDENSATE gal/hr	CONDENSATE gal/MCF
	9.518			
	1.346			
	0.623			
	0.503			
	2.472			
	1.232	4.32	4.451	0.285
	0.113	4.24	0.415	0.027
	1.071	5.00	3.344	0.214
	0.361	4.86	1.160	0.074
	0.575	5.45	1.648	0.106
	0.134	5.25	0.398	0.026
	0.194	5.54	0.547	0.035
	3.680		11.963	0.767
	3.637		8.846	0.567
	7.317		20.809	1.334
	0.990		1.947	0.125
	8.307		22.756	1.459
	8.408		15.751	1.009
	9.398		17.698	1.134
	10.781			

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	83.0	7.342	98.0	7.195
400-550	11.2	0.991	91.4	0.906
550 +	5.8	0.513	114.6	0.588

	RECOVERY %	#/hr	gal/hr
PROPYLENE	44.1	8.48	
C_3 POLY GASO.	87.5	7.42	1.241
C_3 POLY TAR	12.5	1.06	0.141

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	12.38	2.446	1.5
C_4H_{10}	4.86	5.64	1.160	68.0
C_4 FREE GASO.			11.029	5.8
C_4 POLY TAR	7.53	2.09	0.278	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	14.635	0.9378	5084
GAS OIL	0.906	0.0581	315
FUEL OIL	0.588	0.0377	204
POLY TAR	0.419	0.0268	145
TOTAL	16.548	1.0604	5748
W. S. CHEM.	1.947	0.1248	677
TOTAL	18.495	1.1851	6425

Form ML—:1

**Included in Reactor Effluent Total

g/NCM = 16.91X#/MCF

*9488 MCFH H_2+CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS			
PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	444	Fresh Feed	15,999
Natural Gas	450	Recycle	15,372
Generator Outlet	419	Combined Feed	31,371
Reactor Inlet	415	Wet Gas—Measured	4,599
Condenser Inlet		Adjusted	5,159
Product Accumulator	365	Loss	560
TEMPERATURES—°F.		Recycle/Fresh Feed	0.96
Oxygen	493	Inlet Velocity—ft./sec.	0.97
Natural Gas	812	Fresh Feed Rate—S.C.F.H. / H_2+CO	15606
Generator	2277	per Cu. Ft. Dense Bed	1102
Quench Accumulator	154	per Lb. Catalyst	7.20
Reactor Inlet	333	per Sq. Ft.	23645
Condenser Inlet	584		
Product Accumulator	94		
Catalyst No. Height			
1 See Period A			
2	656		
3	650		
4	660		
5 Average 657	663		
6	663		
7	656		
8	650		
9	643		
10	638		
11	524		

PRODUCT TESTS	OIL	WATER
°API	52.1	10.7
Neut. No.	44.7	34.2
Sap. No.	56.7	37.9
Hydrox. No.		
Bromine No.	86	
Pour °F.		
Chemicals, % by K_2CO_3		11.0
HEMPEL. DIST. %		°API
205 °F.		
400	82.0	54.6
400-550	11.2	35.2
550+	6.8	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	101	
10%	132	
50%	212	
90%	329	
EP	375	
Rec.	97.0	

CATALYST DATA		PARTICLE SIZE			
INVENTORY DATA		Screen Analysis		Sedimentation	
In Reactor at Start of Period		Mesh	Microns	%	Microns	%
Fresh Catalyst Added		On 40	419+		80+	
Total		100	150		40—80	
Catalyst Recovered	40	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				
0 See Period A						
1	73	CATALYST				
2	81	Bulk Density, Lbs./Cu.Ft.				
3	78	Aerated				
4	370	Settled				
Total	602	Compacted				
		Particle Density, gm./cc.				
CALCULATED FROM dp		NH_3 Value, ml./gm.				
Density, Lbs./Cu.Ft.	153	N_2 Surface, m^2/gm.				
Inventory, Lbs.	2166					
Bed Depth, Ft.	21.46	CHEMICAL ANALYSIS				
Vol., Cu. Ft.	14.16	Fe				
		C				
		O				
		H				
		K_2O, W+. % basis Fe				
		X-Ray Analysis—				
		$Fe_{20}C_9$				
		Fe_3O_4				
		Fe				

GAS ANALYSES	1400	2200	0600	AVERAGE
HOUR				
FRESH FEED				
CO 28.010	37.24	37.03	37.34	37.203
H_2 2.016	60.37	60.42	60.23	60.340
CO_2 44.010	2.00	2.30	2.14	2.147
N_2 28.016	0.17	0.20	0.19	0.187
CH_4 16.042	0.22	0.05	0.10	0.123
			M. W	12.65403
			H_2O 18.016	
			BALANCE	

GENERATOR BALANCE	M/HR	C	H	O
FRESH FEED				
CO 28.010	15.684	15.684		15.684
H_2 2.016	25.438		50.876	
CO_2 44.010	0.905	0.905		1.810
N_2 28.016	0.079			
CH_4 16.042	0.052	0.052	0.208	
			7.503	3.752
		16.641	58.587	21.246
BALANCE		101.86	100.91	98.77

	Mol %	M/Hr	C	H	O
O_2 32.000	0.27	10.540 0.036			21.152
CO_2 44.010	1.36	0.179	0.179		0.358
N_2 28.016	0.83	0.110			
CH_4 16.042	83.02	10.955	10.955	43.820	
C_2H_6 30.068	6.90	0.911	1.822	5.466	
C_3H_8 44.094	5.45	0.719	2.157	5.752	
C_6H_{14} 86.120	1.56	0.206	0.824	2.060	
C_6H_{12} 72.146	0.61	0.080	0.400	0.960	
MW =	20.06012				
TOTAL			16.337	58.058	21.510

WEIGHT BALANCE	#/hr Measured	At Wt. Balance
WET GAS	294.25	330.05
OIL	56.76	56.76
WATER	146.66	146.66
TOTAL	497.67	533.47
FRESH FEED	533.47	
WEIGHT BALANCE	93.29	
WET GAS FACTOR	1121665	
INDICATED LOSS—S C F H	560	

WET GAS				
CO 28.010	7.38	7.47	7.53	7.460
H_2 2.016	37.23	37.12	36.44	36.930
CO_2 44.010	30.81	31.47	32.17	31.484
N_2 28.016	1.54	1.62	1.79	1.650
CH_4 16.042	10.43	9.93	9.70	10.020
C_2H_4 28.052	2.53	2.65	2.48	2.554
C_2H_6 30.068	1.90	1.95	1.91	1.920
C_3H_6 42.078	3.44	3.49	3.15	3.360
C_3H_8 44.094	0.31	0.29	0.28	0.293
C_4H_8 56.104	2.25	2.18	2.15	2.193
C_6H_{12} 86.120	0.70	0.54	0.91	0.717
C_5H_{10} 70.130	0.97	0.91	0.95	0.943
C_6H_{12} 72.146	0.23	0.15	0.26	0.213
C_6H_{12} 84.156	0.28	0.23	0.28	0.263
			M. W.	24.28001

GAS FLOW RATES	V̄R	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
		414.9	70	2287808		
FRESH FEED	79.31	6.496	20.727	0.9905	1.5126	15.999	42.158
		1.51	68	1192338		
WET GAS	158.44	6.654	4.026	0.9924	1.0919	4.599	12.119
		414.8	126			
RECYCLE	79.31	8.500	20.724	0.9420	1.0919	14.370	37.866
BLEED	5.02	8.821	20.724	1.0000	1.0919	1.002	2.640
		449.9	204	1443162		
NATURAL GAS	28.43	7.688	21.555	0.8849	1.2013	5.008	13.196
		443.5	74			
OXYGEN	27.07	6.995	21.406	0.9868		4.000	10.540
STEAM	215.7	2.471					

LIQUID PRODUCT RATES	HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL		7'3½"	386.41	70	0.9951	384.52	52.1	2467.08	
		5'0"	266.38	52	1.0039	267.42	6.416	1715.77	
		3'1⅝"	169.79	52	1.0039	170.45		1093.61	
		1'5¾"	77.06	72	0.9941	76.61		491.53	
						+1.36		+8.75	56.76
						212.30		1362.14	8.846
WATER		7'1⅝"	388.59	84	0.99692	387.39	10.7		
		3'0⅝"	193.82	68	0.99920	193.66	8.287		
		4'7½"	246.74	70	0.99896	246.48			
		0'3½"	15.49	79	0.99775	15.46			146.66
						424.75		3519.90	17.698

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THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-I
HOURS 168-192
CATALYST Mill Scale Red. at Brownsville

	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
CO 28.010	37.337	15.891	445.11	7.587	1.070	29.97	3.060	18.951	4.130	-14.821	-415.14				
H_2 2.016	60.323	25.674	51.76	37.974	5.355	10.80	15.316	40.990	20.671	-20.319	-40.96				
CO_2 44.010	1.987	0.846	37.23	30.707	4.331	190.60	12.386	13.232	16.717	3.485	153.37	9.723			
N_2 28.016	0.210	0.089	2.49	1.780	0.251	7.03	0.718	0.807	0.969						
CH_4 16.042	0.143	0.061	0.98	9.360	1.320	21.18	3.775	3.836	5.095	1.259	20.20	1.281			
C_2H_4 28.052				2.630	0.371	10.41	1.061	1.061	1.432	0.371	10.41	0.660			
C_2H_6 30.068				1.833	0.259	7.79	0.739	0.739	0.998	0.259	7.79	0.494			
C_1+C_2											38.40	2.435			
C_3H_6 42.078				3.083	0.435	18.30	1.244	1.244	1.679	0.435	18.30	1.160	4.32	4.236	0.269
C_3H_8 44.094				0.250	0.035	1.54	0.101	0.101	0.136	0.035	1.54	0.098	4.24	0.363	0.023
C_4H_8 56.104				2.280	0.322	18.07	0.920	0.920	1.242	0.322	18.07	1.146	5.00	3.614	0.229
C_4H_{10} 58.120				0.753	0.106	6.16	0.304	0.304	0.410	0.106	6.16	0.391	4.86	1.267	0.080
C_5H_{10} 70.130				1.113	0.157	11.01	0.449	0.449	0.606	0.157	11.01	0.698	5.45	2.020	0.128
C_5H_{12} 72.146				0.223	0.031	2.24	0.090	0.090	0.121	0.031	2.24	0.142	5.28	0.427	0.027
C_6H_{12} 84.156				0.427	0.060	5.05	0.172	0.172	0.232	0.060	5.05	0.320	5.54	0.912	0.058
C_3-C_6											62.37	3.955		12.839	0.814
TOTAL		42.561	537.57		14.103	340.15	40.335	82.896	62.124						
H_2+CO	97.660	41.565	15774	SCFH	6.425		18.376	59.941	24.801	-35.140					
H_2/CO		1.62	Factor 633954		5.01		5.01	2.16	5.01	1.37					

