TABLE XXXIX

PROPYLENE PROPERTIES USED IN ECONOMIC ANALYSIS

Property	Value
MON, Octane	97
RON, Octane	110
RVP, psi	5.0
Density, lb/gal.	6.4
Operating Cost, cents/gal.	30

DIPE economics are very sensitive to propylene feedstock cost. In a refinery where propylene was higher-valued as feed for alkylation or as polymer grade propylene, the manufacture of DIPE would have a smaller effect on FCU product value.

8.2 Calculation of Hydrocracking Product Values and Comparison With Pilot Plant FCC Product Values

An economic analysis of hydrocracking F-T wax was made. The economics for using Fischer-Tropsch wax as feedstock for a mild-severity hydrocracking process are given in Table XL. Figure 74 shows the refinery configuration which set the basis for the economic evaluation. Light ends from the hydrocracker were valued as fuel gas, i-butane as alkylation feed, n-butane as gasoline, all C_5 and C_6 hydrocrackate as isomerization feed, all C_7 to 350°F endpoint hydrocrackate as naphtha reformer feed, all 350+°F hydrocrackate as diesel fuel, and all off-gas from the naphtha reformer at its heating value. The hydrocracking product values were calculated using yield and density data consistent with the Bechtel/DOE computer modelling project for the hydrocracking of F-T liquids.[9] The price structure used for the hydrocracking case is shown in Table XL, and is the same as was used with the FCC cases. Table XLI summarizes the yield information and calculates the value of the hydrocrackate products, in terms of dollars per day.

Figure 75 plots the "simple refinery" and "complex refinery" product values for the eight FCC pilot plant runs that were given in Table XXXVII plus the single-yield hydrocracker product value line. Since both FCU and hydrocracker diesel are sulfur-free, neither processing scheme offers an advantage concerning sulfur. Figure 75 shows that the product value for the hydrocracker process were similar to the FCC product values for a simple refinery configuration. The hydrocracker product value used was based on a simple refinery configuration when mild severity hydrocracking produced 31.4 wt% of C_5 to 350°F hydrocrackate plus alkylate and 65.4 wt% of diesel fuel, while catalytic cracking produced 68.2-80.8 wt% of C_5-430°F gasoline plus alkylate and only 2.7-9.0 wt% of diesel. Diesel fuel has a lower value than gasoline. If hydrocracking severity were higher, producing more naphtha such as in the all-gasoline mode operation, the product value from hydrocracking might be higher than from FCC in a simple refinery configuration. The FCU diesel had an average cetane index of 58.6. For Amoco, the incremental cetane value is between $0.0/cetane-barrel and %0.04/cetane-barrel, depending on season and location. Using an average value of $0.02/cetane barrel and a cetane of 75 for hydrocracker diesel, the price increment for hydrocracker diesel was calculated to be 0.78 cpg. This calculated value was viewed as too small to incorporate into the economic analysis. As a sensitivity, a 10% increase in diesel product value for the hydrocracker case would raise the value of the hydrocracker products by 6.2%. This interaction would be

TABLE XL

FISCHER-TROPSCH WAX HYDROCRACKING CASE: PRICE STRUCTURE CALCULATIONS

Component	Price	Properties	
gasoline (ULR)	55.70 cpg	9.0 RVP	87.0 (R+M)/2
FO #2	52.10 cpg		
FO #6	31.8 cpg		
MTBE	86.00 cpg	9.0 RVP	108.0 (R+M)/2
iC4	37.20 cpg	87.0 RVP	97.6 (R+M)/2
nC4	29.80 cpg	65.0 RVP	90.6 (R+M)/2
N. Gas	2.00 $/MMBTU		
Power	2.28 ¢/kw-hr		
H2SO4	75.00 $/ton		
Caustic	395.00 $/ton		
Methanol	50.00 cpg	32.04 MW	278.418 lb/gal
Incremental Property Values	1.44 ¢/octane-gal		
	(0.55)¢/RVP-gal		
Alkylate	62.49 cpg	7.3 RVP	91.1 (R+M)/2
Isomerate	46.43 cpg	10.1 RVP	81.0 (R+M)/2
Reformate	63.13 cpg	3.4 RVP	90.0 (R+M)/2

Component	BTU/Gal	Value To Fuel, cpg	RVP, psi	Octane (R+M)/2	Value to ULR, cpg	Value to Alky, cpg	Value to Isom, cpg	Value to Reformer, cpg	Value to Diesel, cpg
Hydrogen	30,160	6.03							
Methane	53,754	10.75							
Ethane	60,592	12.12							
Propane	84,100	16.82							
i-Butane	91,830	18.37	87.0	97.6	27.71	37.20			
n-Butane	95,603	19.12	65.0	90.6	29.80				
i-Pentane	100,540	20.11	22.0	87.7	49.44		43.39		
n-Pentane	101,770	20.35	17.0	74.9	33.81		43.80		
i-Hexane	106,608	21.32	8.0	77.2	42.11		48.48		
n-Hexane	107,113	21.42	5.0	25.4	(30.96)		48.79		
C7-300 F HC									
300 F - 350 F HC								60.69	
350 F - 500 F HC								63.49	
500 F - 700 F HC									52.10
									52.10

TABLE XLI

ECONOMIC ANALYSIS OF F-T WAX HYDROCRACKER CASE

Rate Basis: 283,657 lb/hr

Component	normalized wt % Yield	lb/hr	BBL/Day	cpg	$/Day	Valued as	
Hydrogen	0.000	0	0	6.0	0	Fuel Gas	2
Methane	0.049	139	32	10.8	145	Fuel Gas	2
Ethane	0.049	139	27	12.1	136	Fuel Gas	2
Propane	1.460	4,141	559	16.8	3,945	Fuel Gas	2
i-Butane	1.934	5,486	668	37.2	10,433	Alkylation	3
n-Butane	1.569	4,451	522	29.8	6,532	Gasoline	6
i-Pentane	2.407	6,828	752	43.4	13,700	Isom Unit	4
n-Pentane	2.033	5,766	626	43.8	11,522	Isom Unit	4
i-Hexane	3.828	10,858	1,068	48.5	21,754	Isom Unit	4
n-Hexane	2.348	6,661	651	48.8	13,344	Isom Unit	4
C7 - 300 F HC	14.287	40,526	3,949	60.7	100,678	Reformer	5
300 F - 350 F HC	4.588	13,014	1,220	63.5	32,550	Reformer	5
350 F - 500 F HC	20.918	59,336	5,379	52.1	117,711	Diesel	7
500 F - 700 F HC	44.530	126,312	10,961	52.1	239,849	Diesel	7
Total	100.000	283,657	26,414		572,300		

