Table B9 (continued)

FILE: 1256111C T6Q3 A1

C5+-END PT	82.49	81.68	59.64	59.74	62.06
ISO/NORMAL MOLE RATIO					
C4	0.0173	0.0000	0.0338	0.0368	0.0404
C5	0.0281	0.0244	0.0447	0.0428	0.0423
C6	0.0672	0.0596	0.1660	0.1299	0.0942
C4=	0.0592	0.0571	0.1475	0.1380	0.1402
PARAFFIN/OLEFIN RATIO					
C3	1.1330	1.1938	14.7314	10.4804	8.4479
C4	0.6649	0.6508	3.0931	2.2192	1.8742
C5	2.0699	2.0672	7.6577	5.7200	5.3703
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8780		0.8402	0.8116	0.8525
RATIO CH4/(1-A)**2	5.2195		7.9307	7.3217	11.0112
ALPHA FRM CORRELATION	0.8957	0.8957	0.8907	0.8917	0.8906
ALPHA (EXPTL/CORR)	0.9802		0.9432	0.9102	0.9572
W%CH4 FRM CORRELATION	5.5421	5.5178	8.6729	8.3588	8.5542
W%CH4 (EXPTL/CORR)	1.4028	1.4633	2.3364	3.1103	2.8013
LIQ HC COLLECTION					
PHYS. APPEARANCE	OIL WAX	OIL WAX	OIL WAX	OIL WAX	OIL WAX
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	339.00		259.00	265.00	262.00
16	380.00		304.00	297.00	306.00
50	571.00		518.00	428.00	518.00
84	791.00		764.00	610.00	739.00
90	859.00		837.00	680.00	806.00
RANGE(16-84 %)	411.00		460.00	313.00	433.00
WT % @ 420 F	24.50	24.50	34.50	47.60	32.67
WT % @ 700 F	72.14	72.14	76.44	91.33	79.15

Table B10

FILE: 1257006A T6Q3 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12570-06
CATALYST CO,X11-TC12365 #12524 - 74 80 CC 38.43G(TO 58.53, +20G)
FEED H2:CO:ARGON= 50:50:0 @ 400. CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12570-06-01	570-06-02	570-06-03	570-06-04	570-06-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	23.50	44.50	120.00	139.00	162.50
PRESSURE,PSIG	299.20	300.20	301.20	300.10	299.00
TEMP. C	240.00	242.00	241.50	241.50	241.50
FEED CC/MIN	400.00	400.00	400.00	400.00	400.00
HOURS FEEDING	20.75	21.00	75.50	19.00	23.50
EFFLNT GAS LITER	345.78	344.42	1390.00	318.33	393.15
GM AQUEOUS LAYER	32.36	34.73	113.43	26.90	31.75
GM OIL	9.59	9.81	59.38	20.19	23.47
MATERIAL BALANCE					
GM ATOM CARBON %	93.84	91.63	113.02	102.87	101.45
GM ATOM HYDROGEN %	86.03	90.03	92.55	96.52	94.81
GM ATOM OXYGEN %	102.17	100.94	116.80	101.31	99.96
RATIO CHX/(H2O+CO2)	0.5922	0.5910	0.8239	1.0764	1.0767
RATIO X IN CHX	2.2881	2.3567	2.2848	2.2512	2.2579
USAGE H2/CO FRODT	2.7522	2.4636	2.0663	1.8187	1.8437
FEED H2/CO FRM EFFLNT	0.9167	0.9826	0.8189	0.9383	0.9346
RESIDUAL H2/CO RATIO	0.6384	0.6918	0.5609	0.6733	0.6759
RATIO CO2/(H2O+CO2)	0.0127	0.0694	0.0779	0.0901	0.0810
K SHIFT IN EFFLNT	0.0082	0.0516	0.0474	0.0667	0.0596
SPEC ACTVTY SA,CO/X11	0.3735	0.3953	0.5070	0.5980	0.5716
CONVERSION					
ON CO %	13.17	16.41	17.14	23.14	22.15
ON H2 %	39.54	41.15	43.24	44.85	43.70
ON CO+H2 %	25.78	28.57	28.89	33.65	32.56
PRDT SELECTIVITY,WT %					
CH4	8.73	11.60	7.67	5.91	6.41
C2 HC'S	1.58	1.96	1.57	1.39	1.35
C3H8	1.69	2.51	2.16	1.89	1.85
C3H6=	3.50	2.40	1.95	1.60	1.72
C4H10	1.98	2.50	2.07	1.78	1.80
C4H8=	6.28	5.36	4.51	3.93	4.01
C5H12	3.50	4.65	4.07	3.56	3.38
C5H10=	4.55	3.64	2.36	1.99	2.04
C6H14	4.49	6.32	4.16	3.61	3.61
C6H12= & CYCLO'S	0.00	0.00	0.00	0.00	0.00
C7+ IN GAS	9.66	10.20	6.60	5.73	6.10
LIQ HC'S	54.03	48.87	62.88	68.60	67.74
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	23.76	26.33	19.93	16.50	17.13
C5 -420 F	36.52	35.25	27.67	26.33	26.27
420-700 F	35.46	18.89	24.53	26.76	26.24
700-END PT	4.25	19.54	27.88	30.41	30.35

Table B10 (continued)