Weight Recovery, %	92.20	Catalyst Age, hrs.	192	Space Velocity, vhv	1126
Pressure, psig	412	Inlet Velocity, Ft/sec	0.98	Catalyst Vol., CF.	14.01
Temperature, °F	658	Bed Depth, Ft	21.23	Weight, #	2158
Recycle Ratio	0.95	Bed Density, #/CF	154	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ =	11.98

	NET CHANGE m/hr	NET CHANGE #/hr	#/MCF	#/gal	gal/hr	gal/MCF
RECOVERED OIL	0.394**	55.25	3.503		8.593	0.545
TOTAL OIL		117.62	7.458		21.432	1.359
WATER SOLUBLE CHEMICALS	0.308**	16.34	1.036		2.060	0.131
TOTAL LIQUID PRODUCTS C_3+		133.96	8.494		23.492	1.490
NET WATER	6.984**	125.83	7.977		15.106	0.958
GROSS WATER		142.17	9.013		17.166	1.088
HYDROCARBON TOTAL—C_1+		172.36	10.929			

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3+/C_1+
66.86	93.27	79.14	84.51	78.21	49.57	58.62	77.72

YIELD BASIS H_2+CO FED — YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL %	gal/hr	TREATING RECOVERY %	gal/hr
400 EP	82.0	7.047	98.0	6.906
400-550	11.2	0.962	91.4	0.879
550 +	6.8	0.584	114.6	0.669

	RECOVERY %	#/hr	gal/hr
PROPYLENE	42.9	7.85	
C_3 POLY GASO.	87.5	6.87	1.149
C_3 POLY TAR	12.5	0.98	0.130

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	15.81	2.644	1.5
C_4H_{10}	4.86	6.16	1.267	68.0
C_4-FREE GASO.			11.414	5.8
C_4 POLY TAR	7.53	2.26	0.300	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	15.273	0.9682	5249
GAS OIL	0.879	0.0557	302
FUEL OIL	0.669	0.0424	230
POLY TAR	0.430	0.0273	148
TOTAL	17.251	1.0936	5929
W. S. CHEM.	2.060	0.1306	708
TOTAL	19.311	1.2242	6637

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91 × #/MCF

*9488 MCFH H_2+CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	440	Fresh Feed	16,152
Natural Gas	448	Recycle	15,307
Generator Outlet	416	Combined Feed	31,459
Reactor Inlet	412	Wet Gas—Measured	4,692
Condenser Inlet		Adjusted	5,352
Product Accumulator	360	Loss	660
TEMPERATURES—°F.		Recycle/Fresh Feed	0.95
Oxygen	488	Inlet Velocity—ft./sec.	0.98
Natural Gas	790	Fresh Feed Rate—S.C.F.H. H_2+CO	15774
Generator	2283	per Cu.Ft. Dense Bed	1126
Quench Accumulator	150	per Lb. Catalyst	7.31
Reactor Inlet	343	per Sq. Ft.	23900
Condenser Inlet	586		
Product Accumulator	96	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 414 #/hr.	
1 See Period A	-	@705 psia & 506°F. =	
2	658	1201 Btu/#	
3	650	Water in @ 70°F.= 38°F.	
4	660	Net Heat Transferred/# steam =	
5	665	= 1163 Btu	
6	665	(1163)(414) = 481,482 Btu/hr.	
7	658	Ave. Bed Temp. = 658°F.	
8	652	dT = 658-506 = 152°F.	
9	644	Tube Area = 37.7 sq. ft.	
10	640	$K = \frac{481,482}{(37.7)(152)}$ =	
11	524	= 84.0 Btu/°F./sq. ft.	

PRODUCT TESTS

	OIL	WATER
°API	51.7	10.8
Neut. No.	44.8	34.6
Sap. No.	55.6	35.6
Hydrox. No.		
Bromine No.	86	
Pour °F.		
Chemicals, % by K_2CO_3		12.0
HEMPEL, DIST. %		°API
205 °F.		
400	81.0	54.2
400-550	11.2	35.6
550+	7.8	
A. S. T. M. DIST. ON Naphtha °F.		
IBP	104	
10%	129	
50%	221	
90%	338	
EP	390	
Rec.	97.5	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	20.5
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	-
1	73
2	87
3	74
4	365
Total	599
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	154
Inventory, Lbs.	2158
Bed Depth, Ft.	21.23
Vol., Cu. Ft.	14.01

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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 / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	37.37	37.48	37.16	37.337	15.891	15.891		15.891
H_2 2.016	60.29	60.13	60.55	60.323	25.674		51.348	
CO_2 44.010	1.91	2.08	1.97	1.987	0.846	0.846		1.692
N_2 28.016	0.22	0.24	0.17	0.210	0.089			
CH_4 16.042	0.21	0.07	0.15	0.143	0.061	0.061	0.244	
			M. W	12.63046				
			H_2O 18.016				7.406	3.703
						16.798	58.998	21.286
			BALANCE			101.34	100.41	99.44

	Mol %	M/Hr	C	H	O
O_2 32.000	0.24	10.503 0.032			21.070
CO_2 44.010	1.27	0.168	0.168		0.336
N_2 28.016	0.37	0.049			
CH_4 16.042	83.23	11.003	11.003	44.012	
C_2H_6 30.068	6.96	0.920	1.840	5.520	
C_3H_8 44.094	5.49	0.726	2.178	5.808	
C_4H_{10} 58.120	1.69	0.223	0.892	2.230	
C_5H_{12} 72.146	0.75	0.099	0.495	1.188	
MW=	20.127959				
TOTAL			16.576	58.758	21.406

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	298.21	340.15
OIL	55.25	55.25
WATER	142.17	142.17
TOTAL	495.63	537.57
FRESH FEED	537.57	
WEIGHT BALANCE	92.20	
WET GAS FACTOR	1140639	
INDICATED LOSS—S C F H	660	

WET GAS	1400	2200	0600	AVERAGE
CO 28.010	7.63	7.62	7.51	7.587
H_2 2.016	38.61	37.05	38.26	37.974
CO_2 44.010	29.98	31.47	30.67	30.707
N_2 28.016	1.58	1.68	2.08	1.780
CH_4 16.042	9.84	0.29	8.95	9.360
C_2H_4 28.052	2.64	2.61	2.64	2.630
C_2H_6 30.068	1.82	1.90	1.78	1.833
C_3H_6 42.078	3.31	2.90	3.04	3.083
C_3H_8 44.094	0.31	0.21	0.23	0.250
C_4H_8 56.104	2.22	2.38	2.24	2.280
C_4H_{10} 58.120	0.57	0.89	0.80	0.753
C_5H_{10} 70.130	1.04	1.23	1.07	1.113
C_5H_{12} 72.146	0.16	0.32	0.19	0.223
C_6H_{12} 84.156	0.29	0.45	0.54	0.427
			M. W.	24.11905

GAS FLOW RATES

	$\sqrt{H}$	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.596	411.6 / 20.647	73 / 0.9877	2292078 / 1.5140	16,152	42.561
WET GAS 158.44	6.783	1.52 / 4.027	71 / 0.9896	1200296 / 1.0956	4,692	12.364
RECYCLE 79.31	8.508	412.3 / 20.664	128 / 0.9404	1.0956	14,366	37.855
BLEED 5.02	8.283	20.664	1.0000	1.0956	941	2.480
NATURAL GAS 28.43	7.717	448.2 / 21.515	202 / 0.8863	1438297 / 1.1993	5,017	13.220
OXYGEN 27.07	7.008	440.4 / 21.333	76 / 0.9850		3,986	10.503
STEAM 215.7	6.665	29.1 / 4.7 / 33.8 / 0.2882		414 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	6'10 3/4"	365.68	60	1.0000	365.68	51.7	2351.32	
	3'1 7/8"	169.79	52	1.0039	170.45	6.430	1095.99	
					+11.00		+70.75	55.25
					206.23		1326.08	8.593
WATER	7'3 1/4"	385.32	80	0.99759	384.39	10.8		
	4'7 1/2"	246.74	70	0.99896	246.48	8.282		
	6'4"	336.22	75	0.99832	335.66			
	1'2 1/4"	61.74	80	0.99759	61.59			142.17
					411.98		3412.02	17.166

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-J
HOURS 192-216
CATALYST Mill Scale Red. at Brownsville

	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	YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*				
CO 28.010	37.800	15.878	444.72	8.150	1.204	33.72	3.342	19.220	4.546	-14.674	-411.00						CORRECTED HEMPEL %	gal/hr	TREATING RECOVERY %	gal/hr
H_2 2.016	59.747	25.096	50.59	38.803	5.732	11.56	15.910	41.006	21.642	-19.364	-39.03					400 EP	84.2	6.698	98.0	6.564
CO_2 44.010	2.113	0.888	39.08	30.520	4.511	198.52	12.514	13.402	17.025	3.623	159.44	10.253				400-550	11.2	0.891	91.4	0.814
N_2 28.016	0.207	0.087	2.44	1.466	0.217	6.08	0.601	0.688	0.818							550 +	4.6	0.366	114.6	0.419
CH_4 16.042	0.133	0.056	0.90	9.366	1.384	22.20	3.840	3.896	5.224	1.328	21.30	1.370								
C_2H_4 28.052				2.580	0.381	10.69	1.058	1.058	1.439	0.381	10.69	0.687					RECOVERY %	#/hr	gal/hr	
C_2H_6 30.068				1.797	0.265	7.97	0.737	0.737	1.002	0.265	7.97	0.513				PROPYLENE	40.1	7.57		
C_1+C_2											39.96	2.570				C_3 POLY GASO.	87.5	6.62	1.107	
C_3H_6 42.078				3.037	0.449	18.89	1.245	1.245	1.694	0.449	18.89	1.215	4.32	4.373	0.281	C_3 POLY TAR	12.5	0.95	0.126	
C_3H_8 44.094				0.287	0.042	1.85	0.118	0.118	0.160	0.042	1.85	0.119	4.24	0.436	0.028					
C_4H_8 56.104				2.017	0.298	16.72	0.827	0.827	1.125	0.298	16.72	1.075	5.00	3.344	0.215		#/gal	#/hr	gal/hr	RVP
C_4H_{10} 58.120				0.570	0.084	4.88	0.234	0.234	0.318	0.084	4.88	0.314	4.86	1.004	0.065	C_4H_8	5.00	0.50	0.100	68.0
C_5H_{10} 70.130				0.900	0.133	9.33	0.369	0.369	0.502	0.133	9.33	0.600	5.45	1.712	0.110	C_4 POLY GASO.	5.98	14.19	2.373	1.5
C_5H_{12} 72.146				0.247	0.036	2.60	0.101	0.101	0.137	0.036	2.60	0.167	5.25	0.495	0.032	C_4H_{10}	4.86	4.88	1.004	68.0
C_6H_{12} 84.156				0.260	0.038	3.20	0.107	0.107	0.145	0.038	3.20	0.206	5.54	0.578	0.037	C_4-FREE GASO.			10.456	5.8
C_3-C_6											57.47	3.696		11.942	0.768	C_4 POLY TAR	7.53	2.03	0.270	
TOTAL		42.005	537.73		14.774	348.21	41.003	83.008	63.294											
H_2+CO	97.547	40.974	15550	SCFH	6.936		19.252	60.226	26.188	-34.038							gal/hr	gal/MCF	Bbl/Day	
H_2/CO		1.58	Factor 643086		4.76		4.76	2.13	4.76	1.32						10 # RVP 400 EP GASOLINE	13.933	0.8960	4858	