FIGURE 74

SCHEMATIC OF BASIS REFINERY CONFIGURATION
FOR HYDROCRACKING CASE ECONOMICS

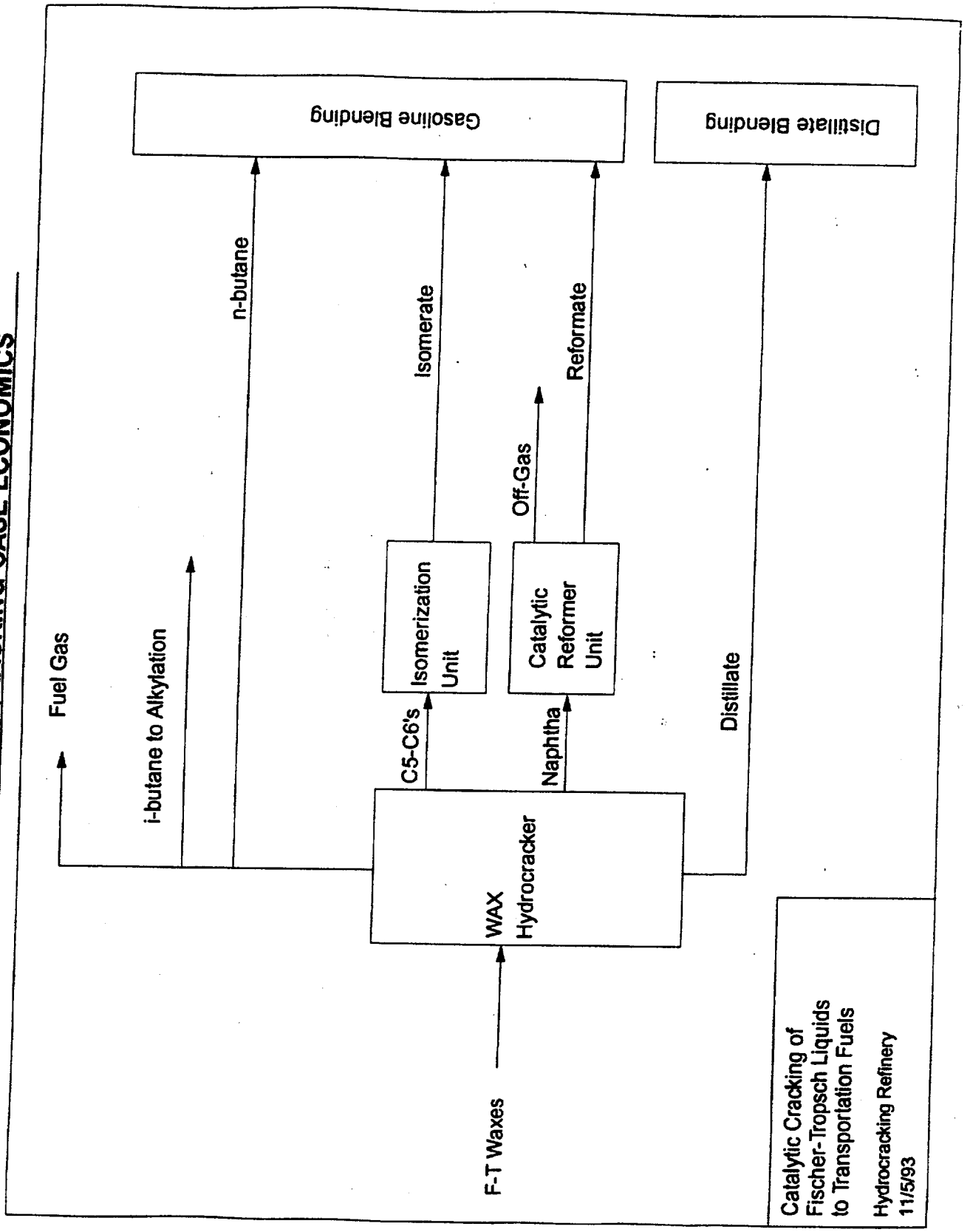
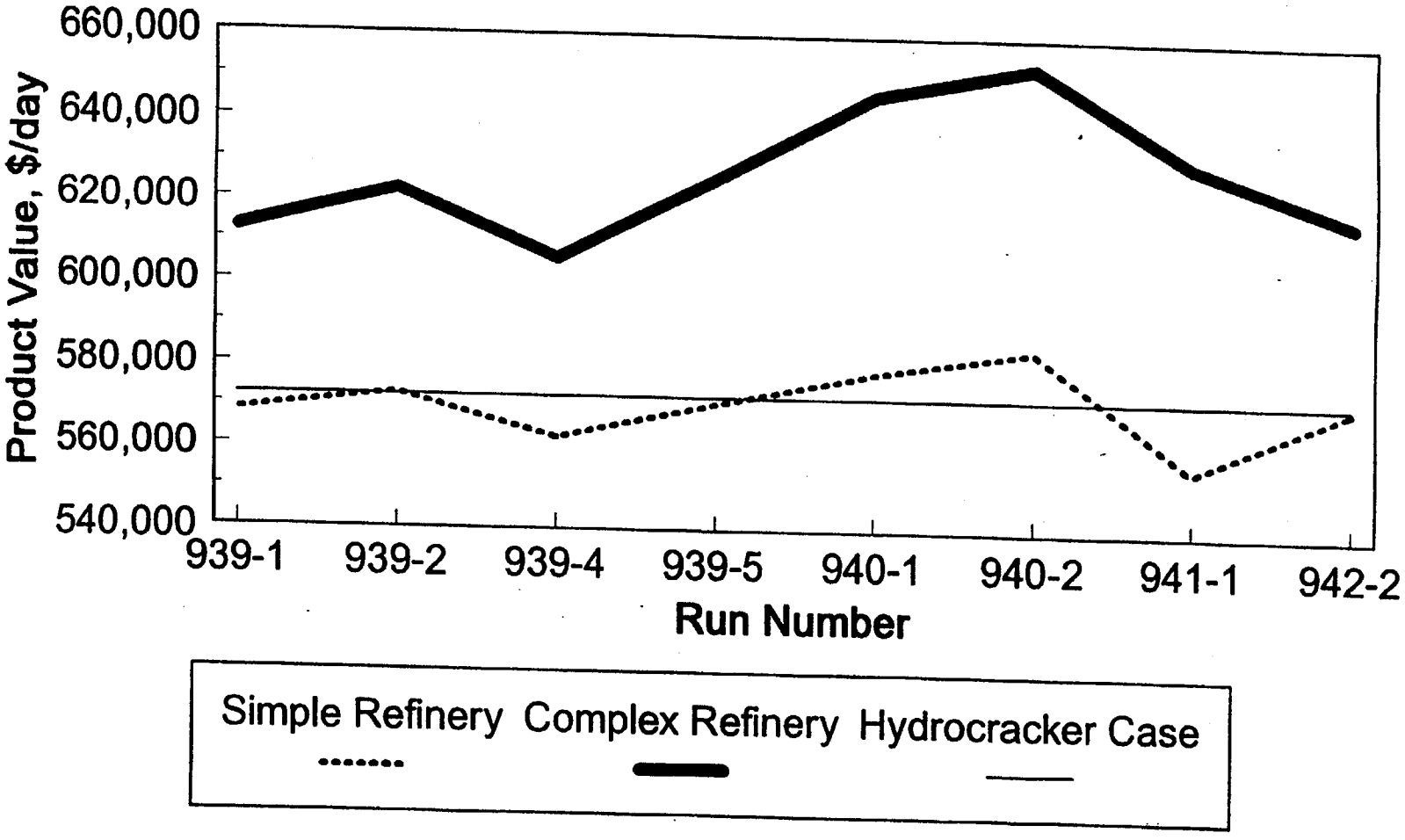


FIGURE 75

NET PRODUCT VALUE FOR FCC PILOT PLANT RUNS
AND HYDROCRACKER CASE



much smaller for the FCU cases, because the diesel yields are much smaller.