FILE: 1257006A T6Q3 A1

C5+-END PT	76.24	73.67	80.07	83.50	82.87
ISO/NORMAL MOLE RATIO					
C4	0.0000	0.0203	0.0221	0.0256	0.0156
C5	0.0254	0.0452	0.0448	0.0519	0.0476
C6	0.4183	0.4615	0.1505	0.1608	0.1434
C4=	0.0116	0.0561	0.0556	0.0636	0.0537
PARAFFIN/OLEFIN RATIO					
C3	0.4620	1.0000	1.0570	1.1281	1.0231
C4	0.3040	0.4506	0.4429	0.4377	0.4325
C5	0.7481	1.2428	1.6737	1.7409	1.6166
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8252			0.8905	
RATIO CH4/(1-A)**2	2.8563			4.9261	
ALPHA FRM CORRELATION	0.9009	0.8975	0.9052	0.8986	0.8984
ALPHA (EXPTL/CORR)	0.9159			0.9910	
WT%CH4 FRM CORRELATION	4.1200	5.1242	3.0440	4.8042	4.8551
WT%CH4 (EXPTL/CORR)	2.1182	2.2639	2.5184	1.2302	1.3209
LIQ HC COLLECTION					
PHYS. APPEARANCE					
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	345.00			368.00	
16	382.00			418.00	
50	514.00			657.00	
84	649.00			916.00	
90	688.00			987.00	
RANGE(16-84 %)	267.00			498.00	
WT % @ 420 F	26.50	21.37	16.67	16.67	16.45
WT % @ 700 F	92.13	60.01	55.67	55.67	55.19

Table B11

FILE: 1257006B T6Q3 A1

RESULT OF SYNGAS OPERATION

RUN NO. 12570-06
CATALYST CO,XI1-TC123 65 #12524 - 74 80 CC 38.43G(TO 58.53G,+20G)
FEED H2:CO:ARGON= 50:50:0 @ 400. CC/MN OR 300 GHSV

RUN & SAMPLE NO.	12570-06-06	570-06-07	570-06-08	570-06-09	570-06-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	187.00	210.00	284.00	307.00	331.50
PRESSURE,PSIG	301.20	295.70	295.90	303.20	299.80
TEMP. C	241.50	241.50	240.00	240.50	240.50
FEED CC/MIN	400.00	400.00	400.00	400.00	400.00
HOURS FEEDING	24.50	23.00	74.00	23.00	24.50
EFFLNT GAS LITER	410.32	382.89	1228.70	381.33	414.33
GM AQUEOUS LAYER	34.30	32.65	105.11	31.56	33.02
GM OIL	24.43	24.63	75.34	23.63	23.91
MATERIAL BALANCE					
GM ATOM CARBON %	101.03	101.86	100.38	99.80	100.67
GM ATOM HYDROGEN %	95.10	96.48	97.57	95.01	94.63
GM ATOM OXYGEN %	100.49	100.21	98.25	98.37	99.81
RATIO CHX/(H2O+CO2)	1.0269	1.0819	1.1078	1.0745	1.0451
RATIO X IN CHX	2.2391	2.2492	2.2899	2.2291	2.2185
USAGE H2/CO PRODT	1.8750	1.8385	1.8926	1.8785	1.9117
FEED H2/CO FRM EFFLNT	0.9413	0.9472	0.9720	0.9520	0.9401
RESIDUAL H2/CO RATIO	0.6808	0.6800	0.6972	0.6919	0.6874
RATIO CO2/(H2O+CO2)	0.0780	0.0802	0.0594	0.0622	0.0554
K SHIFT IN EFFLNT	0.0576	0.0593	0.0440	0.0459	0.0403
SPEC ACTVTY SA,CO/X11	0.5572	0.5936	0.6206	0.5789	0.5506
CONVERSION					
ON CO %	21.81	23.06	22.99	21.92	20.63
ON H2 %	43.45	44.76	44.76	43.26	41.96
ON CO+H2 %	32.30	33.62	33.72	32.33	30.97
PRDT SELECTIVITY,WT %					
CH4	5.39	6.05	5.58	4.98	4.50
C2 HC'S	1.39	1.25	9.44	1.24	1.22
C3H8	1.85	1.78	0.21	1.69	1.65
C3H6=	1.80	1.67	1.45	1.88	2.04
C4H10	1.74	1.64	1.44	1.57	1.57
C4H8=	4.25	4.01	3.80	4.03	4.46
C5H12	3.20	3.16	2.60	3.00	2.80
C5H10=	2.03	1.92	1.84	2.07	2.20
C6H14	3.38	3.21	2.74	3.06	2.96
C6H12= & CYCLO'S	0.05	0.06	0.09	0.12	0.18
C7+ IN GAS	5.81	5.79	5.06	5.78	6.09
LIQ HC'S	69.10	69.45	65.74	70.56	70.33
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	16.41	16.40	21.93	15.41	15.45
C5 -420 F	25.70	25.26	22.95	25.56	25.83
420-700 F	26.59	26.55	25.19	27.09	27.08
700-END PT	31.30	31.79	29.93	31.94	31.65

Table B11 (continued)