Weight Recovery, %	90.63	Catalyst Age, hrs.	216	Space Velocity, vhv	1112
Pressure, psig	409	Inlet Velocity, Ft/sec	0.99	Catalyst Vol., CF	13.99
Temperature, °F	658	Bed Depth, Ft	21.19	Weight, #	2126
Recycle Ratio	0.98	Bed Density, #/CF	152	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 11.78

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3+/C_1+
64.83	92.42	77.16	83.07	76.35	47.22	56.52	75.48

	NET CHANGE m/hr	NET CHANGE #/hr	#/MCF	#/gal	gal/hr	gal/MCF		gal/hr	gal/MCF	Bbl/Day
RECOVERED OIL	0.366**	51.30	3.299		7.955	0.512	GAS OIL	0.814	0.0523	284
TOTAL OIL		108.77	6.995		19.897	1.280	FUEL OIL	0.419	0.0269	146
WATER SOLUBLE CHEMICALS	0.268**	14.21	0.914		1.802	0.116	POLY TAR	0.396	0.0255	138
TOTAL LIQUID PRODUCTS C_3+		122.98	7.909		21.699	1.396	TOTAL	15.562	1.0007	5426
NET WATER	6.883**	124.01	7.975		14.887	0.957	W. S. CHEM.	1.802	0.1159	628
GROSS WATER		138.22	8.389		16.689	1.073	TOTAL	17.364	1.1166	6054
HYDROCARBON TOTAL—C_1+		162.94	10.479							

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91×#/MCF

*9488 MCFH H_2+CO, Bbl/Day = 5421.6× gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	439	Fresh Feed	15941
Natural Gas	447	Recycle	15561
Generator Outlet	414	Combined Feed	31502
Reactor Inlet	409	Wet Gas—Measured	4795
Condenser Inlet		Adjusted	5607
Product Accumulator	360	Loss	812
TEMPERATURES—°F.		Recycle/Fresh Feed	0.98
Oxygen	500	Inlet Velocity—ft./sec.	0.99
Natural Gas	791	Fresh Feed Rate—S.C.F.H.	15550
Generator	2270	per Cu. Ft. Dense Bed	1112
Quench Accumulator	147	per Lb. Catalyst	7.31
Reactor Inlet	342	per Sq. Ft.	23561
Condenser Inlet	590		
Product Accumulator	97	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 407#/hr.	
1 See Period A		@705 psia & 506°F =	
2	658	1201 Btu/#	
3	650	Water in @69°F = 37 Btu/#	
4	660	Net Heat Trans./#steam	
5	665	1164 Btu	
6	665	(1164)(407) = 473,748 Btu/hr.	
7	660	Ave. Bed Temp.= 658°F.	
8	650	dT = 658-506 = 152°F	
9	646	Tube Area = 37.8 sq. ft.	
10	642	$K = \frac{473,748}{(37.8)(152)} =$	
11	526	82.5 Btu/°F/sq.ft.	

PRODUCT TESTS

	OIL	WATER
°API	51.2	10.8
Neut. No.	49.2	36.4
Sap. No.	61.0	40.2
Hydrox. No.		
Bromine No.	82	
Pour °F.		
Chemicals, % by K_2CO_3		12.0
HEMPEL, DIST. %		°API
205 °F.		
400	83.2	53.0
400-550	11.2	53.8
550+	5.6	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	102	
10%	132	
50%	218	
90%	339	
EP	389	
Rec.	97.0	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	33
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	
1	74
2	88
3	68
4	360
Total	590
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	152
Inventory, Lbs.	2126
Bed Depth, Ft.	21.19
Vol., Cu. Ft.	13.99

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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 / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O		Mol %	M/Hr	C	H	O
FRESH FEED									O_2 32.000	0.26	10.472 0.034			21.012
CO 28.010	37.77	37.74	37.89	37.800	15.878	15.878		15.878	CO_2 44.010	1.36	0.180	0.180		0.360
H_2 2.016	59.70	59.77	59.77	59.747	25.096		50.192		N_2 28.016	1.16	0.153			
CO_2 44.010	2.08	2.17	2.09	2.113	0.888	0.888		1.776	CH_4 16.042	82.76	10.927	10.927	43.708	
N_2 28.016	0.23	0.20	0.19	0.207	0.087				C_2H_6 30.068	6.79	0.897	1.794	5.382	
CH_4 16.042	0.22	0.12	0.06	0.133	0.056	0.056	0.224		C_3H_8 44.094	5.34	0.705	2.115	5.640	
			M. W	12.80154					C_4H_{10} 58.120	1.61	0.213	0.852	2.130	
			H_2O 18.016				7.510	3.755	C_5H_{12} 72.146	0.72	0.095	0.475	1.140	
						16.822	57.926	21.409	MW =	20.13450				
			BALANCE			102.93	99.87	100.17	TOTAL			16.343	58.000	21.372

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	297.80	348.21
OIL	51.30	51.30
WATER	138.22	138.22
TOTAL	487.32	537.73
FRESH FEED	537.73	
WEIGHT BALANCE	90.63	
WET GAS FACTOR	1169274	
INDICATED LOSS—S C F H	812	

WET GAS	1400	2200	0600	AVERAGE
CO 28.010	7.86	8.20	8.39	8.150
H_2 2.016	38.81	38.83	38.77	38.803
CO_2 44.010	30.22	30.62	30.72	30.520
N_2 28.016	1.49	1.45	1.46	1.466
CH_4 16.042	9.64	0.39	9.07	0.366
C_2H_4 28.052	2.53	2.57	2.64	2.580
C_2H_6 30.068	1.85	1.79	1.75	1.797
C_3H_6 42.078	3.14	2.98	2.99	3.037
C_3H_8 44.094	0.29	0.29	0.28	0.287
C_4H_8 56.104	2.13	1.94	1.98	2.017
C_4H_{10} 58.120	0.57	0.57	0.57	0.570
C_5H_{10} 70.130	0.96	0.87	0.87	0.900
C_5H_{12} 72.146	0.25	0.24	0.25	0.247
C_6H_{12} 84.156	0.26	0.26	0.26	0.260
			M. W.	23.569744

GAS FLOW RATES

	$\sqrt{H}$	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.563	408.8 20.579	71 0.9896	2261446 1.5038	15,941	42.005
WET GAS 158.44	6.854	1.51 4.026	71 0.9896	1228269 1.1083	4,795	12.635
RECYCLE 79.31	8.529	410.8 20.628	128 0.9404	1.1083	14,543	38.321
BLEED 5.02	8.867	20.628	1.0000	1.1083	1,018	2,682
NATURAL GAS 28.43	7.708	446.9 21.485	200 0.8876	1437830 1.1991	5,011	13.204
OXYGEN 27.07	6.983	439.3 21.307	74 0.9868		3,974	10.472
STEAM 215.7	6.579	28.7 4.7 33.4 0.2866		407 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'4½"	390.78	63	0.9985	390.19	51.2		
	6'10¾"	365.68	60	1.0000	365.68	6.448		
	3'4"	179.09	60	1.0000	179.09			
	0'4"	17.70	68	0.9961	17.63			
					+4.96		+32.00	51.30
					190.93		1231.12	7.955
WATER	7'3½"	386.41	74	0.99846	385.81	10.8		
	6'4"	336.22	75	0.99832	335.66	8.282		
	7'1½"	377.68	77	0.99804	376.94			
	1'8¾"	90.37	69	0.99907	90.29			
	2'2¼"	115.92	76	0.99819	115.71			
	1'0"	52.00	64	0.99963	51.98			138.22
					400.53		3317.19	16.689

THE TEXAS COMPANY — MONTEBELLO LABORATORY

YIELD CALCULATIONS

RUN NO. 63-K
HOURS 216-240
CATALYST Mill Scale Red. at Brownsville

	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
CO 28.010	36.430	15.432	432.28	8.256	1.210	33.89	3.435	18.867	4.645	-14.222	-398.39				
H_2 2.016	61.240	25.943	52.30	40.136	5.880	11.85	16.701	42.644	22.581	-20.063	-40.45				
CO_2 44.010	1.927	0.816	35.91	28.863	4.229	186.08	12.010	12.826	16.239	3.413	150.17	9.564			
N_2 28.016	0.263	0.111	3.11	1.397	0.205	5.74	0.581	0.692	0.786						
CH_4 16.042	0.140	0.059	0.95	9.376	1.374	22.04	3.901	3.960	5.275	1.315	21.09	1.343			
C_2H_4 28.052				2.527	0.370	10.38	1.051	1.051	1.421	0.370	10.38	0.661			
C_2H_6 30.068				1.837	0.269	8.09	0.764	0.764	1.033	0.269	8.09	0.515			
C_1+C_2											39.56	2.519			
C_3H_6 42.078				3.140	0.460	19.36	1.307	1.307	1.767	0.460	19.36	1.233	4.32	4.481	0.285
C_3H_8 44.094				0.327	0.048	2.12	0.136	0.136	0.184	0.048	2.12	0.135	4.24	0.500	0.032
C_4H_8 56.104				2.077	0.304	17.06	0.864	0.864	1.168	0.304	17.06	1.087	5.00	3.412	0.217
C_4H_{10} 58.120				0.647	0.095	5.52	0.269	0.269	0.364	0.095	5.52	0.352	4.86	1.136	0.072
C_5H_{10} 70.130				0.940	0.138	9.68	0.391	0.391	0.529	0.138	9.68	0.617	5.45	1.776	0.113
C_5H_{12} 72.146				0.177	0.026	1.88	0.074	0.074	0.100	0.026	1.88	0.120	5.25	0.358	0.023
C_6H_{12} 84.156				0.300	0.044	3.70	0.125	0.125	0.169	0.044	3.70	0.236	5.54	0.668	0.043
C_3-C_6											59.32	3.780		12.331	0.785
TOTAL		42.361	524.55		14.652	337.39	41.610	83.971	63.698						
H_2+CO	97.670	41.375	15701	SCFH	7.090		20.136	61.511	27.226	-34.285					
H_2/CO		1.68	Factor	636902	4.86		4.86	2.26	4.86	1.41					