Figure 75 shows that hydrocracker values are always lower than the FCC product values for a complex refinery configuration. Since hydrocracking does not generate olefins, catalytic cracking is preferred because of its high yields of iso-olefins for use as feedstocks for ether production.

For the reasons discussed above in section 8.1.2, valuation of the propylene from the FCC process as feedstock for a DIPE unit rather than as fuel would further increase the value of the FCC process over the hydrocracking process in a complex refinery configuration.

9.0 CONCLUSIONS

The catalytic cracking of F-T wax feedstocks gave high conversions with low activity catalysts and low process severities. Catalyst selection and process optimization will depend on product valuation. HZSM-5 and beta zeolite catalysts gave higher yields of propylene, isobutylene, and isoamylenes but a lower gasoline yield than Y zeolite catalysts. For a given catalyst and process condition, Sasol and LaPorte waxes gave similar conversions and product selectivities. The contaminant iron F-T catalyst fines in the LaPorte wax caused higher coke and hydrogen yields.

The net product values for catalytic cracking F-T wax feedstock in eight pilot plant runs were calculated with the iso-olefins valued as alkylate or gasoline (simple refinery configuration) and as feedstock to an ether unit (complex refinery configuration). Irrespective of catalyst, the net product values from catalytic cracking F-T wax feedstock were always higher when the iso-olefins were valued as feed to an ether unit rather than fuel. In a simple refinery configuration, additional experimental work would be required to identify the catalyst that gave the highest net product value. In a complex refinery configuration, HZSM-5 and beta zeolite catalysts gave higher net product values than Y zeolite catalyst because of their higher yields of iso-olefins. The net product values of the HZSM-5 and beta zeolite catalysts were additionally increased over the Y zeolite catalyst when propylene was valued as feedstock to an di-isopropyl ether unit rather than fuel gas.

The product value for mild-severity hydrocracking F-T wax was calculated from literature data and compared with the product values from the eight pilot plant runs. The value for the hydrocracking case was below the values for catalytic cracking using a complex refinery configuration but were similar to the product values for catalytic cracking using a simple refinery configuration. If hydrocracking severity were higher, producing more naphtha such as in the all-gasoline mode operation, the product value from hydrocracking might be higher than from FCC in a simple refinery configuration.

The 200-°F product from catalytic cracking pilot plant runs was demonstrated to be a good feedstock for the production of mixed ethers by reaction with methanol using conventional technology.

10.0 REFERENCES

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NOTICE

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APPENDIX A

MYU Run Data

APPENDIX A -- MYU Run Data

Run Number	Feedstock	Catalyst Identification	Catalyst Type	C/O Ratio	Reaction Temperature, F	Recovery Wt%	Conversion Wt%	Coke Wt%
91-59-098	Sasol Wax	CCC-408	Eq. USY	3.94	971	76.8	90.2	2.99
91-59-099	Sasol Wax	CCC-408	Eq. USY	3.72	971	81.8	99.1	2.06
91-59-100	Sasol Wax	CCC-408	Eq. USY	2.72	971	111.1	85.3	1.85
91-59-101	Sasol Wax	CCC-408	Eq. USY	3.06	970	97.6	88.1	2.21
92-59-001	Sasol Wax	CCC-408	Eq. USY	3.16	971	92.7	88.2	3.03
92-59-002	Sasol Wax	st. CCC-1397	St. Eq. USY	3.20	971	94.3	87.6	0.97
92-59-003	Sasol Wax	st. CCC-1397	St. Eq. USY	3.27	972	91.7	87.2	1.18
92-59-004	Sasol Wax	st.'CCC-1875	St. Beta	3.26	972	92.2	90.9	0.82
92-59-005	Sasol Wax	st. CCC-1875	St. Beta	3.37	972	89.5	91.8	0.91
92-59-006	Sasol Wax	st. 1397	St. Eq. USY	3.35	939	89.7	85.8	1.13
92-59-007	Sasol Wax	st. CCC-1875	St. Beta	3.29	939	91.6	91.4	1.08
92-59-008	Sasol Wax	st. 1397	St. Eq. USY	3.28	909	91.7	87.6	1.59
92-59-009	Sasol Wax	st. 1875	St. Beta	3.31	909	90.7	91.4	1.25
92-59-010	Sasol Wax	st. 1397	St. Eq. USY	3.32	880	90.2	88.2	1.84
92-59-011	Sasol Wax	CCC-1875	St. Beta	3.16	879	94.3	92.4	1.29
92-59-014	Sasol Wax	1397(1:1-1872)	Eq. USY	1.62	970	86.8	86	1.11
92-59-015	Sasol Wax	1397(1:1-1872)	Eq. USY	1.55	969	90.7	85.1	0.91
92-59-016	Sasol Wax	1397(1:1-1872)	Eq. USY	1.58	969	88.8	86.2	1.05
92-59-017	Sasol Wax	1397(1:1w1872)	Eq. USY	1.63	969	89.9	86.1	1.04
92-59-018	Sasol Wax	1397(1:3w1872)	Eq. USY	0.85	969	86.7	84.3	0.5
92-59-019	Sasol Wax	1397(1:3w1872)	Eq. USY	0.84	969	87.1	84.4	0.57
92-59-020	Sasol Wax	1397(1:3w1872)	Eq. USY	0.82	970	93.6	93.6	0.55
92-59-021	Sasol Wax	1397(1:3w1872)	Eq. USY	0.79	969	93.5	84.5	0.52
92-59-022	Sasol Wax	1397(1:3w1872)	Eq. USY	0.76	881	91.9	70.1	0.6
92-59-023	Sasol Wax	1397(1:3w1872)	Eq. USY	0.80	881	87.1	82.6	0.71
92-59-024	Sasol Wax	1397(1:3w1872)	Eq. USY	0.89	880	84.1	81.8	0.86
92-59-025	Sasol Wax	1397(1:3w1872)	Eq. USY	0.82	881	92.1	74.7	0.77
92-59-026	Sasol Wax	1875(1:3w1872)	St. Beta	0.89	881	85.2	91.2	0.5
92-59-027	Sasol Wax	1875(1:3w1872)	St. Beta	0.93	880	83.4	89.6	0.47
92-59-028	Sasol Wax	1875(1:7w1872)	St. Beta	0.45	880	88.3	88.9	0.35
92-59-029	Sasol Wax	1875(1:7w1872)	St. Beta	0.46	881	89.2	84.2	0.28
92-59-030	Sasol Wax	1397(1:7w1872)	Eq. USY	0.43	880	91.7	77.6	0.32
92-59-031	Sasol Wax	1397(1:7w1872)	Eq. USY	0.43	880	86.8	83	0.31
92-59-032	Sasol Wax	CCC-1891	St. HZSM-5	3.58	880	83	93.6	0.35
92-59-033	Sasol Wax	CCC-1891	St. HZSM-5	3.65	880	81.5	90.4	0.38