FILE: 1257006B T6Q3 A1

C5+-END PT	83.59	83.60	78.07	84.59	84.55
ISO/NORMAL MOLE RATIO					
C4	0.0000	0.0000	0.0000	0.0000	0.0000
C5	0.0409	0.0370	0.0337	0.0348	0.0278
C6	0.1311	0.1357	0.0991	0.1111	0.0924
C4=	0.0525	0.0560	0.0456	0.0412	0.0433
PARAFFIN/OLEFIN RATIO					
C3	0.9819	1.0168	0.1411	0.8573	0.7738
C4	0.3954	0.3945	0.3647	0.3766	0.3398
C5	1.5292	1.5993	1.3771	1.4069	1.2396
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))		0.8878			0.8790
RATIO CH4/(1-A)**2		4.8081			3.0762
ALPHA FRM CORRELATION	0.8983	0.8979	0.8976	0.8982	0.8982
ALPHA (EXPTL/CORR)		0.9887			0.9787
W%CH4 FRM CORRELATION	4.8963	4.9540	5.0045	4.9026	4.8831
W%CH4 (EXPTL/CORR)	1.1004	1.2215	1.1147	1.0167	0.9223
LIQ HC COLLECTION					
PHYS. APPEARANCE					
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F		380.00			381.00
16		420.00			419.00
50		671.00			655.00
84		961.00			988.00
90		1035.00			1060.00
RANGE(16-84 %)		541.00			569.00
WT % @ 420 F	16.23	16.00	16.17	16.34	16.50
WT % @ 700 F	54.71	54.23	54.48	54.73	55.00

Table 312

FILE: 1161713A T6Q3 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-13
CATALYST CO,X9,X11-TC123 #12524-79 240 CC 122.2G(TO 177.4, +55G)
FEED H2:CO:ARGON= 50:50:0 @ 1212 CC/MN OR 303 GHSV

RUN & SAMPLE NO.	11617-13-01	617-13-02	617-13-03	617-13-04	617-13-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	60:40: 0
HRS ON STREAM	72.00	93.50	122.50	142.00	165.50
PRESSURE,PSIG	303.80	304.00	303.70	303.00	494.00
TEMP. C	245.00	240.50	240.50	240.00	257.50
FEED CC/MIN	1212.00	1212.00	1212.00	1212.00	1212.00
HOURS FEEDING	68.25	21.50	29.00	19.50	23.50
EFFLNT GAS LITER	2740.50	959.90	1285.50	892.80	619.56
GM AQUEOUS LAYER	535.99	141.11	187.75	124.78	227.92
GM OIL	312.86	92.39	132.60	78.37	150.80
MATERIAL BALANCE					
GM ATOM CARBON %	97.05	101.27	102.54	101.29	104.11
GM ATOM HYDROGEN %	101.70	102.34	102.63	102.07	101.01
GM ATOM OXYGEN %	100.76	101.00	100.40	101.45	97.50
RATIO CHX/(H2O+CO2)	0.8884	1.0096	1.0780	0.9941	1.1247
RATIO X IN CHX	2.2185	2.2098	2.2027	2.2097	2.3850
USAGE H2/CO PRODT	2.0285	1.9583	1.9168	2.0055	1.7880
FEED H2/CO FRM EFFLNT	1.0479	1.0106	1.0008	1.0078	1.4554
RESIDUAL H2/CO RATIO	0.5756	0.6197	0.6084	0.6292	0.8829
RATIO CO2/(H2O+CO2)	0.0605	0.0468	0.0415	0.0348	0.1184
K SHIFT IN EFFLNT	0.0371	0.0304	0.0263	0.0227	0.1186
SPEC ACTVTY SA,CO/X11	0.7138	0.7703	0.8048	0.7362	0.5158
CONVERSION					
ON CO %	32.51	29.20	29.99	27.50	63.25
ON H2 %	62.93	56.59	57.45	54.74	77.71
ON CO+H2 %	48.08	42.97	43.73	41.17	71.82
PRDT SELECTIVITY,WT %					
CH4	4.84	4.41	4.09	4.36	12.37
C2 HC'S	1.28	1.34	1.26	1.18	2.36
C3H8	1.32	1.29	1.21	1.34	4.18
C3H6=	2.09	2.22	2.21	2.39	1.22
C4H10	1.21	1.26	1.19	1.35	2.45
C4H8=	3.81	3.94	3.75	4.11	2.71
C5H12	2.23	2.34	2.21	2.51	3.29
C5H10=	2.73	2.89	2.67	2.95	1.37
C6H14	2.34	2.51	2.27	2.61	2.77
C6H12= & CYCLO'S	0.50	0.59	0.60	0.76	0.29
C7+ IN GAS	4.83	5.83	6.03	6.35	4.56
LIQ HC'S	72.81	71.38	72.50	70.09	62.42
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	14.55	14.46	13.71	14.73	25.29
C5 -420 F	27.20	27.55	26.47	28.14	27.27
420-700 F	28.55	26.47	25.34	25.70	21.51
700-END PT	29.70	31.53	34.48	31.42	25.93

Table B12 (continued)

FILE: 1161713A T6Q3 A1

C5+-END PT	85.45	85.54	86.29	85.27	74.71
ISO/NORMAL MOLE RATIO					
C4	0.0205	0.0171	0.0201	0.0157	0.0311
C5	0.0387	0.0318	0.0339	0.0330	0.0538
C6	0.0971	0.0835	0.0736	0.0767	0.1365
C4=	0.0566	0.0537	0.0538	0.0506	0.1029
PARAFFIN/OLEFIN RATIO					
C3	0.6023	0.5551	0.5215	0.5356	3.2569
C4	0.3065	0.3086	0.3053	0.3168	0.8746
C5	0.7935	0.7882	0.8048	0.8288	2.3366
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8923		0.8847		0.8656
RATIO CH4/(1-A)**2	4.1696		3.0764		6.8469
ALPHA FRM CORRELATION	0.9033	0.9022	0.9028	0.9017	0.8965
ALPHA (EXPTL/CORR)	0.9878		0.9799		0.9655
WT%CH4 FRM CORRELATION	3.6875	3.8387	3.6663	3.9354	6.9258
WT%CH4 (EXPTL/CORR)	1.3122	1.1487	1.1160	1.1071	1.7866
LIQ HC COLLECTION					
PHYS. APPEARANCE					
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	345.00		348.00		304.00
16	386.00		416.00		349.00
50	639.00		676.00		626.00
84	904.00		997.00		988.00
90	987.00		1072.00		1066.00
RANGE(16-84 %)	518.00		581.00		639.00
WT % @ 420 F	20.00	18.75	17.50	18.50	24.00
WT % @ 700 F	59.21	55.83	52.45	55.17	58.46