							NET CHANGE m/hr	NET CHANGE #/hr	#/MCF	#/gal	gal/hr	gal/MCF
Weight Recovery, %	92.84	Catalyst Age, hrs.	240	Space Velocity, vhv	1133	RECOVERED OIL	0.357**	50.08	3.190		7.770	0.495
Pressure, psig	409	Inlet Velocity, Ft/sec	1.01	Catalyst Vol.,CF	13.86	TOTAL OIL		109.40	6.970		20.101	1.280
Temperature, °F	661	Bed Depth, Ft	21.00	Weight, #	2079	WATER SOLUBLE CHEMICALS	0.272**	14.45	0.920		1.820	0.116
Recycle Ratio	0.99	Bed Density, #/CF	150	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$	= 11.60	TOTAL LIQUID PRODUCTS C_3+		123.85	7.890		21.921	1.396
					SELECTIVITY	NET WATER	6.807**	122.63	7.810		14.722	0.933
					C_3+/C_1+	GROSS WATER		137.08	8.730		16.542	1.054
					75.79	HYDROCARBON TOTAL—C_1+		163.41	10.409			

FRESH FEED CONVERSION — % Contraction	CO	H_2	H_2+CO	TOTAL FEED CONVERSION — % CO	H_2	CO+H_2
65.41	92.16	77.33	82.86	75.38	47.05	55.74

YIELD BASIS H_2+CO FED — YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	85.0	6.605	98.0	6.473
400-550	10.4	0.808	91.4	0.739
550 +	4.6	0.357	114.6	0.409

	RECOVERY %	#/hr	gal/hr
PROPYLENE	40.8	7.90	
C_3 POLY GASO.	87.5	6.91	1.156
C_3 POLY TAR	12.5	0.99	0.131

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	14.93	2.496	1.5
C_4H_{10}	4.86	(5.52) 5.45	(1.136) 1.121	68.0
C_4-FREE GASO.			10.431	5.8
C_4 POLY TAR	7.53	2.13	0.283	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	14.048	0.8947	4851
GAS OIL	0.739	0.0471	255
FUEL OIL	0.409	0.0260	141
POLY TAR	0.414	0.0264	143
TOTAL	15.610	0.9942	5390
W. S. CHEM.	1.920	0.1159	628
TOTAL	17.430	1.1101	6018

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91×#/MCF

*9488 MCFH H_2 + CO, Bbl/Day = 5421.6×gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	438	Fresh Feed	16,076
Natural Gas	450	Recycle	15,891
Generator Outlet	414	Combined Feed	31,967
Reactor Inlet	409	Wet Gas—Measured	4,941
Condenser Inlet		Adjusted	5,560
Product Accumulator	359	Loss	619
TEMPERATURES—°F.		Recycle/Fresh Feed	0.99
Oxygen	481	Inlet Velocity—ft./sec.	1.01
Natural Gas	787	Fresh Feed Rate—S.C.F.H. H_2 + CO	15701
Generator	2294	per Cu.Ft. Dense Bed	1133
Quench Accumulator	124	per Lb. Catalyst	7.55
Reactor Inlet	358	per Sq. Ft.	23789
Condenser Inlet	593		
Product Accumulator	95	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 404#/hr.	
1 See Period A	-	@705 psia & 506°F. =	
2	660	1201 Btu/#	
3	652	Water in @62°F = 30 Btu/#	
4	662	Net Heat Trans/# steam =	
5	668	1171 Btu	
6	667	(1171)(404) = 473,084 Btu/hr.	
7	662	Ave. Bed Temp. = 661°F.	
8	656	dT = 661-506 = 155°F.	
9	650	Tube Area = 37.6 sq. ft.	
10	646	K = $\frac{473,084}{(37.6)(155)}$ =	
11	528	81.2 Btu/°F/sq.ft.	

PRODUCT TESTS

	OIL	WATER
°API	51.3	10.7
Neut. No.	49.3	35.2
Sap. No.	61.0	39.0
Hydrox. No.		
Bromine No.	78	
Pour °F.		
Chemicals, % by K_2CO_3		11.0
HEMPEL. DIST. %		°API
205 °F.		
400	84.0	53.5
400-550	10.4	34.0
550+	5.6	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	98	
10%	130	
50%	220	
90%	334	
EP	394	
Rec.	37.4	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	39.5
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	
1	72
2	87
3	68
4	350
Total	577
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	150
Inventory, Lbs.	2079
Bed Depth, Ft.	21.00
Vol., Cu. Ft.	13.86

PARTICLE SIZE

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
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 / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	36.51	36.50	36.28	36.430	15.432	15.432		15.432
H_2 2.016	61.00	61.27	61.45	61.240	25.943		51.886	
CO_2 44.010	2.06	1.79	1.93	1.927	0.816	0.816		1.632
N_2 28.016	0.34	0.24	0.21	0.263	0.111			
CH_4 16.042	0.09	0.20	0.13	0.140	0.059	0.059	0.236	
			M. W	12.38286				
			H_2O 18.016				7.021	3.511
						16.307	59.143	20.575
			BALANCE			100.28	102.22	96.97

	Mol %	M/Hr	C	H	O
O_2 32.000	0.21	10.408 0.028			20.872
CO_2 44.010	1.31	0.173	0.173		0.346
N_2 28.016	1.41	0.187			
CH_4 16.042	82.79	10.952	10.952	43.808	
C_2H_6 30.068	6.79	0.898	1.796	5.388	
C_3H_8 44.094	5.31	0.702	2.106	5.616	
C_4H_{10} 58.120	1.56	0.206	0.824	2.060	
C_5H_{12} 72.146	0.62	0.082	0.410	0.984	
MW = 20.056914					
TOTAL			16.261	57.856	21.218

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	299.81	337.39
OIL	50.08	50.08
WATER	137.08	137.08
TOTAL	486.97	524.55
FRESH FEED	524.55	
WEIGHT BALANCE	92.84	
WET GAS FACTOR	1125346	
INDICATED LOSS—S C F H	619	

WET GAS	1400	2200	0600	AVERAGE
CO 28.010	8.20	7.98	8.59	8.256
H_2 2.016	39.74	40.53	40.14	40.136
CO_2 44.010	29.38	28.77	28.44	28.863
N_2 28.016	1.39	1.32	1.48	1.397
CH_4 16.042	9.23	9.69	9.21	9.376
C_2H_4 28.052	2.54	2.56	2.48	2.527
C_2H_6 30.068	1.86	1.81	1.84	1.837
C_3H_6 42.078	3.15	3.16	3.11	3.140
C_3H_8 44.094	0.33	0.33	0.32	0.327
C_4H_8 56.104	2.09	2.00	2.14	2.077
C_4H_{10} 58.120	0.58	0.57	0.79	0.647
C_5H_{10} 70.130	1.00	0.88	0.94	0.940
C_5H_{12} 72.146	0.14	0.14	0.25	0.177
C_6H_{12} 84.156	0.37	0.26	0.27	0.300
			M. W.	23.0271

GAS FLOW RATES

	√h	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED 79.31	6.492	408.7 / 20.577	68 / 0.9924	2337909 / 1.5290	16,076	42.361
WET GAS 158.44	6.963	1.50 / 4.025	68 / 0.9924	1257214 / 1.1213	4,941	13.020
RECYCLE 79.31	8.554	409.5 / 20.596	124 / 0.9436	1.1213	14,784	38.957
BLEED 5.02	8.688	20.596	1.0000	1.1213	1,007	2.653
NATURAL GAS 28.43	7.667	450.2 / 21.562	198 / 0.8890	1443392 / 1.2014	5,020	13.228
OXYGEN 27.07	6.917	437.9 / 21.274	69 / 0.9915		3,950	10.408
STEAM 215.7	6.504	29.1 + 4.7 = 33.8 / 0.2882		404 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#HR GAL HR
OIL	6'9⅛"	360.22	57	1.0015	360.76	51.3		
	3'4"	179.09	60	1.0000	179.09	6.445		
					+4.81		+31.00	50.08
					186.48		1201.86	7.770
WATER	7'2¾"	383.14	78	0.99788	382.33	10.7		
	2'2¼"	115.92	76	0.99819	115.71	8.287		
	3'7¼"	193.28	71	0.99883	193.05			
	1'2⅛"	62.73	70	0.99896	62.66			137.08
					397.01		3290.02	16.542

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-L
HOURS 240-264
CATALYST

	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
CO 28.010	37.170	15.763	441.53	9.120	1.408	39.44	3.825	19.588	5.233	-14.355	-402.09				
H_2 2.016	60.604	25.701	51.81	41.153	6.354	12.81	17.260	42.961	23.614	-19.347	-39.00				
CO_2 44.010	1.790	0.759	33.40	27.710	4.278	188.26	11.621	12.380	15.899	3.519	154.86	9.841			
N_2 28.016	0.173	0.073	2.05	1.493	0.231	6.47	0.626	0.699	0.857						
CH_4 16.042	0.263	0.112	1.80	9.313	1.438	23.07	3.906	4.018	5.344	1.326	21.27	1.352			
C_2H_4 28.052				2.417	0.373	10.46	1.014	1.014	1.387	0.373	10.46	0.665			
C_2H_6 30.068				1.767	0.273	8.21	0.741	0.741	1.014	0.273	8.21	0.522			
C_1+C_2											39.94	2.539			
C_3H_6 42.078				2.790	0.431	18.14	1.170	1.170	1.601	0.431	18.14	1.153	4.32	4.199	0.267
C_3H_8 44.094				0.287	0.044	1.94	0.120	0.120	0.164	0.044	1.94	0.123	4.24	0.458	0.029
C_4H_8 56.104				1.863	0.288	16.16	0.781	0.781	1.069	0.288	16.16	1.027	5.00	3.232	0.205
C_4H_{10} 58.120				0.740	0.114	6.63	0.310	0.310	0.424	0.114	6.63	0.421	4.86	1.364	0.087
C_5H_{10} 70.130				0.830	0.128	8.98	0.348	0.348	0.476	0.128	8.98	0.571	5.45	1.648	0.105
C_5H_{12} 72.146				0.260	0.040	2.89	0.109	0.109	0.149	0.040	2.89	0.184	5.25	0.550	0.035
C_6H_{12} 84.156				0.257	0.040	3.37	0.108	0.108	0.148	0.040	3.37	0.214	5.54	0.608	0.039
C_3-C_6											58.11	3.693		12.059	0.767
TOTAL		42.408	530.59		15.440	346.83	41.939	84.347	64.543						
H_2+CO	97.774	41.464	15736	SCFH	7.762		21.085	62.549	28.847	-33.702					
H_2/CO		1.63	Factor 635485		4.51		4.51	2.19	4.51	1.35					

Weight Recovery, %	92.18	Catalyst Age, hrs.	264	Space Velocity, vhv	1149	RECOVERED OIL	0.357**	50.02	3.179		7.757	0.493
Pressure, psig	408	Inlet Velocity, Ft/sec	1.01	Catalyst Vol., CF	13.70	TOTAL OIL		108.13	6.872		19.816	1.260
Temperature, °F	661	Bed Depth, Ft	20.76	Weight, #	2041	WATER SOLUBLE CHEMICALS	0.316**	16.79	1.067		2.098	0.133
Recycle Ratio	0.99	Bed Density, #/CF	149	Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ =	11.05	TOTAL LIQUID PRODUCTS C_3+		124.92	7.939		21.914	1.393
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %	SELECTIVITY	NET WATER	6.491**	116.95	7.432		14.040	0.892
Contraction	CO	H_2	H_2+CO	CO / H_2 / CO+H_2	C_3+/C_1+	GROSS WATER		133.74	8.499		16.138	1.025
63.59	91.07	75.28	81.28	73.28 / 45.03 / 53.88	75.77	HYDROCARBON TOTAL—C_1+		164.86	10.478			