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Propylene Wt%	Total C3 Wt%	Isobutylene Wt%	Total C4 Wt%	Isoamylenes Wt%	C5-430 deg. F Wt%	RON	MON	Conversion by Sim. Dis., Wt%	Comments
91-59-098	10.31	12.23	3.5	18.19	3.51	54.41	85.7	78.2		
91-59-099	9.86	11.69	3.83	19.83	5.82	63.3	86.9	78		
91-59-100	7.08	8.32	2.55	13.68	4.79	59.83	84.7	77.3		
91-59-101	9.95	11.39	4.49	19.99	5.79	51.16	85.8	77.6		
92-59-001	11.42	13.26	3.24	15.88	4.46	53.08	83.5	77.6		
92-59-002	11.04	12.34	6.4	21.39	7.19	51.18	86.1	77.9		
92-59-003	10.94	12.3	6.28	21.15	6.89	50.78	85.7	77.4		
92-59-004	14.6	16.5	8.3	31.84	5.73	39.85	86	78.6		
92-59-005	15.35	17.36	8.24	32.26	6.09	39.35	87.1	79.2		
92-59-006	10.42	11.67	6.3	21.64	6.92	50.12	85.8	77.5		
92-59-007	13.4	15.32	8.4	33.56	5.95	39.88	86.1	78.5		
92-59-008	10.96	12.46	6.17	22.66	6.89	49.55	86.2	78.5		
92-59-009	14.3	16.33	7.67	31.26	6.33	41.27	86.6	79		
92-59-010	9.88	11.26	6.22	22.94	7.44	51.02	87.2	78.7		
92-59-011	12.14	13.89	8.82	31.53	7.69	44.89	87.3	78.8		
92-59-014	10.4	11.7	6	22.58	6.35	49.02	85.9	78.4		
92-59-015	9.98	11.17	6.1	21.57	7.07	50.11	87.3	78.7		
92-59-016	10.66	11.92	5.81	21.7	6.59	50.06	85.8	78.3		
92-59-017	10.62	11.85	5.73	21.44	6.69	50.31	85.9	78.3		
92-59-018	9.8	10.81	6.14	19.95	7.4	51.74	86	77.3	91.8	
92-59-019	9.88	10.92	6.26	19.79	7.14	51.76	85.6	77.1	91.8	
92-59-020	9.56	10.58	5.93	18.61	7.4	53.27	85.9	77.3	91.7	
92-59-021	9.46	10.43	4.96	18.87	7.78	53.46	85.9	77.2	92.2	
92-59-022	4.69	5.23	3.56	11.13	5.29	52.83	86	75.9	77.3	
92-59-023	7.61	8.82	5.41	17.38	7.08	54.95	85.3	77	89.8	
92-59-024	7.96	8.88	5.13	17.02	6.52	54.34	85.2	77.1	89.5	
92-59-025	5.44	6.06	3.64	11.65	5.67	55.74	85.8	76.4	82.8	
92-59-026	12.06	13.2	10.37	27.2	9.35	49.59	83.8	76	97.1	
92-59-027	11.44	12.54	10.1	26.7	9.27	49.23	85.6	76.6	95.1	
92-59-028	10.85	11.82	10.23	24.33	9.85	51.78	84.2	75.2		
92-59-029	9.53	10.39	9.03	21.68	9.22	51.35	84.5	75.1		
92-59-030	5.75	6.37	4.63	13.26	6.49	57.2	85.2	75.7		
92-59-031	7.45	8.25	5.78	16.81	7.66	56.99	85.2	76.2	89.2	
92-59-032	11.16	19.08	6.31	29.77	3.81	38.49	96.4	83		
92-59-033	12.46	18.93	7.02	27.23	3.97	39.18	93	81.2		

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Feedstock	Catalyst Identification	Catalyst Type	C/O Ratio	Reaction Temperature, F	Recovery Wt%	Conversion Wt%	Coke Wt%
92-59-034	Sasol Wax	1397(1:15w1872)	Eq. USY	0.21	880	90.9	55.1	0.17
92-59-035	Sasol Wax	1397(1:15w1872)	Eq. USY	0.23	880	85.6	64	0.18
92-59-036	Sasol Wax	1875(1:15w1872)	St. Beta	0.22	881	86.6	64.7	0.17
92-59-037	Sasol Wax	1875(1:15w1872)	St. Beta	0.22	880	87.1	80.3	0.17
92-59-038	Sasol Wax	1397(1:15w1872)	Eq. USY	0.24	880	85.2	71.6	0.23
92-59-039	Sasol Wax	1397(1:15w1872)	Eq. USY	0.21	880	90.4	62.2	0.16
92-59-040	Sasol Wax	1397(1:15w1872)	Eq. USY	0.22	880	88	69.2	0.19
92-59-041	Sasol Wax	1397(1:15w1872)	Eq. USY	0.22	880	88.8	71.6	0.19
92-59-042	Sasol Wax	1875(1:15w1872)	St. Beta	0.23	880	83.1	83.3	0.19
92-59-043	Sasol Wax	1875(1:15w1872)	St. Beta	0.22	879	89.5	58	0.18
92-59-044	Sasol Wax	1875(1:15w1872)	St. Beta	0.20	969	91.7	76.7	0.09
92-59-045	Sasol Wax	1875(1:15w1872)	St. Beta	0.21	970	89.7	80.9	0.09
92-59-046	Sasol Wax	1397(1:15w1872)	Eq. USY	0.20	970	95.5	70.9	0.12
92-59-047	Sasol Wax	1397(1:15w1872)	Eq. USY	0.20	969	94.9	71.8	0.12
92-59-048	Sasol Wax	CCC 1894	Octacat Matrix	3.30	970	92	72.6	0.61
92-59-049	Sasol Wax	CCC 1894	Octacat Matrix	3.27	970	92.8	73	0.64
92-59-050	Sasol Wax	CCC 1891 (1:3w1872)	St. HZSM-5	0.95	880	81.8	84.1	0.19
92-59-051	Sasol Wax	1891 (1:3w1872)	St. HZSM-5	0.91	880	84.7	87.7	0.19
92-59-052	Sasol Wax	1891 (1:7w1872)	St. HZSM-5	0.48	880	89.3	88.3	0.16
92-59-053	Sasol Wax	1891 (1:7w1872)	St. HZSM-5	0.48	879	80.6	85.6	0.15
92-59-054	Sasol Wax	1891 (1:15w1872)	St. HZSM-5	0.22	880	88	84.1	0.11
92-59-055	UOP Naph.	1891 (1:15w1872)	St. HZSM-5	0.22	880	83.8	85.9	0.13
92-59-056	UOP Naph.	1397(1:15d1872)	Eq. USY	0.20	881	92.3	76.2	0.17
92-59-057	UOP Naph.	1397(1:15d1872)	Eq. USY	0.20	880	93.4	75	0.16
92-59-058	UOP Naph.	1875(1:15d1872)	St. Beta	0.21	880	90.9	79.1	0.14
92-59-059	UOP Naph.	1875(1:15d1872)	St. Beta	0.20	881	91.2	79.2	0.12
92-59-060	UOP Naph.	1891 (1:15/1872)	St. HZSM-5	0.21	881	90.4	61.3	0.13
92-59-061	UOP Naph.	1891 (1:15/1872)	St. HZSM-5	0.21	880	90.7	62.9	0.1
92-59-062	UOP Naph.	1872	Diluent	3.20	880	95	696.8	0.18
92-59-063	UOP Naph.	1872	Diluent	3.18	880	95.3	73	0.16
92-59-064	Sasol Wax	1875(1:31w1872)	St. Beta	0.12	881	80.1	65.5	0.16
92-59-065	Sasol Wax	1875(1:31w1872)	St. Beta	0.12	879	84.2	66.7	0.11
92-59-068	UOP Naph.	1397(1:15d1872)	Eq. USY	0.23	879	0.2	68.5	0.14
92-59-069	UOP Naph.	1397(1:15d1872)	Eq. USY	0.21	970	88.5	100.1	0.23
92-59-070	UOP Naph.	1875(1:15d1872)	St. Beta	0.22	969	87.7	101.6	0.18
92-59-071	UOP Naph.	1891 (1:15d1872)	St. HZSM-5	0.21	969	90	100.1	0.12