Table B13

FILE: 1161713B T6Q3 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-13
CATALYST CO,X9,X11-TC123 #12524-79 240 CC 122.2G(TO 177.4, +55G)
FEED H2:CO:ARGON= 60:40:0 @ 1212 CC/MN OR 303 GHSV

RUN & SAMPLE NO.	11617-13-06	617-13-07	617-13-08	617-13-09	617-13-10
FEED H2:CO:AR	60:40: 0	60:40: 0	60:40: 0	60:40: 0	60:40: 0
HRS ON STREAM	190.50	243.00	263.50	290.50	314.50
PRESSURE,PSIG	498.50	503.20	499.90	498.60	498.30
TEMP. C	259.50	260.00	260.00	260.00	260.00
FEED CC/MIN	1212.00	885.00	1212.00	1212.00	1212.00
HOURS FEEDING	25.00	52.50	20.50	27.00	24.50
EFFLNT GAS LITER	643.91	1047.70	513.70	681.30	624.90
GM AQUEOUS LAYER	295.98	366.95	220.21	289.35	259.21
GM OIL	156.41	217.03	134.81	175.52	158.14
MATERIAL BALANCE					
GM ATOM CARBON %	102.20	101.16	101.26	100.55	99.64
GM ATOM HYDROGEN %	106.30	97.25	101.00	100.73	99.95
GM ATOM OXYGEN %	105.53	98.42	99.29	98.94	98.39
RATIO CHX/(H2O+CO2)	0.9463	1.0532	1.0351	1.0290	1.0229
RATIO X IN CHX	2.3848	2.3929	2.3439	2.3430	2.3482
USAGE H2/CO PRODT	1.9703	1.8687	1.9087	1.9253	1.9427
FEED H2/CO FRM EFFLNT	1.5603	1.4421	1.4961	1.5027	1.5046
RESIDUAL H2/CO RATIO	0.8650	0.8359	0.8290	0.8373	0.8434
RATIO CO2/(H2O+CO2)	0.0888	0.1018	0.0816	0.0767	0.0727
K SHIFT IN EFFLNT	0.0843	0.0947	0.0737	0.0695	0.0661
SPEC ACTVTY SA,CO/X11	1.3507	0.3110	0.4523	0.4418	0.4687
CONVERSION					
ON CO %	62.91	58.70	61.79	61.15	60.15
ON H2 %	79.44	76.06	78.83	78.35	77.66
ON CO+H2 %	72.98	68.95	72.00	71.48	70.67
PRDT SELECTIVITY,WT %					
CH4	12.45	13.11	10.76	10.78	11.02
C2 HC'S	2.31	2.30	1.85	1.83	1.84
C3H8	4.17	3.84	3.11	3.05	3.05
C3H6=	1.10	1.43	1.31	1.32	1.33
C4H10	2.39	2.36	1.99	1.95	1.94
C4H8=	2.51	2.81	2.52	2.46	2.46
C5H12	3.19	3.22	2.87	2.78	2.73
C5H10=	1.91	2.03	1.92	1.91	1.90
C6H14	2.85	2.88	2.75	2.64	2.48
C6H12= & CYCLO'S	0.89	0.34	0.48	0.49	0.44
C7+ IN GAS	4.53	5.12	4.53	4.75	3.78
LIQ HC'S	61.70	60.57	65.91	66.04	67.03
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	24.94	25.84	21.55	21.39	21.64
C5 -420 F	28.69	29.64	30.56	30.99	30.39
420-700 F	21.80	22.45	25.01	25.40	26.13
700-END PT	24.58	22.07	22.89	22.22	21.84

Table B13 (continued)

FILE: 1161713B T6Q3 A1

C5+-END PT	75.06	74.16	78.45	78.61	78.36
ISO/NORMAL MOLE RATIO					
C4	0.0292	0.0346	0.0329	0.0326	0.0335
C5	0.0556	0.0622	0.0581	0.0572	0.0577
C6	0.2220	0.2334	0.2239	0.2193	0.2240
C4=	0.1097	0.1082	0.1036	0.1038	0.1045
PARAFFIN/OLEFIN RATIO					
C3	3.6199	2.5639	2.2649	2.2143	2.1989
C4	0.9221	0.8125	0.7617	0.7629	0.7605
C5	1.6296	1.5393	1.4517	1.4132	1.3965
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))			0.8725		
RATIO CH4/(1-A)**2			6.6226		
ALPHA FRM CORRELATION	0.8969	0.8983	0.8984	0.8979	0.8976
ALPHA (EXPTL/CORR)			0.9712		
W%CH4 FRM CORRELATION	6.9060	6.5792	6.5405	6.6518	6.7241
W%CH4 (EXPTL/CORR)	1.8021	1.9922	1.6459	1.6213	1.6389
LIQ HC COLLECTION					
PHYS. APPEARANCE					
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F			299.00		
16			343.00		
50			586.00		
84			887.00		
90			975.00		
RANGE(16-84 %)			544.00		
WT % @ 420 F	24.83	26.50	27.33	27.89	28.44
WT % @ 700 F	60.16	63.57	65.27	66.35	67.42