YIELD BASIS H_2+CO FED — YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*

	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	86.2	6.687	98.0	6.553
400-550	8.2	0.636	91.4	0.581
550 +	5.6	0.434	114.6	0.497
	RECOVERY %	#/hr	gal/hr	
PROPYLENE	38.6	7.00		
C_3 POLY GASO.	87.5	6.12	1.023	
C_3 POLY TAR	12.5	0.88	0.117	
	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	14.14	2.365	1.5
C_4H_{10}	4.86	(6.63) 5.34	(1.364) 1.098	68.0
C_4-FREE GASO.			10.382	5.8
C_4 POLY TAR	7.53	2.02	0.268	
	gal/hr	gal/MCF	Bbl/Day	
10 # RVP 400 EP GASOLINE	13.845	0.8798	4770	
GAS OIL	0.581	0.0369	200	
FUEL OIL	0.497	0.0316	171	
POLY TAR	0.385	0.0245	133	
TOTAL	15.308	0.9728	5274	
W. S. CHEM.	2.098	0.1333	723	
TOTAL	17.406	1.1061	5997	

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91 × #/MCF

*9488 MCFH H_2 + CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	436	Fresh Feed	16,094
Natural Gas	459	Recycle	15,916
Generator Outlet	413	Combined Feed	32,010
Reactor Inlet	408	Wet Gas—Measured	5,159
Condenser Inlet		Adjusted	5,860
Product Accumulator	358	Loss	701
TEMPERATURES—°F.		Recycle/Fresh Feed	0.99
Oxygen	492	Inlet Velocity—ft./sec.	1.01
Natural Gas	765	Fresh Feed Rate—S.C.F.H. H_2 + CO	15,736
Generator	2264	per Cu. Ft. Dense Bed	1149
Quench Accumulator	109	per Lb. Catalyst	7.71
Reactor Inlet	353	per Sq. Ft.	23842
Condenser Inlet	597		
Product Accumulator	91	Heat Transfer Calculations	
Catalyst No. Height		Steam Rate = 399#/hr.	
1 See Period A	-	@705 psia & 506°F.=	
2	661	1201 Btu/#	
3	650	Water in @56°F = 24 Btu/#	
4	660	Net Heat Trans/# steam=	
5	668	1177 Btu	
6	668	(1177)(399) = 469,623 Btu/hr.	
7	663	Ave. Bed Temp. = 661°F.	
8	659	dT = 661-506 = 155°F.	
9	651	Tube AREA = 37.5 Sq. ft.	
10	648	$K = \frac{469,623}{(37.5)(155)} = 80.3$ Btu/°F.sq.ft.	
11			

PRODUCT TESTS

	OIL	WATER
°API	51.2	10.7
Neut. No.	48.5	37.4
Sap. No.	65.1	39.2
Hydrox. No.		
Bromine No.	76	
Pour °F.		
Chemicals, % by K_2CO_3		13.0
HEMPEL. DIST. %		°API
205 °F.		
400	85.2	52.8
400-550	8.2	34.0
550+	6.6	
A. S. T. M. DIST. ON Naphtha °F.		
IBP	98	
10%	128	
50%	210	
90%	330	
EP	394	
Rec.	97.9	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	11
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	-
1	71
2	90
3	65
4	340
Total	566
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	149
Inventory, Lbs.	2041
Bed Depth, Ft.	20.76
Vol., Cu. Ft.	13.70

PARTICLE SIZE

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

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

GAS ANALYSES / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O		Mol %	M/Hr	C	H	O
FRESH FEED									O_2 32.000	0.23	10.472 0.031			21.006
CO 28.010	37.12	37.44	36.95	37.170	15.763	15.763		15.763	CO_2 44.010	1.19	0.160	0.160		0.320
H_2 2.016	60.55	60.41	60.85	60.604	25.701		51.402		N_2 28.016	1.39	0.186			
CO_2 44.010	1.78	1.81	1.78	1.790	0.759	0.759		1.518	CH_4 16.042	82.49	11.062	11.062	44.248	
N_2 28.016	0.14	0.19	0.19	0.173	0.073				C_2H_6 30.068	7.35	0.986	1.972	5.916	
CH_4 16.042	0.41	0.15	0.23	0.263	0.112	0.112	0.448		C_3H_8 44.094	5.34	0.716	2.148	5.728	
			M. W	12.51153					C_4H_{10} 58.120	1.48	0.198	0.792	1.980	
			H_2O 18.016				7.482	3.741	C_5H_{12} 72.146	0.53	0.071	0.355	0.852	
						16.634	59.332	21.022	MW = 20.026955					
			BALANCE			100.88	101.04	98.57	TOTAL			16.489	58.724	21.326

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	305.36	346.83
OIL	50.02	50.02
WATER	133.74	133.74
TOTAL	489.12	530.59
FRESH FEED	530.59	
WEIGHT BALANCE	92.18	
WET GAS FACTOR	1135806	
INDICATED LOSS—S C F H	701	

WET GAS	1400	2200	0600	AVERAGE
CO 28.010	9.76	8.62	8.98	9.120
H_2 2.016	40.62	40.93	41.91	41.153
CO_2 44.010	27.21	28.32	27.60	27.710
N_2 28.016	1.26	1.71	1.51	1.493
CH_4 16.042	9.84	9.12	8.98	9.313
C_2H_4 28.052	2.39	2.38	2.48	2.417
C_2H_6 30.068	1.76	1.75	1.79	1.767
C_3H_6 42.078	2.75	2.83	2.79	2.790
C_3H_8 44.094	0.27	0.29	0.30	0.287
C_4H_8 56.104	1.94	1.90	1.75	0.863
C_4H_{10} 58.120	0.78	0.77	0.67	0.740
C_5H_{10} 70.130	0.89	0.85	0.75	0.830
C_5H_{12} 72.146	0.26	0.26	0.26	0.260
C_6H_{12} 84.156	0.27	0.27	0.23	0.257
			M. W.	22.46269

GAS FLOW RATES

		√H	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED	79.31	6.521	407.9 / 20.557	65 / 0.9952	2313865 / 1.5211	16,094	42.408
WET GAS	158.44	7.150	1.57 / 4.034	66 / 0.9943	1288803 / 1.1353	5,159	13.594
RECYCLE	79.31	8.546	407.9 / 20.557	123 / 0.9444	1.1353	14,939	39.365
BLEED	5.02	8.338	20.557	1.0000	1.1353	977	2.574
NATURAL GAS	28.43	7.721	458.6 / 21.755	202 / 0.8863	1445551 / 1.2023	5,089	13.410
OXYGEN	27.07	6.963	435.8 / 21.225	67 / 0.9933		3,974	10.472
STEAM	215.7	6.392	29.5 + 4.7 = 34.2 / 0.2897		399 #/hr.		

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'0"	371.14	54	1.0030	372.25	51.2		
	6'9½"	360.22	57	1.0015	360.76	6.448		
	3'7¼"	193.28	54	1.0030	193.86			
	0'5½"	24.34	50	1.0049	24.46			
					+5.27		+34.00	50.02
					186.16		1200.36	7.757
WATER	7'3¾"	387.50	76	0.99819	386.80	10.7		
	3'7¼"	193.28	71	0.99883	193.05	8.287		
	4'7¾"	247.83	66	0.99942	247.69			
	1'0¼"	54.14	63	0.99973	54.13			133.74
					387.31		3209.64	16.138

THE TEXAS COMPANY — MONTEBELLO LABORATORY

YIELD CALCULATIONS

RUN NO. 63-M
HOURS 264-288
CATALYST

FRESH FEED	%	m/hr	#/hr
CO 28.010	37.023	15.813	442.90
H_2 2.016	60.677	25.915	52.24
CO_2 44.010	1.673	0.715	31.47
N_2 28.016	0.227	0.097	2.72
CH_4 16.042	0.400	0.171	2.74
C_2H_4 28.052			
C_2H_6 30.068			
C_3+C_4			
C_3H_8 42.078			
C_3H_6 44.094			
C_4H_8 56.104			
C_4H_{10} 58.120			
C_5H_{10} 70.130			
C_5H_{12} 72.146			
C_6H_{12} 84.156			
C_5-C_6			
TOTAL		42.711	532.07
H_2+CO	97.700	41.728	15836 SCFH
H_2/CO		1.64	Factor 631472

WET GAS	%	At Wt. Balance m/hr	At Wt. Balance #/hr
CO 28.010	9.103	1.453	40.70
H_2 2.016	42.147	6.729	13.57
CO_2 44.010	27.133	4.333	190.70
N_2 28.016	1.507	0.241	6.75
CH_4 16.042	8.957	1.430	22.94
C_2H_4 28.052	2.423	0.387	10.86
C_2H_6 30.068	1.737	0.277	8.33
C_3H_8 42.078	2.807	0.448	18.35
C_3H_6 44.094	0.310	0.049	2.16
C_4H_8 56.104	1.893	0.302	16.94
C_4H_{10} 58.120	0.627	0.100	5.81
C_5H_{10} 70.130	0.873	0.139	9.75
C_5H_{12} 72.146	0.203	0.032	2.31
C_6H_{12} 84.156	0.280	0.045	3.79
C_5-C_6			
TOTAL		15.965	353.46
H_2+CO	8.182		
H_2/CO	4.63		

RECYCLE m/hr	COMBINED FEED m/hr	EFFLUENT m/hr	NET CHANGE m/hr	NET CHANGE #/hr
3.878	19.691	5.331	-14.360	-402.20
17.956	43.071	24.685	-19.186	-38.67
11.559	12.274	16.607	3.618	159.23
0.642	0.739	0.980		
3.816	3.987	5.417	1.259	20.20
1.032	1.032	1.419	0.387	10.86
0.740	0.740	1.017	0.277	8.33
				39.39
1.196	1.196	1.644	0.448	18.85
0.132	0.132	0.181	0.049	2.16
0.806	0.806	1.108	0.302	16.94
0.267	0.267	0.367	0.100	5.81
0.372	0.372	0.511	0.139	9.75
0.086	0.086	0.118	0.032	2.31
0.119	0.119	0.164	0.045	3.79
				59.61
42.601	85.312	65.635		
21.834	63.562	55.931	-33.546	
4.63	2.23	4.63	1.34	

YIELD BASIS H_2+CO FED — CONDENSATE	#/MCF	#/gal	gal/hr	gal/MCF
	10.055			
	0.980			
	1.276			
	0.686			
	0.526			
	2.488			
	1.190	4.32	4.363	0.276
	0.136	4.24	0.509	0.032
	1.070	5.00	3.388	0.214
	0.367	4.86	1.195	0.075
	0.616	5.45	1.789	0.113
	0.146	5.25	0.440	0.028
	0.239	5.54	0.684	0.043
	3.764		12.368	0.781