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Propylene Wt%	Total C3 Wt%	Isobutylene Wt%	Total C4 Wt%	Isoamylenes Wt%	C5-430 deg. F Wt%	RON	MON	Conversion by Sim. Dis., Wt%	Comments
92-59-034	3.4	3.82	2.93	8.16	3.53	42.54	84.9	74.3	57.6	
92-59-035	4.29	4.79	3.61	10.11	4.73	48.53	84.9	74.6	72.8	
92-59-036	6.4	7.04	6.83	15.98	6.37	41.03	84.3	74.5		
92-59-037	7.92	8.71	8.77	19.82	8.91	51.12	84.2	74.5		
92-59-038	5.72	6.36	4.88	13.52	6.21	50.98	85.1	75.3		
92-59-039	4.07	4.55	3.58	10.14	4.68	46.92	85	74.8		
92-59-040	4.76	5.28	4.15	11.45	5.68	51.83	85.6	75.1		
92-59-041	5.53	6.15	4.61	12.74	6.3	51.98	84.5	75		
92-59-042	8.94	9.79	9.45	21.24	9.18	51.44	84.4	74.6		
92-59-043	5.41	5.97	5.56	13.01	4.81	38.41	83.4	73.8		
92-59-044	8.35	9.17	7.61	17.37	5.09	48.89	83.6	73.6		
92-59-045	9.7	10.58	8.69	19.94	5.91	49.07	82.8	73.7		
92-59-046	5.73	6.39	4.22	11.49	5.94	51.85	86.1	75	77.7	
92-59-047	6.16	6.84	4.38	12.02	6.25	51.62	86.2	75.3	83	
92-59-048	9.64	10.65	7.21	18.66	8.08	41.22	88.6	76.8		
92-59-049	10.53	11.61	7.38	19.52	7.59	39.75	87.9	76.9		
92-59-050	16.9	21.4	10.62	31.57	5.72	26.95	83.5	76.3		
92-59-051	16.05	20.39	10.31	34.55	6.09	28.74	87.4	78.2		
92-59-052	15.69	19.23	12.46	34.47	7.81	31.25	84.4	76.4		
92-59-053	15.27	18.64	12.09	33.08	7.85	30.82	86.6	77.5		
92-59-054	17.01	19.71	12.52	31.43	9.44	31.21	85.4	76.4		
92-59-055	17.48	20.18	12.28	30.91	9.75	31.06	84.4	76		
92-59-056	2.98	3.04	0.47	2.92	1.02	66.84	77.3	69.6		
92-59-057	2.81	2.86	0.5	3.09	1.23	65.87	76.8	69.5		
92-59-058	3.71	3.78	1.49	5.17	2.75	67.12	75.8	68.9		
92-59-059	3.83	3.9	1.64	5.64	2.93	66.65	75.3	68.7		
92-59-060	8.22	8.29	2.84	8.53	4.24	39.93	74.6	68.6		
92-59-061	8.12	8.19	2.95	9.03	4.54	41.08	75.6	69.2		
92-59-062	0.98	1.11	0.44	1.66	0.2	692.83	77.6	66.2		
92-59-063	1.1	1.23	0.58	1.94	0.24	68.61	74.1	65.1		
92-59-064	15.54	17.5	9.26	22.62	6.69	24.16	84.2	75.1		
92-59-065	14.62	16.41	9.02	22.54	7.88	26.7	85.2	75.9		
92-59-068	8.19	9.33	6.48	17.86	8.6	40.43	83.6	74.3		
92-59-069	4.13	4.25	1.31	6.59	3.32	83.99	79.4	70.3		
92-59-070	6.44	6.58	3.15	9.34	5.84	80.15	74.6	68.3		
92-59-071	11.75	11.86	5.91	14.16	8.93	67.95	75.9	69.4		