Table B14

FILE: 11617I3C T6Q3 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-13
CATALYST CO,X9,X11-TC123 #12524-79 240 CC 122.2G(TO 177.4, +55G)
FEED H2:CO:ARGON= 60:40:0 @ 1212 CC/MN OR 303 GHSV

RUN & SAMPLE NO.	11617-13-11	617-13-12	617-13-13	617-13-14	617-13-15
FEED H2:CO:AR	60:40: 0	60:40: 0	60:40: 0	60:40: 0	60:40: 0
HRS ON STREAM	337.50	405.50	435.00	458.50	482.50
PRESSURE,PSIG	502.00	500.10	502.00	499.30	500.00
TEMP. C	260.00	259.50	260.00	260.00	260.00
FEED CC/MIN	1212.00	1212.00	1212.00	1212.00	1212.00
HOURS FEEDING	23.00	67.83	29.50	23.50	24.00
EFFLNT GAS LITER	596.60	1823.80	777.27	644.76	660.90
GM AQUEOUS LAYER	240.77	702.10	301.54	243.47	243.64
GM OIL	147.61	420.49	178.01	135.81	140.57
MATERIAL BALANCE					
GM ATOM CARBON %	100.98	100.64	99.63	99.78	99.28
GM ATOM HYDROGEN %	100.61	100.28	99.38	99.58	98.62
GM ATOM OXYGEN %	98.40	99.08	97.31	100.10	99.32
RATIO CHX/(H2O+CO2)	1.0476	1.0293	1.0441	0.9941	0.9991
RATIO X IN CHX	2.3479	2.3556	2.3629	2.3716	2.3758
USAGE H2/CO PRODT	1.9281	1.9538	1.9495	1.9892	1.9872
FEED H2/CO FRM EFFLNT	1.4946	1.4947	1.4962	1.4969	1.4901
RESIDUAL H2/CO RATIO	0.8447	0.8547	0.8509	0.8485	0.8495
RATIO CO2/(H2O+CO2)	0.0717	0.0681	0.0672	0.0674	0.0674
K SHIFT IN EFFLNT	0.0653	0.0625	0.0613	0.0613	0.0614
SPEC ACTVTY SA,CO/X11	0.4682	0.4571	0.4520	0.4362	0.4298
CONVERSION					
ON CO %	59.99	58.22	58.74	56.85	56.30
ON H2 %	77.39	76.11	76.53	75.54	75.09
ON CO+H2 %	70.42	68.94	69.41	68.05	67.55
PRDT SELECTIVITY,WT %					
CH4	11.01	11.50	11.51	12.21	12.37
C2 HC'S	1.83	1.93	1.95	2.04	2.07
C3H8	3.06	3.10	3.09	3.27	3.28
C3H6=	1.32	1.29	1.25	1.32	1.34
C4H10	1.97	1.93	1.94	2.09	2.06
C4H8=	2.48	2.49	2.53	2.67	2.65
C5H12	2.87	2.84	2.86	3.21	3.05
C5H10=	1.96	2.06	2.08	2.29	2.04
C6H14	2.72	2.30	4.86	2.74	2.69
C6H12= & CYCLO'S	0.60	0.52	0.52	0.63	0.70
C7+ IN GAS	4.39	4.52	3.72	4.41	2.88
LIQ HC'S	65.77	65.51	63.70	63.11	64.87
TOTAL	100.00	100.00	100.00	100.00	100.00
SUB-GROUPING					
C1 -C4	21.68	22.26	22.26	23.60	23.76
C5 -420 F	31.62	33.59	35.57	35.38	32.77
420-700 F	25.98	26.32	25.74	25.65	26.36
700-END PT	20.72	17.83	16.43	15.37	17.10

Table B14 (continued)

FILE: 1161713C T6Q3 A1

C5+-END PT	78.32	77.74	77.74	76.40	76.24
ISO/NORMAL MOLE RATIO					
C4	0.0324	0.0340	0.0336	0.0326	0.0332
C5	0.0569	0.0576	0.0585	0.0569	0.0584
C6	0.2156	0.1322	1.3200	0.1383	0.2235
C4=	0.1060	0.1019	0.1036	0.1024	0.1024
PARAFFIN/OLEFIN RATIO					
C3	2.2087	2.2886	2.3636	2.3538	2.3418
C4	0.7655	0.7491	0.7407	0.7535	0.7513
C5	1.4205	1.3402	1.3379	1.3599	1.4515
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8708			0.8583	
RATIO CH4/(1-A)**2	6.5950			6.0826	
ALPHA FRM CORRELATION	0.8978	0.8974	0.8976	0.8975	0.8975
ALPHA (EXPTL/CORR)	0.9699			0.9563	
W%CH4 FRM CORRELATION	6.6933	6.7724	6.7633	6.7698	6.7724
W%CH4 (EXPTL/CORR)	1.6452	1.6979	1.7025	1.8043	1.8261
LIQ HC COLLECTION					
PHYS. APPEARANCE					
DENSITY					
N, REFRACTIVE INDEX					
SIMULT'D DISTILATN					
10 WT % @ DEG F	299.00			296.00	
16	342.00			331.00	
50	570.00			515.00	
84	853.00			786.00	
90	935.00			868.00	
RANGE(16-84 %)	511.00			455.00	
WT % @ 420 F	29.00	32.60	33.80	35.00	33.00
WT % @ 700 F	68.50	72.78	74.21	75.64	73.64