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*	CORRECTED HEMPEL. %	gal/hr	TREATING RECOVERY.%	gal/hr
400 EP	83.5	6.173	98.0	6.050
400-550	11.2	0.828	91.4	0.757
550 +	5.3	0.392	114.6	0.449
	RECOVERY %	#/hr	gal/hr	
PROPYLENE	37.6	7.09		
C_3 POLY GASO.	87.5	6.20	1.037	
C_3 POLY TAR	12.5	0.89	0.118	
	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	14.82	2.479	1.5
C_4H_{10}	4.86	(5.81) 5.28	(1.195) 1.087	68.0
C_4 FREE GASO.			10.000	5.8
C_4 POLY TAR	7.53	2.12	0.282	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	13.566	0.8567	4645
GAS OIL	0.757	0.0478	259
FUEL OIL	0.449	0.0284	154
POLY TAR	0.400	0.0253	137
TOTAL	15.172	0.9582	5195
W. S CHEM.	1.902	0.1201	651
TOTAL	17.074	1.0783	5846

Weight Recovery, %	90.70	Catalyst Age, hrs.	288	Space Velocity, vhv	1187	RECOVERED OIL	0.338##	47.46	2.997	7.393	0.467
Pressure, psig	406	Inlet Velocity, Ft/sec	1.02	Catalyst Vol., CF	13.34	TOTAL OIL		107.07	6.761	19.761	1.248
Temperature, °F	658	Bed Depth, Ft	20.21	Weight, #	1961	WATER SOLUBLE CHEMICALS	0.283##	14.99	0.947	1.902	0.120
Recycle Ratio	1.00	Bed Density, #/CF	147	Effluent $(H_2)(CO_2)$ / Shift Ratio $(H_2O)(CO)$ = 11.93		TOTAL LIQUID PRODUCTS C_5^+		122.06	7.708	21.663	1.368
						WET WATER	6.448##	116.16	7.335	13.945	0.881
						GROSS WATER		131.15	8.282	15.847	1.001
						HYDROCARBON TOTAL—C_1^+		161.45	10.196		

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3^+/C_1^+
62.62	90.81	74.03	80.39	72.93	43.73	52.78	75.60

Form ML—11

##Included in Reactor Effluent Total

g/NCM = 16.91 × ¢/MCF ©9488 MCFH H_2+CO. Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS		RATES S.C.F.H.	
PRESSURES PSIG			
Oxygen	435	Fresh Feed	16,209
Natural Gas	471	Recycle	16,167
Generator Outlet	411	Combined Feed	32,376
Reactor Inlet	406	Wet Gas—Measured	5,210
Condenser Inlet		Adjusted	6,058
Product Accumulator	356	Loss	848
TEMPERATURES—°F.		Recycle/Fresh Feed	1.00
Oxygen	511	Inlet Velocity—ft./sec.	1.02
Natural Gas	771	Fresh Feed Rate—S.C.F.H. H_2+CO	15836
Generator	2277	per Cu. Ft. Dense Bed	1187
Quench Accumulator	110	per Lb. Catalyst	8.08
Reactor Inlet	354	per Sq. Ft.	23994
Condenser Inlet	590		
Product Accumulator	87		
Catalyst No. Height			
1 See Period A	-		
2	656		
3	649		
4	659		
5 Ave. 658	663		
6	664		
7	660		
8	655		
9	647		
10	645		
11	523		

PRODUCT TESTS	OIL	WATER
°API	52.0	10.9
Neut. No.	49.6	37.2
Sap. No.	65.0	40.5
Hydrox. No.		
Bromine No.	73	
Pour °F.		
Chemicals, % by K_2CO_3		12.0
Recycle/Fresh Feed		
Inlet Velocity—ft./sec.		
Fresh Feed Rate—S.C.F.H. H_2+CO		
HEMPEL. DIST. %		°API
205 °F.		
400	82.5	53.6
400-550	11.2	34.9
550+	6.3	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	92	
10%	124	
50%	198	
90%	328	
EP	384	
Rec.	97.0	

CATALYST DATA — INVENTORY DATA		PARTICLE SIZE	Screen Analysis		Sedimentation	
In Reactor at Start of Period		Mesh	Microns	%	Microns	%
Fresh Catalyst Added		On 40	419+		80+	
Total		100	150		40—80	
Catalyst Recovered	33	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				
0 See Period A						
1	70	CATALYST				
2	88	Bulk Density, Lbs./Cu.Ft.				
3	65	Aerated				
4	320	Settled				
Total	543	Compacted				
		Particle Density, gm./cc.				
CALCULATED FROM dp		NH_3 Value, ml./gm.				
Density, Lbs./Cu.Ft.	147	N_2 Surface, m^2 gm.				
Inventory, Lbs.	1961					
Bed Depth, Ft.	20.21	CHEMICAL ANALYSIS				
Vol., Cu. Ft.	13.34	Fe				
		C				
		O				
		H				
		K₂O. W+. % basis Fe				
		X-Ray Analysis—				
		$Fe_{20}C_9$				
		Fe_3O_4				
		Fe				

GAS ANALYSES — HOUR	1400	2200	0600	AVERAGE
FRESH FEED				
CO 28.010	37.13	37.02	36.92	37.023
H_2 2.016	60.29	60.94	60.80	60.677
CO_2 44.010	1.79	1.43	1.80	1.673
N_2 28.016	0.19	0.20	0.29	0.227
CH_4 16.042	0.60	0.41	0.19	0.400
			M. W	12.45744
			H_2O 18.016	
			BALANCE	
WET GAS				
CO 28.010	8.99	9.29	9.03	9.103
H_2 2.016	42.62	42.56	41.26	42.147
CO_2 44.010	26.87	26.72	27.81	27.133
N_2 28.016	1.37	1.56	1.59	1.507
CH_4 16.042	9.23	9.07	8.57	8.957
C_2H_4 28.052	2.37	2.37	2.53	2.423
C_2H_6 30.068	1.69	1.74	1.78	1.737
C_3H_8 42.078	2.81	2.65	2.96	2.807
C_3H_6 44.094	0.33	0.28	0.32	0.310
C_4H_8 56.104	1.83	1.80	2.05	1.893
C_4H_{10} 58.120	0.58	0.65	0.65	0.627
C_5H_{10} 70.130	0.87	0.81	0.94	0.873
C_5H_{12} 72.146	0.17	0.22	0.22	0.203
C_6H_{12} 84.156	0.27	0.28	0.29	0.280
			M. W.	22.1403

GENERATOR BALANCE	M/HR	C	H	O
FRESH FEED				
CO 28.010	15.813	15.813		15.813
H_2 2.016	25.915		51.830	
CO_2 44.010	0.715	0.715		1.430
N_2 28.016	0.097			
CH_4 16.042	0.171	0.171	0.684	
			6.717	3.359
		16.699	59.231	20.602
TOTAL	102.84	102.93	96.07	

	Mol %	M/Hr	C	H	O
O_2 32.000	0.26	10.495 0.035			21.060
CO_2 44.010	1.44	0.192	0.192		0.384
N_2 28.016	2.53	0.350			
CH_4 16.042	81.30	10.815	10.815	43.260	
C_2H_6 30.068	6.87	0.914	1.828	5.484	
C_3H_8 44.094	5.15	0.685	2.055	5.480	
C_4H_{10} 58.120	1.63	0.217	0.868	2.170	
C_5H_{12} 72.146	0.72	0.096	0.480	1.152	
MW =	20.29923				
TOTAL			16.238	57.546	21.444

GAS FLOW RATES	V/H	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED		406.1	69	23.23912		
	6.592	20.513	0.9915	1.5244	16,209	42.711
WET GAS		1.68	67	1307567		
	7.154	4.047	0.9933	1.1435	5,210	13.729
RECYCLE		406.0	122			
	8.600	20.511	0.9452	1.1435	15,121	39.845
BLEED						
	8.883	20.511	1.0000	1.1435	1,046	2.756
NATURAL GAS		470.9	201	1426162		
	7.608	22.036	0.8870	1.1942	5,049	13.304
OXYGEN		435.4	73			
	7.021	21.216	0.9877		3,983	10.495
STEAM						
	6.142					

WEIGHT BALANCE	# hr Measured	At Wt. Balance
WET GAS	303.96	353.46
OIL	47.46	47.46
WATER	131.15	131.15
TOTAL	482.57	532.07
FRESH FEED	532.07	
WEIGHT BALANCE	90.70	
WET GAS FACTOR	1162850	
INDICATED LOSS—S C F H	848	

LIQUID PRODUCT RATES	HOUR	GAGE	GAL	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR. GAL HR
OIL		6'10"	362.41	57	1.0015	362.95	52.0		
		3'7½"	193.28	54	1.0030	193.86	6.420		
						48.33		453.50	47.46
						177.42		1139.04	7.393
WATER		7'11¾"	377.68	80	0.99759	376.77	10.9		
		4'7½"	247.83	66	0.99942	247.69	8.276		
		6'5½"	342.76	67	0.99932	342.53			
		1'9"	91.50	80	0.99759	91.28			131.15
						380.33		3147.61	15.847

THE TEXAS COMPANY — MONTEBELLO LABORATORY

YIELD CALCULATIONS

RUN NO. 63-N
HOURS 288-312
CATALYST Mill Scale Red. at Brownsville

FRESH FEED	%	m/hr	#/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	37.337	15.892	445.13	10.000	1.656	46.38	4.217	20.109	5.873	-14.236	-398.75
H_2 2.016	60.276	25.656	51.72	42.387	7.022	14.16	17.875	43.531	24.897	-18.634	-37.56
CO_2 44.010	1.970	0.839	36.92	26.920	4.459	196.27	11.352	12.191	15.811	3.620	159.35
N_2 28.016	0.207	0.088	2.47	1.353	0.224	6.28	0.571	0.659	0.795		
CH_4 16.042	0.210	0.089	1.43	8.390	1.390	22.30	3.538	3.627	4.928	1.301	20.87
C_2H_4 28.052				2.380	0.394	11.05	1.004	1.004	1.398	0.394	11.05
C_2H_6 30.068				1.680	0.278	8.36	0.708	0.708	0.986	0.278	8.36
C_3+C_4											40.28
C_3H_6 42.078				2.683	0.444	18.68	1.131	1.131	1.575	0.444	18.68
C_3H_8 44.094				0.277	0.046	2.03	0.117	0.117	0.163	0.046	2.03
C_4H_8 56.104				1.873	0.310	17.39	0.790	0.790	1.100	0.310	17.39
C_4H_{10} 58.120				0.647	0.107	6.22	0.273	0.273	0.380	0.107	6.22
C_5H_{10} 70.130				0.903	0.150	10.52	0.381	0.381	0.531	0.150	10.52
C_5H_{12} 72.146				0.210	0.035	2.53	0.089	0.089	0.124	0.035	2.53
C_6H_{12} 84.156				0.297	0.049	4.12	0.125	0.125	0.174	0.049	4.12
C_5-C_6											61.49
TOTAL		42.564	537.67		16.564	366.29	42.171	84.735	65.554		
H_2+CO	97.613	41.548	15767 SCFH		8.678		22.092	63.640	30.770	-32.870	
H_2/CO		1.61	Factor 634236		4.24		4.24	2.16	4.24	1.31	