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Feedstock	Catalyst Identification	Catalyst Type	C/O Ratio	Reaction Temperature, F	Recovery Wt%	Conversion Wt%	Coke Wt%
92-59-072	UOP Naph.	1891 (1:15d1872)	St. HZSM-5	0.21	969	86.4	99.8	0.19
92-59-084	Sasol Wax	14040- 43-1 (1:15w1872)	St. HZSM-5	0.25	882	80	88.9	0.16
92-59-085	Sasol Wax	14040- 43-2 (1:15w1872)	St. HZSM-5	0.23	881	78.7	89.6	0.13
92-59-086	Sasol Wax	14040- 43-3 (1:15W1872)	St. HZSM-5	0.23	879	0.2	68.5	0.14
92-59-087	Sasol Wax	1891(1:15W1872)	St. HZSM-5	0.27	880	72.1	91.9	0.14
92-59-088	Sasol Wax	1891(1:15W1872)	St. HZSM-5	0.24	880	76.8	89.8	1.28
92-59-089	Sasol Wax	1891(1:15W1872)	St. HZSM-5	0.24	881	76.9	92.8	0.14
92-59-090	Sasol Wax	14040- 45-1 (1:15 1872)	St. HZSM-5	0.22	880	78.8	83.8	0.13
92-59-091	Sasol Wax	14040- 43-1 (1:15w1872)	St. HZSM-5	0.24	880	80.3	90	0.12
92-59-092	Sasol Wax	14040- 43-2 (1:15w1872)	St. HZSM-5	0.25	881	73.1	95.1	0.15
92-59-093	Sasol Wax	14040- 43-3 (1:15W1872)	St. HZSM-5	0.22	880	83.7	75.7	0.12
92-59-094	Sasol Wax	14040- 45-1 (1:15w1872)	St. HZSM-5	0.24	881	78.6	117.7	0.15
92-59-095	Sasol Wax	14040- 44-4 (1:15w1872)	St. Mordenite	0.18	880	107.4	37.7	0.1
92-59-096	Sasol Wax	14040- 42-1 (1:15w1872)	Reo/HZSM-5	0.24	880	77.3	85	0.14
92-59-097	Sasol Wax	14040- 42-2 (1:15w1872)	Reo/HZSM-5	0.24	880	80.4	85.1	0.13
92-59-098	Sasol Wax	14040- 42-3 (1:15W1872)	Reo/HZSM-5	0.22	880	80.6	82.1	0.13
92-59-099	Sasol Wax	1701 (1:3w1872)	St. USY	0.89	880	81.9	91.6	0.83
92-59-100	Sasol Wax	1702 (1:3w1872)	St. Reo/USY	0.82	880	99.6	87.9	0.79
92-59-101	Sasol Wax	1703 (1:3w1872)	St. Reo/USY	0.81	880	90.5	84.3	0.8
92-59-102	Sasol Wax	1704 (1:3w1872)	St. Reo/USY	0.86	881	86.4	90.8	0.94
92-59-103	Sasol Wax	1705 (1:3w1872)	St. Reo/USY	0.82	878	89.3	90.1	0.83
92-59-104	Sasol Wax	1706 (1:3w1872)	St. Reo/USY	0.90	880	80.3	94.2	0.13
92-59-106	Sasol Wax	1891 (1:31d1872)	St. HZSM-5	0.12	880	75	83.8	0.14
92-59-107	Sasol Wax	14040- 45-1 (1:31)	St. HZSM-5	0.11	880	79.1	83.3	0.15
92-59-108	Sasol Wax	14040- 43-1 (1:31 1872)	St. HZSM-5	0.11	880	80.1	80.4	0.13
92-59-109	Sasol Wax	14040- 43-2 (1:31 1872)	St. HZSM-5	0.11	880	83.1	90.2	0.12
92-59-110	Sasol Wax	14040- 43-3 (1:31 1872)	St. HZSM-5	0.10	880	88.3	46.7	0.16
92-59-111	Sasol Wax	14040- 42-1 (1:31d1872)	Reo/HZSM-5	0.10	880	85.8	64.2	0.17
92-59-112	Sasol Wax	14040- 42-2 (1:31d1872)	Reo/HZSM-5	0.10	880	86.5	59.9	0.14
92-59-113	Sasol Wax	14040- 42-3 (1:31d1872)	Reo/HZSM-5	0.11	880	84.3	56.5	0.15
92-59-114	Sasol Wax	1891 (1:31d1872)	St. HZSM-5	0.12	880	76.4	80.5	0.17
92-59-115	Sasol Wax	14040- 45-1 (1:31d1872)	St. HZSM-5	0.11	877	82.6	84.7	0.13
92-59-116	Sasol Wax	14040- 43-1 (1:31 1872)	St. HZSM-5	0.12	880	75.8	82.6	0.15
92-59-117	Sasol Wax	14040- 43-2 (1:31 1872)	St. HZSM-5	0.13	880	68.8	85.8	0.17
92-59-118	Sasol Wax	14040- 43-3 (1:31 1872)	St. HZSM-5	0.11	880	81.9	41.4	0.15
92-59-119	Sasol Wax	14040- 42-1 (1:31d1872)	Reo/HZSM-5	0.11	881	67.7	79.8	0.14

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Propylene Wt%	Total C3 Wt%	Isobutylene Wt%	Total C4 Wt%	Isoamylenes Wt%	C5-430 deg. F Wt%	RON	MON	Conversion by Sim. Dis., Wt%	Comments
92-59-072	8.8	8.9	3.93	12.16	7.63	73.24	74.4	68.6		
92-59-084	9.41	11.28	10.07	28.1	11.67	47.62	84.4	75		
92-59-085	10.38	12.48	9.3	26.36	10.74	49.02	86.2	75.7		
92-59-086	8.19	9.33	6.48	17.86	8.6	40.43	83.6	74.3		
92-59-087	13	15.8	11.74	31.1	8.73	42.23	80.9	74.2		
92-59-088	11.65	13.75	10.35	26.87	10.73	46.33	84.3	75.1		
92-59-089	15.11	17.82	12.19	31.44	10.69	41.14	82.5	74.8		
92-59-090	12.86	14.73	9.48	24.2	10.23	43.54	84.3	74.9		
92-59-091	14.79	17.23	10.75	27.38	9.96	43.47	81.7	74.2		
92-59-092	17.98	21.77	11.94	32.75	9.25	36.98	85	76.5		
92-59-093	11.94	13.33	8.05	20.19	10.25	41.28	84.8	75.3		
92-59-094	14.96	17.72	13.03	33.46	14.98	64.14	82.3	74.3		
92-59-095	1.74	2.11	1.54	4.45	1.98	30.4	76.2	70.2		
92-59-096	13.45	15.35	10.05	24.79	11.22	43.54	83.3	74.7		
92-59-097	13.01	14.86	10.16	25.09	11.63	43.94	83.7	75		
92-59-098	12.19	13.92	9.85	24.28	11.08	42.67	83.3	74.8		
92-59-099	7.67	8.57	5.9	19.58	7.74	61.85	89.8	78.1		
92-59-100	7.28	8.14	4.92	16.77	6.57	61.5	88.8	76.5		
92-59-101	5.99	6.72	4.23	14.39	6.02	61.79	87.7	74.9		
92-59-102	6.65	7.45	4.36	15.83	6.48	65.75	88.1	76.1		
92-59-103	5.56	6.21	4.01	14.05	6.12	68.34	86.6	74.1		
92-59-104	7.37	8.2	6.16	19.14	8.52	65.94	88.8	76.7		
92-59-106	13.83	15.84	10.14	25.65	10.62	40.74	84.2	75.2		
92-59-107	13.7	15.48	9.4	23.51	11.19	43.05	84.3	75.2		
92-59-108	12.31	14.01	8.96	22.2	10.6	42.98	83.6	74.7		
92-59-109	14.18	16.48	10.74	27.24	11.56	44.67	83.9	75.1		
92-59-110	6.8	7.45	3.96	11.01	4.61	27.49	83.4	74		
92-59-111	10.99	12.26	7.18	18.07	7.38	32.82	83.5	74.5		
92-59-112	9.84	10.9	6.1	15.64	6.97	32.39	85.9	74.4		
92-59-113	9.87	10.9	6.02	15.49	6.04	29.16	83.2	74.3		
92-59-114	15.32	17.53	10.38	25.84	8.97	35.13	81.5	74.3		
92-59-115	14.91	17.03	10.9	27.05	11.31	39.09	84.6	75.6		
92-59-116	13.57	15.58	10.45	25.92	10.97	39.49	84.1	75.4		
92-59-117	14.58	17.72	9.24	24.7	10.04	41.12	83.3	75		
92-59-118	6.81	7.61	3.91	10.52	3.76	22.48	80.6	73.1		
92-59-119	11.59	12.87	7.35	18.34	8.74	35.57	84.8	75.2		