Table B15

FILE: 1161713D T6Q3 A1

RESULT OF SYNGAS OPERATION

RUN NO. 11617-13
CATALYST CO,X9,X11-TC123 #12524-79 240 CC 122.2G(TO 177.4, +55G)
FEED H2:CO:ARGON= 60:40:0 @ 1212 CC/MN OR 300 GHSV

RUN & SAMPLE NO.	11617-13-16	617-13-17
FEED H2:CO:AR	60:40: 0	60:40: 0
HRS ON STREAM	505.50	573.00
PRESSURE,PSIG	498.50	500.90
TEMP. C	260.00	260.00
FEED CC/MIN	1212.00	1212.00
HOURS FEEDING	23.50	67.50
EFFLNT GAS LITER	642.77	1904.50
GM AQUEOUS LAYER	238.61	679.63
GM OIL	137.31	393.84
MATERIAL BALANCE		
GM ATOM CARBON %	98.75	100.85
GM ATOM HYDROGEN %	98.66	100.07
GM ATOM OXYGEN %	98.76	99.70
RATIO CHX/(H2O+CO2)	0.9998	1.0221
RATIO X IN CHX	2.3846	2.3847
USAGE H2/CO PRODT	1.9929	1.9687
FEED H2/CO FRM EFFLNT	1.4987	1.4884
RESIDUAL H2/CO RATIO	0.8553	0.8654
RATIO CO2/(H2O+CO2)	0.0667	0.0696
K SHIFT IN EFFLNT	0.0611	0.0647
SPEC ACTVTY SA,CO/X11	0.4299	0.4279
CONVERSION		
ON CO %	56.55	56.47
ON H2 %	75.20	74.69
ON CO+H2 %	67.74	67.37
PRDT SELECTIVITY,WT %		
CH4	12.41	12.63
C2 HC'S	2.76	2.87
C3H8	3.29	3.27
C3H6=	1.32	1.31
C4H10	2.06	2.02
C4H8=	0.31	2.55
C5H12	3.08	2.94
C5H10=	2.05	1.93
C6H14	2.80	2.43
C6H12= & CYCLO'S	0.81	0.79
C7+ IN GAS	4.41	3.83
LIQ HC'S	64.69	63.43
TOTAL	100.00	100.00
SUB-GROUPING		
C1 -C4	22.16	24.65
C5 -420 F	33.21	27.78
420-700 F	26.29	25.78
700-END PT	18.34	21.79

Table B15 (continued)

FILE: 1161713D T6Q3 A1

C5+-END PT	77.84	75.35
ISO/NORMAL MOLE RATIO		
C4	0.0341	0.0359
C5	0.0577	0.0563
C6	0.2218	0.1582
C4=	0.1052	0.1052
PARAFFIN/OLEFIN RATIO		
C3	2.3809	2.3740
C4	0.7658	0.7658
C5	1.4638	1.4793
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))		0.8784
RATIO CH4/(1-A)**2		8.5408
ALPHA FRM CORRELATION	0.8971	0.8969
ALPHA (EXPTL/CORR)		0.9794
W%CH4 FRM CORRELATION	6.8566	6.9384
W%CH4 (EXPTL/CORR)	1.8106	1.8200
LIQ HC COLLECTION		
PHYS. APPEARANCE		
DENSITY		
N, REFRACTIVE INDEX		
SIMULT'D DISTILATN		
10 WT % @ DEG F		306.00
16		374.00
50		595.00
84		864.00
90		941.00
RANGE(16-84 %)		490.00
WT % @ 420 F	31.00	25.00
WT % @ 700 F	71.64	65.64

Appendix C.

THE REACTION RATE AND PRODUCT SELECTIVITY CORRELATIONS FOR THE Co/X11/TC-123 CATALYST AND ITS POTENTIAL PERFORMANCE IN AN ARGE FIXED-BED TUBULAR REACTOR

Chang-lee Yang

Appendix C. THE REACTION RATE AND PRODUCT SELECTIVITY CORRELATIONS FOR THE Co/X11/TC-123 CATALYST AND ITS POTENTIAL PERFORMANCE IN AN ARGE FIXED-BED TUBULAR REACTOR

Chang-lee Yang

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FIGURES

I. Introduction

During the previous contract with DOE on the Liquid Hydrocarbon Fuels From Syngas (DE-AC22-81PC40077, Mar. 1981 to Sept. 1984), Union Carbide Corp. developed several cobalt-based catalysts which showed good C5+ conversions and good stability. We also developed (ref. 1) a power law rate expression for one of these catalysts, as well as product selectivity correlations (for its Wt%CH4 make and its alpha parameter).

The measured syngas conversion rate of a tested catalyst was then divided by the calculated syngas conversion rate of the reference catalyst at the same operating conditions; this ratio was called the Specific Activity.

These correlations for the reference catalyst were also used in a fixed-bed reactor simulation computer program (Fig. C1) to provide process design data to the MITRE Corporation for their techno-economic evaluation of the Union Carbide catalysts (Fig. C2 and Fig. 1,9 of ref. 1).

One of the problems with a cobalt based catalyst for FT-synthesis is the high methane make in its product slate (Fig. C3). Methane has been found to be an economically undesirable product. The extent of the methane make is a strong function of temperature and the hydrogen/carbon-monoxide ratio in the reactor. In order to inhibit the methane formation, we had to lower the H2/CO feed ratio. Because this also caused a lowering of the catalyst activity, we also had to lower the space velocity to achieve our desired 85% overall conversion. The following table summarizes the two cases of estimated process performance we sent to MITRE Corporation in late 1984 for their economic study based on the most promising catalyst at that time (with a specific activity of 2.68) and on the catalyst we hoped to develop in the future (with a specific activity of 3.64).