CONDENSATE #/MCF	#/gal	gal/hr	gal/MCF
0.701			
0.530			
2.555			
1.185	4.32	4.324	0.274
0.129	4.24	0.479	0.030
1.103	5.00	3.478	0.221
0.394	4.86	1.280	0.081
0.667	5.45	1.930	0.122
0.160	5.25	0.482	0.031
0.261	5.54	0.744	0.047
3.899		12.717	0.806

YIELD BASIS H_2+CO FED

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*	CORRECTED HEMPEL, %	gal/hr	TREATING RECOVERY, %	gal/hr
400 EP	83.5	5.793	98.0	5.677
400-550	11.0	0.763	91.4	0.697
550 +	5.5	0.382	114.6	0.438

	RECOVERY %	#/hr	gal/hr
PROPYLENE	36.1	6.74	
C_3 POLY GASO.	87.5	5.90	0.987
C_3 POLY TAR	12.5	0.84	0.116

	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	-	-	68.0
C_4 POLY GASO.	5.98	15.22	2.545	1.5
C_4H_{10}	4.86	(6.22) 5.27	(1.280) 1.084	68.0
C_4-FREE GASO.			9.820	5.8
C_4 POLY TAR	7.53	2.17	0.288	

	gal/hr	gal/MCF	Bbl/Day
10 # RVP 400 EP GASOLINE	13.449	0.8530	4625
GAS OIL	0.697	0.0442	240
FUEL OIL	0.438	0.0278	151
POLY TAR	0.404	0.0256	139
TOTAL	14.988	0.9506	5155
W. S. CHEM.	1.837	0.1165	632
TOTAL	16.825	1.0671	5787

Weight Recovery, %	90.99	Catalyst Age, hrs.	312	Space Velocity, vhv	1218	RECOVERED OIL	0.31988	44.76	2.839
Pressure, psig	404	Inlet Velocity, Ft/sec	1.02	Catalyst Vol., CF	12.94	TOTAL OIL		106.25	6.738
Temperature, °F	658	Bed Depth, Ft	19.61	Weight, #	1876	WATER SOLUBLE CHEMICALS	0.27188	14.39	0.913
Recycle Ratio	0.99	Bed Density, #/CF	145	Effluent $\frac{(H_2)(CO_2)}{\text{Shift Ratio } (H_2O)(CO)}$ =	10.76	TOTAL LIQUID PRODUCTS C_5+		120.64	7.651
						NET WATER	6.22988	112.23	7.118
						GROSS WATER		126.62	8.031
						HYDROCARBON TOTAL—C, +		160.92	10.206

FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %			SELECTIVITY
Contraction	CO	H_2	H_2+CO	CO	H_2	$CO+H_2$	C_3+/C_1+
61.08	89.58	72.63	79.11	70.79	42.81	51.65	74.97

Form ML—11

**Included in Reactor Effluent Total

g/NCM = 16.91 × #/MCF

*9488 MCFH H_2 + CO, Bbl/Day = 5421.6 × gal/MCF

OPERATING CONDITIONS				
PRESSURES PSIG		RATES S.C.F.H.		
Oxygen	433	Fresh Feed	16,153	
Natural Gas	472	Recycle	16,004	
Generator Outlet	408	Combined Feed	32,157	
Reactor Inlet	404	Wet Gas—Measured	5,455	
Condenser Inlet		Adjusted	6,286	
Product Accumulator	354	Loss	831	
TEMPERATURES—°F.		Recycle/Fresh Feed	0.99	
Oxygen	463	Inlet Velocity—ft./sec.	1.02	
Natural Gas	780	Fresh Feed Rate—S.C.F.H.	15767	
Generator	2283	per Cu. Ft. Dense Bed	1218	
Quench Accumulator	126	per Lb. Catalyst	8.40	
Reactor Inlet	362	per Sq. Ft.	23889	
Condenser Inlet	598			
Product Accumulator	87			

Catalyst No.	Height	
1	See Period A	-
2		656
3		650
4		660
5	Ave.	663
6		664
7		660
8		654
9		646
10		645
11		530

PRODUCT TESTS	OIL	WATER
°API	51.1	11.0
Neut. No.	49.5	37.6
Sap. No.	64.6	41.0
Hydrox. No.		
Bromine No.	73	
Pour °F.		
Chemicals, % by K_2CO_3		12.0
HEMPEL. DIST. %		°API
205 °F.		
400	82.5	53.4
400-550	11.0	31.2
550+	6.5	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	93	
10%	127	
50%	200	
90%	326	
EP	386	
Rec.	96.2	

CATALYST DATA — INVENTORY DATA		
In Reactor at Start of Period		
Fresh Catalyst Added		
Total		
Catalyst Recovered	42	
In Reactor at End of Period		
REACTOR d-p, Inches H_2O		
No. Height		
0 See Period A		
1	69	
2	85	
3	65	
4	300	
Total	519	
CALCULATED FROM dp		
Density, Lbs./Cu.Ft.	145	
Inventory, Lbs.	1876	
Bed Depth, Ft.	19.61	
Vol., Cu. Ft.	12.94	

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

CATALYST

Bulk Density, Lbs./Cu.Ft.

Aerated

Settled

Compacted

Particle Density, gm./cc.

NH_3 Value, ml./gm.

N_2 Surface, m^2/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	1400	2200	0600	AVERAGE
HOUR				
FRESH FEED				
CO 28.010	37.42	37.27	37.32	37.337
H_2 2.016	60.30	60.30	60.23	60.276
CO_2 44.010	1.71	2.07	2.13	1.970
N_2 28.016	0.19	0.22	0.21	0.207
CH_4 16.042	0.38	0.14	0.11	0.210
			M. W	12.631936
			H_2O 18.016	
			BALANCE	
WET GAS				
CO 28.010	9.48	9.74	10.78	10.000
H_2 2.016	43.06	41.46	42.64	42.387
CO_2 44.010	26.05	27.66	27.05	26.920
N_2 28.016	1.43	1.34	1.29	1.353
CH_4 16.042	9.34	7.77	8.06	8.390
C_2H_4 28.052	2.31	2.43	2.40	2.380
C_2H_6 30.068	1.68	1.69	1.67	1.680
C_3H_6 42.078	2.57	2.94	2.54	2.683
C_3H_8 44.094	0.27	0.26	0.30	0.277
C_4H_8 56.104	1.73	2.25	1.64	1.873
C_4H_{10} 58.120	0.72	0.77	0.45	0.647
C_5H_{10} 70.130	0.86	1.07	0.78	0.903
C_5H_{12} 72.146	0.22	0.25	0.16	0.210
C_6H_{12} 84.156	0.28	0.37	0.24	0.297
			M. W.	22.113455

GENERATOR BALANCE	M/HR	C	H	O
FRESH FEED	15.892	15.892		15.892
	25.656		51.312	
	0.839	0.839		1.678
	0.088			
	0.089	0.089	0.356	
			7.472	3.736
		16.820	59.140	21.306
		101.99	100.94	98.72

	Mol %	M/Hr	C	H	O
O_2 32.000	0.24	10.564 0.032			21.192
CO_2 44.010	1.45	0.195	0.195		0.390
N_2 28.016	1.60	0.215			
CH_4 16.042	82.28	11.058	11.058	44.232	
C_2H_4 30.068	6.98	0.938	1.876	5.628	
C_3H_8 44.094	5.33	0.716	2.148	5.728	
C_4H_{10} 58.120	1.56	0.210	0.840	2.100	
C_6H_{12} 72.146	0.56	0.075	0.375	0.900	
MW =	20.122205				
TOTAL			16.492	58.588	21.582

WEIGHT BALANCE	#/hr Measured	At Wt. Balance
WET GAS	317.86	366.29
OIL	44.76	44.76
WATER	126.62	126.62
TOTAL	489.24	537.67
FRESH FEED	537.67	
WEIGHT BALANCE	90.99	
WET GAS FACTOR	1152362	
INDICATED LOSS—S C F H	831	

GAS FLOW RATES

	$\sqrt{H}$	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
		404.3	68	2291810		
FRESH FEED	6,623	20.469	0.9924	1.5139	16,153	42.564
		1.74	66	1309157		
WET GAS	7.463	4.055	0.9943	1.1442	5,455	14.374
		403.3	124			
RECYCLE	8.558	20.445	0.9436	1.1442	14,982	39.478
BLEED	8.700	20.445	1.0000	1.1442	1,022	2.693
		471.9	205	1438709		
NATURAL GAS	7.667	22.059	0.8843	1.1995	5,100	13.439
		432.8	71			
OXYGEN	7.075	21.154	0.9896		4,009	10.564
		28.8				
STEAM	6.263					

LIQUID PRODUCT RATES

HOUR	GAGE	GAL	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	# HR GAL HR
OIL	7'0"	371.14	55	1.0025	372.07	51.1		
	6'10"	362.41	57	1.0015	362.95	6.451		
	3'10½"	206.37	51	1.0044	207.28			
	1'0"	52.00	49	1.0054	52.28			
					+2.40		+15.50	44.76
					166.52		1074.22	6.938
WATER	6'9"	358.04	66	0.99942	357.83	11.0		
	6'5½"	342.76	67	0.99932	342.53	8.870		
	7'6½"	399.50	69	0.99907	399.13			
	1'3½"	67.20	62	0.99982	67.19			
	1'11"	100.59	63	0.99973	100.56			
	1'6½"	80.37	63	0.99973	80.35			186.6
					367.45		3038.81	15.310