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Feedstock	Catalyst Identification	Catalyst Type	C/O Ratio	Reaction Temperature, F	Recovery Wt%	Conversion Wt%	Coke Wt%
92-59-120	Sasol Wax	14040- 42-2 (1:31d1872)	Reo/HZSM-5	0.11	880	83.7	67.6	0.15
92-59-121	Sasol Wax	14040- 42-3 (1:31d1872)	Reo/HZSM-5	0.11	880	81.2	67.9	0.15
92-59-122	Sasol Wax	1701 (1:15d1872)	St. USY	0.22	881	81.7	86.1	0.15
92-59-123	Sasol Wax	1702 (1:15d1872)	St. Reo/USY	0.21	881	85.6	85.3	0.23
92-59-124	Sasol Wax	1703 (1:15d1872)	St. Reo/USY	0.20	881	85.7	83.8	0.26
92-59-125	Sasol Wax	1704 (1:15d1872)	St. Reo/USY	0.22	880	84.9	89.9	0.32
92-59-126	Sasol Wax	1705 (1:15d1872)	St. Reo/USY	0.22	879	86.3	36.7	0.17
92-59-127	Sasol Wax	1706 (1:15d1872)	St. Reo/USY	0.20	879	87	69.1	0.23
92-59-128	Sasol Wax	1701 (1:15d1872)	St. USY	0.23	882	85	84.9	0.32
92-59-129	Sasol Wax	1702 (1:15d1872)	St. Reo/USY	0.20	879	91.3	52.4	0.2
92-59-130	Sasol Wax	1703 (1:15d1872)	St. Reo/USY	0.20	878	86.6	75.5	0.23
92-59-131	Sasol Wax	1704 (1:15d1872)	St. Reo/USY	0.26	880	68.2	46.2	0.27
92-59-132	Sasol Wax	1705 (1:15d1872)	St. Reo/USY	0.21	880	87.7	85.7	1.39
92-59-133	Sasol Wax	1706 (1:15d1872)	St. Reo/USY	0.21	880	91.3	44.1	0.17
92-59-134	Sasol Wax	1701 (1:15d1872)	St. USY	0.20	878	93.8	52.3	0.19
92-59-135	Sasol Wax	1702 (1:15d1872)	St. Reo/USY	0.20	877	92.1	39.7	0.2
92-59-136	Sasol Wax	1703 (1:15d1872)	St. Reo/USY	0.22	884	89.8	66.5	0.25
92-59-137	Sasol Wax	1701 (1:3d1872)	St. USY	0.86	881	89	80.1	0.71
92-59-138	Sasol Wax	1702 (1:3d1872)	St. Reo/USY	0.81	880	97.7	83	0.7
92-59-139	Sasol Wax	1703 (1:3d1872)	St. Reo/USY	0.85	880	90.9	81.3	0.76
92-59-140	Sasol Wax	1704 (1:3d1872)	St. Reo/USY	0.81	879	97.1	71.6	0.76
92-59-141	Sasol Wax	1705 (1:3d1872)	St. Reo/USY	0.78	881	93.7	59.7	0.67
92-59-142	Sasol Wax	1706 (1:3d1872)	St. Reo/USY	0.87	880	90.7	62.7	0.56
92-59-143	Sasol Wax	1701 (1:3d1872)	St. USY	0.83	880	89.1	62.9	0.54
92-59-149	Sasol Wax	1701 (1:3d1872)	St. USY	0.86	969	87.4	80.3	0.54
92-59-150	Sasol Wax	1702 (1:3d1872)	St. Reo/USY	0.86	970	87.9	89.3	0.63
92-59-151	Sasol Wax	1703 (1:3d1872)	St. Reo/USY	0.88	969	85.7	90.4	0.6
92-59-152	Sasol Wax	1704 (1:3d1872)	St. Reo/USY	0.85	970	91	87.5	0.22
92-59-153	Sasol Wax	1705 (1:3d1872)	St. Reo/USY	0.98	970	83	97.9	0.8
92-59-154	Sasol Wax	1706 (1:3d1872)	St. Reo/USY	0.89	969	85.7	78.9	0.73
92-59-155	Sasol Wax	14040- 48-1 (1:3d1872)	St. USY	0.85	970	86.7	76.1	0.57
92-59-156	Sasol Wax	14040- 48-2 (1:3d1872)	St. USY	0.85	970	87.5	84.5	0.46
92-59-157	Sasol Wax	9669-153 (1:3d)	Matrix Only	0.83	969	91.4	47.9	0.13
92-59-158	Sasol Wax	14040- 50-5	St. Matrix	3.43	969	89.8	63.3	0.31
92-59-159	Sasol Wax	14040- 50-6 (1:3d)	St. 10% USY	0.83	970	90.9	78.5	0.2
92-59-160	Sasol Wax	14040- 50-7 (1:3d1872)	St. 10% Beta	0.85	970	88.3	64.7	0.18

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Propylene Wt%	Total C3 Wt%	Isobutylene Wt%	Total C4 Wt%	Isoamylenes Wt%	C5-430 deg. F Wt%	RON	MON	Conversion by Sim. Dis., Wt%	Comments
92-59-120	11.67	12.95	7.76	19.45	8.74	34.22	85	75.5		
92-59-121	11	12.18	7.03	17.69	8.02	37.11	82	73.9		
92-59-122	4.94	5.37	5.14	12.88	8.15	67.3	87	75.3		
92-59-123	4.88	5.43	4.74	12.74	7.18	66.21	86.3	74.6		
92-59-124	4.1	4.58	4.17	11.09	6.97	67.31	85.7	73.7		
92-59-125	4.57	5.11	4.02	11.56	6.7	72.37	86.2	74.2		
92-59-126	1.88	2.1	1.7	4.94	0	29.25	88.2	76.4		
92-59-127	3.5	3.94	3.31	9.15	4.78	55.32	86.3	74.5		
92-59-128	5.5	6.11	5.03	13.69	7.3	64.15	87.1	75.2		
92-59-129	2.86	3.16	2.74	7.82	3.35	40.94	86	74.3		
92-59-130	4.17	4.66	4.02	10.83	6.02	59.22	86.6	74.8		
92-59-131	2.43	2.7	2.15	6.43	2.84	36.55	86.9	74.7		
92-59-132	4.49	4.98	4.05	11.57	6.69	67.25	86.8	75.3		
92-59-133	2.26	2.52	2.2	6.37	2.82	34.76	86.1	74.6		
92-59-134	2.56	2.84	2.43	6.77	3.41	42.26	86.6	74.4		
92-59-135	1.98	2.21	1.69	5.01	2.2	32.02	85.5	74.4		
92-59-136	3.54	3.91	3.11	8.6	4.32	53.29	86.8	75		
92-59-137	4.99	5.55	3.66	11.92	6.46	61.49	90.7	77.7		
92-59-138	5.33	5.97	3.93	12.87	6.28	61.48	89.8	76.8		
92-59-139	4.26	4.72	3.28	10.49	6.19	63.37	88.7	76.3		
92-59-140	2.84	3.17	2	7.73	4.3	58.29	87.4	75.5		
92-59-141	2.56	2.87	1.57	6.97	0	48.93	91.3	77.1		
92-59-142	2.89	3.22	2.48	7.78	4.34	50.88	88.6	76.1		
92-59-143	3.01	3.32	2.07	6.62	2.92	52.19	87.1	75.1		
92-59-149	5.8	6.37	3.57	11.8	6.23	60.69	87.8	76.2		
92-59-150	7.35	8.14	4.47	15.43	7.73	63.88	87.6	76.4		
92-59-151	7.4	8.18	4.52	15.74	7.96	64.73	87.6	67.4		
92-59-152	5.6	6.2	3.94	12.45	7.36	67.37	86.8	75		
92-59-153	5.98	6.66	3.23	12.27	5.89	62.07	87	76		
92-59-154	7.2	7.98	4.17	13.79	5.64	55.29	87.5	76.2		
92-59-155	5.91	6.54	3.76	12.4	6.23	55.61	88.7	76.7		
92-59-156	8.11	8.92	4.94	16.39	7.48	57.47	88.2	76.9		
92-59-157	2.58	3	2.18	6.15	2.89	37.43	86	74		
92-59-158	4.96	5.47	4.04	10	5.6	46.75	87.5	74.9		
92-59-159	6.75	7.42	4.93	13.29	7.14	56.57	85.2	75.2		
92-59-160	6.43	7.1	5.91	14.02	5.55	42.5	83	73.7		