SUMMARY OF MITRE'S ECONOMIC STUDY, Apr.12,85 (ref. 2)
(85% Conversion in Single Stage Fixed-Bed Arge-Type Reactor)

	CASE I (realistic) (case)	CASE II (idealistic) (case)
PSIG	300	300
TEMP C.	270	270
SA (Spec.Actvty) req'd	2.68	3.64
RF, Feed H2/CO	1.208	1.394
Usage Ratio, H2/CO consumed	1.6	2.0
SV, Space Velocity	300	360
CVSG, Conv. Syngas	85 %	85 %

Wt%CH4	12.29 %	7.82 %
alpha	0.86435	0.87995
Cost, $/gal. gasoline	$ 1.93	$ 1.87

As one can see, the through-put in terms of the space velocities for 85 % syngas conversion were 300 (the realistic case) and 360 (the idealistic case) respectively.

During the present contract with DOE (DE-AC22-84PC70028), Union Carbide has been experimenting with new additives and new supports for the cobalt based catalyst. We have succeeded in producing catalysts with significantly lower (about 10% lower) methane makes under similar conversion rates, H2/CO ratios, temperatures and pressures.

It appears that the performance characteristics of the new catalyst formulations are quite different from those of the previous simple cobalt-loaded reference catalyst, and that new reaction rate and product selectivty correlations should be conducted on the new catalysts. Hence a new reference catalyst was chosen for the correlation work.

II. The New Reference Catalyst

The catalyst chosen for the new reference has the composition denoted as Co/X11/TC-123, which is a cobalt-based catalyst, promoted by X11, and deposited on a newly developed Molecular Sieve support TC-123. The promoter X11 showed excellent promise in reducing the methane make, and many runs have been conducted around variations of the promoter X11. The data of Run 12570-02, reported as Run no. 45 in the 5th and the 6th Quarterly Reports, was chosen for the correlations; it was a long run with many data points. All togather, this run operated for a total of 1568 hours, or 65 days, and under many different operating conditions. There were 53 data points, falling into eight groups, with 5 levels of residual H2/CO ratios, 2 levels of pressure, 2 levels of feed rate, and 2 levels of temperature; however the temperature range was rather narrow. An abbreviated list of the data is tabulated below:

Summary of the Data

Run 12570-02 Co/X11-TC123 80 cc, 37.44 gm Oct 17-Dec 23,85

No.	RFeed	CCMN	PSI	T C	Usage	RHC	Sp.Actvy	CVCO	CVSG	WCH4	ALPHA
A01	1.1299	400	300	242	3.5325	.5383	1.6779	19.76	42.04	9.74	0.8049
A02	0.9774	"	"	241	1.8061	.5534	3.3151	33.84	48.03	3.55	0.9113
A05	0.9825	"	"	"	1.8703	.5574	3.1022	32.38	46.88	3.76	0.9026
A08	0.9819	"	"	"	1.8064	.5775	3.0128	32.91	46.60	3.41	0.9056
A11	0.9960	400	300	241	1.8881	.5779	2.9455	31.91	46.17	3.39	0.8970

B12	1.4222	400	300	241	1.8738	.9942	2.3175	48.66	57.73	7.30	0.8868
B13	1.4502	"	"	"	1.8599	.9977	2.6186	52.48	61.26	5.72	0.8920
B17	1.4587	"	"	"	1.9576	.9982	2.3724	48.00	57.74	6.13	0.8869
C19	1.7119	"	"	240	2.0542	1.3105	1.8847	53.97	60.79	12.09	.
C21	1.6859	"	"	"	1.9890	1.3013	2.0583	55.93	62.24	11.49	0.8762
D22	1.6545	400	500	239	1.9276	1.1778	1.8419	63.57	70.11	7.18	0.8882
D23	1.7137	"	"	"	2.0276	1.1902	1.7491	62.51	69.74	7.14	0.8886
D27	1.7139	"	"	"	2.0588	1.2145	1.5064	59.15	66.67	7.78	0.8960
D31	1.6457	"	"	"	1.9140	1.2283	1.5881	60.88	67.05	6.48	0.8880
D34	1.6376	"	"	"	1.9391	1.1978	1.5569	59.33	66.11	7.06	0.8961
E35	1.7481	"	"	"	1.9925	1.3566	1.4113	61.57	67.04	9.01	0.8900
E38	1.7351	"	"	"	1.9792	1.3765	1.2894	59.51	64.82	9.06	0.8913
E40	1.7282	"	"	"	1.9665	1.3577	1.3766	60.86	66.17	8.69	0.8912
F45	1.4744	833	500	240	2.1371	1.2219	0.9887	27.59	34.98	8.99	0.8915
F46	1.4312	"	"	"	2.0049	1.2254	0.9438	26.41	32.64	8.95	0.8803
G48	1.6663	400	"	221	1.9570	1.5490	1.1104	28.76	31.89	7.33	0.8897
G52	1.7005	"	"	"	1.9327	1.6139	0.9795	27.15	29.49	8.10	0.8873
H53	1.7012	"	300	238	2.0417	1.4500	1.3082	42.45	47.81	13.43	0.8697
H54	1.7133	"	"	"	2.1162	1.4661	1.1038	38.03	43.58	14.68	0.8654