THE TEXAS COMPANY — MONTEBELLO LABORATORY
YIELD CALCULATIONS

RUN NO. 63-0
HOURS 312-336
CATALYST Mill Scale Red. at Brownsville

	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
CO 28.010	36.943	15.856	444.13	9.794	1.672	46.82	4.151	20.007	5.823	-14.184	-397.31				
H_2 2.016	60.620	26.018	52.45	43.860	7.487	15.09	18.591	44.609	26.078	-18.531	-37.36				
CO_2 44.010	1.890	0.811	35.69	26.064	4.448	195.72	11.048	11.859	15.496	3.637	160.03	10.070			
N_2 28.016	0.217	0.093	2.61	1.223	0.209	5.86	0.518	0.611	0.727						
CH_4 16.042	0.330	0.142	2.28	8.320	1.420	22.78	3.526	3.668	4.946	1.278	20.50	1.290			
C_2H_4 28.052				2.290	0.391	10.97	0.971	0.971	1.362	0.391	10.97	0.690			
C_2H_6 30.068				1.593	0.272	8.18	0.675	0.675	0.947	0.272	8.18	0.515			
C_1+C_2											39.65	2.495			
C_3H_6 42.078				2.693	0.460	19.36	1.141	1.141	1.601	0.460	19.36	1.218	4.32	4.481	0.282
C_3H_8 44.094				0.290	0.050	2.20	0.123	0.123	0.173	0.050	2.20	0.138	4.24	0.519	0.033
C_4H_8 56.104				1.937	0.331	18.57	0.821	0.821	1.152	0.331	18.57	1.169	5.00	3.714	0.234
C_4H_{10} 58.120				0.497	0.085	4.94	0.211	0.211	0.296	0.085	4.94	0.311	4.86	1.016	0.064
C_5H_{10} 70.130				0.923	0.158	11.08	0.391	0.391	0.549	0.158	11.08	0.697	5.45	2.033	0.128
C_5H_{12} 72.146				0.213	0.036	2.60	0.090	0.090	0.126	0.036	2.60	0.164	5.25	0.495	0.031
C_6H_{12} 84.156				0.303	0.052	4.38	0.128	0.128	0.180	0.052	4.38	0.276	5.54	0.791	0.050
C_3-C_6											63.13	3.973		13.049	0.822
TOTAL		42.920	537.16		17.071	368.55	42.385	85.305	59.456						
H_2+CO	97.563	41.874	15891	SCFH	9.159		22.742	64.616	31.901	-32.715					
H_2/CO		1.64	Factor 629287		4.48		4.48	2.23	4.48	1.31					

							m/hr	#/hr	#/MCF	#/gal	gal/hr	gal/MCF
Weight Recovery, %	92.67	Catalyst Age, hrs. 336		Space Velocity, vhv 1265		RECOVERED OIL	0.321**	45.04	2.834		6.985	0.440
Pressure, psig	402	Inlet Velocity, Ft/sec 1.04		Catalyst Vol., CF 12.56		TOTAL OIL		108.17	6.807		20.034	1.262
Temperature, °F	660	Bed Depth, Ft 19.03		Weight, # 1796		WATER SOLUBLE CHEMICALS	0.264**	14.03	0.883		1.793	0.113
Recycle Ratio	0.99	Bed Density, #/CF 143		Effluent Shift Ratio $\frac{(H_2)(CO_2)}{(H_2O)(CO)}$ = 11.41		TOTAL LIQUID PRODUCTS C_3+		122.20	7.690		21.827	1.375
FRESH FEED CONVERSION — %				TOTAL FEED CONVERSION — %	SELECTIVITY	NET WATER	6.080**	109.54	6.893		13.150	0.828
Contraction	CO	H_2	H_2+CO	CO	H_2	CO+H_2	C_3 + /C_1 +	GROSS WATER		123.57	7.776		14.943	0.941
60.23	89.46	71.22	78.13	70.90	41.54	50.63	75.50	HYDROCARBON TOTAL—C_1+		161.85	10.185			

YIELDS BASIS BROWNSVILLE DESIGN FEED RATE*	CORRECTED HEMPEL %	gal/hr	TREATING RECOVERY %	gal/hr
400 EP	84.6	5.910	98.0	5.792
400-550	11.2	0.782	91.4	0.715
550 +	4.2	0.293	114.6	0.336
	RECOVERY %	#/hr	gal/hr	
PROPYLENE	35.2	6.81		
C_3 POLY GASO.	87.5	5.96	0.997	
C_3 POLY TAR	12.5	0.85	0.113	
	#/gal	#/hr	gal/hr	RVP
C_4H_8	5.00	0.51	0.102	68.0
C_4 POLY GASO.	5.98	15.80	2.643	1.5
C_4H_{10}	4.86	4.94	1.016	68.0
C_4-FREE GASO.			10.108	5.8
C_4 POLY TAR	7.53	2.26	0.300	
	gal/hr	gal/MCF	Bbl/Day	
10 # RVP 400 EP GASOLINE	13.869	0.8728	4732	
GAS OIL	0.715	0.0450	244	
FUEL OIL	0.336	0.0211	114	
POLY TAR	0.413	0.0260	141	
TOTAL	15.333	0.9649	5231	
W. S. CHEM.	1.793	0.1128	612	
TOTAL	17.126	1.0777	5843	

Form ML—11 **Included in Reactor Effluent Total g/NCM = 16.91×#/MCF *9488 MCFH H_2 + CO, Bbl/Day = 5421.6×gal/MCF

OPERATING CONDITIONS

PRESSURES PSIG		RATES S.C.F.H.	
Oxygen	432	Fresh Feed	16,288
Natural Gas	474	Recycle	16,085
Generator Outlet	406	Combined Feed	32,373
Reactor Inlet	402	Wet Gas—Measured	5,786
Condenser Inlet		Adjusted	6,479
Product Accumulator	352	Loss	693
TEMPERATURES—°F.		Recycle/Fresh Feed	0.99
Oxygen	408	Inlet Velocity—ft./sec.	1.04
Natural Gas	788	Fresh Feed Rate—S.C.F.H. H_2 + CO	15891
Generator	2280	per Cu. Ft. Dense Bed	1265
Quench Accumulator	140	per Lb. Catalyst	8.85
Reactor Inlet	363	per Sq. Ft.	24077
Condenser Inlet	601		
Product Accumulator	90		
Catalyst No. Height			
1 See Period A	-		
2	659		
3	650		
4	660		
5	667		
6 Ave. 660	667		
7	662		
8	656		
9	647		
10	647		
11	528		

PRODUCT TESTS

	OIL	WATER
°API	51.2	11.0
Neut. No.	49.5	37.6
Sap. No.	64.8	39.7
Hydrox. No.		
Bromine No.	75	
Pour °F.		
Chemicals, % by K_2CO_3		12.0
HEMPEL. DIST. %		°API
205 °F.		
400	83.6	53.8
400-550	11.2	34.0
550+	5.2	
A. S. T. M. DIST. ON		
Naphtha °F.		
IBP	96	
10%	130	
50%	219	
90%	338	
EP	402	
Rec.	96.3	

CATALYST DATA

INVENTORY DATA	
In Reactor at Start of Period	
Fresh Catalyst Added	
Total	
Catalyst Recovered	48
In Reactor at End of Period	
REACTOR d-p, Inches H_2O	
No. Height	
0 See Period A	-
1	69
2	84
3	63
4	280
Total	496
CALCULATED FROM dp	
Density, Lbs./Cu.Ft.	143
Inventory, Lbs.	1796
Bed Depth, Ft.	19.03
Vol., Cu. Ft.	12.56

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

CATALYST	
Bulk Density, Lbs./Cu.Ft.	
Aerated	
Settled	
Compacted	
Particle Density, gm./cc.	
NH_3 Value, ml./gm.	
N_2 Surface, m^2/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 / GENERATOR BALANCE

HOUR	1400	2200	0600	AVERAGE	M/HR	C	H	O
FRESH FEED								
CO 28.010	36.98	36.95	36.90	36.943	15,856	15.856		15.856
H_2 2.016	60.58	60.66	60.62	60.620	26.018		52.036	
CO_2 44.010	1.78	1.88	2.01	1.890	0.811	0.811		1.622
N_2 28.016	0.20	0.19	0.26	0.217	0.093			
CH_4 16.042	0.46	0.32	0.21	0.330	0.142	0.142	0.568	
			M. W	12.515356				
			H_2O 18.016				7.462	3.731
						16.809	60.066	21.209
			BALANCE			99.96	100.71	99.01

	Mol %	M/Hr	C	H	O
O_2 32.000	0.26	10.495 0.035			21.060
CO_2 44.010	1.34	0.181	0.181		0.362
N_2 28.016	0.86	0.116			
CH_4 16.042	82.79	11.192	11.192	44.768	
C_2H_6 30.068	7.03	0.950	1.900	5.700	
C_3H_8 44.094	5.36	0.725	2.175	5.800	
C_4H_{10} 58.120	1.69	0.228	0.912	2.280	
C_5H_{12} 72.146	0.67	0.091	0.455	1.092	
MW =	20.137868				
TOTAL			16.815	59.640	21.422

WEIGHT BALANCE

	#/hr Measured	At Wt. Balance
WET GAS	329.15	368.55
OIL	45.04	45.04
WATER	123.57	123.57
TOTAL	497.76	537.16
FRESH FEED	537.16	
WEIGHT BALANCE	92.67	
WET GAS FACTOR	1119702	
INDICATED LOSS—S C F H	693	

WET GAS	1400	2200	0600	AVERAGE
CO 28.010	9.22	9.81	10.35	9.794
H_2 2.016	42.70	43.83	45.05	43.860
CO_2 44.010	26.41	26.37	25.41	26.064
N_2 28.016	1.13	1.23	1.31	1.223
CH_4 16.042	8.61	8.24	8.11	8.320
C_2H_4 28.052	2.43	2.26	2.18	2.290
C_2H_6 30.068	1.65	1.57	1.56	1.593
C_3H_6 42.078	2.97	2.57	2.54	2.693
C_3H_8 44.094	0.28	0.31	0.28	0.290
C_4H_8 56.104	2.29	1.88	1.64	1.937
C_4H_{10} 58.120	0.54	0.50	0.45	0.497
C_5H_{10} 70.130	1.15	0.86	0.76	0.923
C_5H_{12} 72.146	0.24	0.28	0.12	0.213
C_6H_{12} 84.156	0.38	0.29	0.24	0.303
			M. W.	21.58958

GAS FLOW RATES

		$\sqrt{H}$	PRESSURE	TEMP.	M. W.	S. C. F. H.	M/HR
FRESH FEED	79.31	6.675	401.6 20.403	69 0.9915	2313158 1.5209	16,288	42.920
WET GAS	158.44	7,842	1.75 4.056	69 0.9915	1340924 1.1580	5,786	15.246
RECYCLE	79.31	8.517	401.3 20.396	124 0.9436	1.1580	15,054	39.668
BLEED	5.02	8.692	20.396	1.0000	1.1580	1,031	2.717
NATURAL GAS	28.43	7.663	474.0 22.107	199 0.8883	1437590 1.1990	5,130	13.518
OXYGEN	27.07	7.042	431.9 21.133	72 0.9887		3,983	10.495
STEAM	215.7	6.254					

LIQUID PRODUCT RATES

HOUR	GAGE	GAL.	°F	FACTOR	GAL. AT 60	API° #/GAL.	#	#/HR GAL HR
OIL	7'0"	371.14	58	1.0010	371.51	51.2		
	3'10¼"	206.37	51	1.0044	207.28	6.448		
					+3.41		+22.00	45.04
					167.64		1080.94	6.985
WATER	7'3"	384.23	74	0.99846	383.64	11.0		
	1'11"	100.59	63	0.99973	100.56	8.270		
	2'8½"	145.02	70	0.99896	144.87			
	1'4"	69.39	68	0.99920	69.33			123.57
					358.62		2965.79	14.943