Notations:

No. - sample number of the run, with the first letter for group designation; the operating conditions were very close for the same group designation.
RFeed - Feed ratio in moles H2/CO of the syngas feed.
CCMN - Feed rate in cc/minute at ambient condition, 70 deg. F, 1 atm.
PSI - Pressure in psig.
T C - Temperature in deg C.
Usage - Usage ratio, moles H2 consumed per mole CO.
RHC - Residual H2/CO mole ratio in the Berty reactor - the actual condition that the catalyst was exposed to.
Sp.Actvty - Specific Activity of the catalyst with respect to the previous rate correlation (of the simple cobalt catalyst of 1984).
CVCO - Conversion of CO, in percent.
CVSG - Conversion of syngas(H2+CO), in percent.
WCH4 - Wt.% CH4 in the hydrocarbon product slate.
Alpha - the alpha parameter of the Schulz-Flory distribution for the C3+ hydrocarbon fraction.

To get some idea on the performance of the run, the Wt%CH4 was plotted against the syngas conversion in Figure C4 with the data points shown by their group designations (such as the letters A,B,C,D etc). The letters are in chronological order. The data also showed the influence of various process variables on the performance. For most of the time, the run was operated under the condition of 300 psig, 240 deg.C and 300 SV (space velocity); the data groups A,B,C and H are at these conditions. The only difference between them was in the feed H2/CO ratio (RF) and consequently the residual H2/CO ratio (RHC) in the

reactor. In the groups A,B and C, we see the expected increase in conversion and Wt%CH4 by employing a feed progressively richer in H2/CO ratio. In groups D and E, we see that higher pressure (500 psig) gave a higher conversion with lesser methane make. From D to E, we begin to see some evidence of deactivation. From E to F, the space velocity was doubled with the expected reduction in conversion. From F to G, both the space velocity and the temperature were reduced, with the temperature having the predominant effect. The run was terminated at condition H, where the temperature, pressure and space velocity were the same as the initial operating condition of groups A,B and C, but with the feed H2/CO ratio very close to that of C. The greatly reduced conversion between C and H can only be ascribed to deactivation with an accompanying increase in the methane make.

III. CO Rate Expression for Co/X11/TC123 - Power Law Form

The material balance data of the Run 45 (11 tables in the 6-th Quarterly Report under filetype 5Q4) were used to determine the experimental CO conversion rate and the partial pressures (psia) of H2, CO, CO2, and H2O. This was then used as a data base for the rate correlation. The first data point was discarded due to a very poor material balance (the consistency ratio was 0.288). Fifty two data points remained.

The first attempt for the CO rate expression was of the same power law form used previously (note - double asterisks for exponentiation) :

$$\text{Rate CO} = B1 * \frac{pH2^{**}B2}{pCO^{**}B3} * \frac{TCOEF}{1000}$$

gm moles CO / hr, gm catalyst

$$TCOEF = \exp\left(\frac{B4 * (tc - 240)}{1.98726 * 513.15 * (tc + 273.15)}\right)$$

Arrhenius Temp. Coeff. with 240 C as base temp.

with the result as follows:

Set	B1	B2	B3	B4	No. data points
(1)	1.545105	0.473133	0.216895	25.80126	52

Then the two data points in set H were kicked out because of too much deviation (attributed to deactivation) with the results given below:

Set	B1	B2	B3	B4	No. data points
(2)	2.366298	0.491148	0.320291	25.42718	50, set H out

Since the catalyst deactivated considerably over this 66 day long run, the value of the parameters in set (2) represented the behavoir of a mixture of fresh catalyst and aged catalyst. This is not what we wanted. Hence in the next step, the data points beyond 910 hours (or sets E,F,G,H) were kicked out of the data fitting with the following results:

Set	B1	B2	B3	B4	No. data points
(3)	0.9354636	0.606874	0.238821	(25.42718)	32,sets A,B,C,D

In this set, A,B,C and D had essentially the same temperature at 239, 240, 241 deg C., so we assumed the same activation energy of 25427 cal/gmole, and correlated the other parameters B1, B2, B3 by regression. The value of the parameter in this set (set 3) is reasonable, particularly with respect to the 0.368 difference between B2 and B3.

This means that the rate will go up with the system pressure at a power of 0.368. In the 1984 correlation, the difference was 1.186, a value that was found to be too high when we raised the system pressure from 300 to 500 psig in the Berty reactor.

Because of the narrow range of the run temperatures, the value of the activation energy coefficient, B4, is not as reliable as it could be, particularly since the value was obtained in the regression set (2), where the effect of deactivation was not considered, and therefore may very well have been masked by appearing as a temperature effect. Therefore, the activation energy value of 25427 calorie/gmole should be further refined in the future with a data set covering a wider temperature range.

The goodness of the fit can be estimated by computing the difference between the experimental and the calculated CO rate according to the correlation, and expressed as a percent of the calculated rate. The mean of the percent difference of course should hover around zero, the standard deviation of the percent difference gives a measure of the goodness of the fit. The statistics for the percent difference was computed for set (3) with the results below:

Set (3)	32 data points	Mean of %Difference		0.0924 %
		Std deviation	+/-	4.358 %
		Std Error	+/-	0.770 %

IV. CO Rate Expression for Co,X11-TC123 Langmuir-Hinshelwood Form

The rate data can also be correlated in the Langmuir-Hinshelwood form derived from considerations based on adsorption sites. Some schools consider this form to be more fundamental, and therefore more logical. Many variations of the