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Feedstock	Catalyst Identification	Catalyst Type	C/O Ratio	Reaction Temperature, F	Recovery Wt%	Conversion Wt%	Coke Wt%
92-59-161	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.81	969	94.6	83.2	0.53
92-59-162	Sasol Wax	1891 (1:15d1872)	St. HZSM-5	0.22	880	87	72.3	0.34
92-59-163	Sasol Wax	1891 (1:15d1872)	St. HZSM-5	0.22	880	87.1	65.1	0.34
92-59164	Sasol Wax	1891 (1:15d1872)	St. HZSM-5	0.22	880	86.9	64.8	0.33
92-59-165	Sasol Wax	1891 (1:15d1872)	St. HZSM-5	0.22	880	87	61.8	0.33
92-59-166	Sasol Wax	1891 (1:15d1872)	St. HZSM-5	0.22	880	86.5	6.66	0.34
92-59-173	Sasol Wax	14040- 50-8 (1:3d1872)	St. USY	0.83	970	90.3	86.3	0.42
92-59-174	Sasol Wax	14040-/50-9 9669-153 #2st (1:3	St. Matrix	0.84	969	87.5	58.1	0.15
92-59-175	Sasol Wax	14040-/50-10 9669-154 (1:3187	St. 10% USY	3.21	969	92.7	70.6	0.18
92-59-176	Sasol Wax	14040-/50-11 9669-155 (1:3187	St. 10% Beta	0.84	970	92.2	55.9	0.14
92-59-177	Sasol Wax	14040- 50-8 (1:3d1872)	St. USY	0.85	880	87.8	85.7	0.61
92-59-178	Sasol Wax	14040- 50-9 (1:3d1872)	St. Matrix	0.81	881	90.6	43.1	0.3
92-59-179	Sasol Wax	14040- 50-10 (1:3d1872)	St. 10% USY	0.81	881	92.3	87	0.38
92-59-180	Sasol Wax	14040- 50-11 (1:3d1872)	St. 10% Beta	0.78	880	94.4	34.8	0.24
93-59-005	LaPorte	1397	Eq. Uslt	1.07	974	93.1	92.3	3.01
93-59-006	LaPorte	1891 (1:3d1872)	St. HZSM-5	0.96	970	81.1	81.8	0.75
93-59-007	LaPorte	1875 (1:3d1872)	St. Beta	0.99	970	83.5	88.2	1.19
93-59-008	LaPorte	1397 (1:3d1872)	Eq. USY	0.87	972	87.2	86.4	87.2
93-59-009	LaPorte	1891 (1:3d1872)	St. HZSM-5	0.97	970	84.1	87.7	0.19
93-59-010	Sasol Wax	1875 (1:3d1872)	St. Beta	1.23	972	88.6	90.9	0.42
93-59-011	Sasol Wax	1397 (1:3d1872)	Eq. USY	1.17	971	92.4	94	0.67
93-59-012	Sasol Wax	1875 (1:3d1872)	St. Beta	0.86	970	91.8	79.8	0.38
93-59-013	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.88	969	94	85.8	0.54
93-59-015	LaPorte	1891 (1:3d1872)	St. HZSM-5	1.00	970	77.7	80.1	0.44
93-59-016	LaPorte	1875 (1:3d1872)	St. Beta	0.86	971	88	83.4	1.71
93-59-017	LaPorte	1397 (1:3d1872)	Eq. USY	0.91	971	88.9	84.9	1.32
93-59-018	Sasol Wax	1891 (1:3d1872)	St. HZSM-5	1.32	971	65.6	74.7	0.25
93-59-019	Sasol Wax	1875 (1:3d1872)	St. Beta	1.15	969	77.5	57.2	0.42
93-59-021	Sasol Wax	9363005 (CCC1397)	Eq. USY	5.00	969	89.9	86.2	2.6
93-59-022	Sasol Wax	1397 (1:3d1872)	Eq. USY	1.59	969	69.4	75.7	0.95
93-59-023	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.56	970	91.9	56.4	0.45
93-59-024	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.75	970	83.1	62	0.46
93-59-025	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.77	970	86.3	67.2	0.44
93-59-026	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.81	970	89.3	78.2	0.43
93-59-027	Sasol Wax	1397 (1:3d1872)	Eq. USY	0.71	970	92.2	61.6	0.38

APPENDIX A -- MYU Run Data (Cont'd)

Run Number	Propylene Wt%	Total C3 Wt%	Isobutylene Wt%	Total C4 Wt%	Isoamylenes Wt%	C5-430 deg. F Wt%	RON	MON	Conversion by Sim. Dis., Wt%	Comments
92-59-161	7.89	8.74	4.81	15.74	7.21	57.28	85.1	76		
92-59-162	15.71	17.92	9.18	24.88	7.38	27.93	86.1	76.5		
92-59-163	13.72	15.58	8.15	22.11	6.8	26.08	85.9	76.6		
92-59164	13.18	14.87	7.51	20.19	6.75	28.53	86.3	76.3		
92-59-165	12.85	14.42	7.33	19.76	6.56	26.49	86.3	76.4		
92-59-166	12.52	14	7.07	18.91	6.63	32.61	84.7	75.2		
92-59-173	7.38	8.17	4.99	15.07	7.54	61.67	85.7	76		
92-59-174	6.18	6.81	5.55	13.64	5.09	36.62	83.6	74		
92-59-175	5.11	5.6	3.62	9.88	4.75	54.21	85.3	74.7		
92-59-176	3.91	4.46	3.15	8.46	3.96	41.68	85.8	74.3		
92-59-177	5.51	6.12	4.3	13.1	6.91	65.48	84.3	75.2		
92-59-178	2.82	3.14	3.14	7.69	3.17	31.68	83.7	73.5		
92-59-179	6.62	7.34	5.99	16	8.86	62.65	86.1	75.7		
92-59-180	1.71	1.98	1.85	4.95	2.57	27.33	84.8	73.5		
93-59-005	2.82	3.31	3.1	12.63	8.68	72.91	89.6	79.6		10 runs
93-59-006	20.55	22.99	9.14	25.29	6.15	28.45	92	80.1		
93-59-007	9.6	10.37	7.69	18.23	8.83	57.18	88.3	76.4		
93-59-008	86.4	7.33	4.15	13.48	7.58	63.42	87.8	77.3		
93-59-009	18.64	21.33	10.13	26.93	7.64	36.94	84.4	75.5		
93-59-010	14.89	16.33	9.15	25.67	7.91	47.32	85.5	76.5		
93-59-011	11.01	12.1	6.08	19.65	8.19	60.52	84.8	76.9		
93-59-012	10.78	11.82	7.59	20.48	7.72	46.25	86	75.8		
93-59-013	7.95	8.74	4.96	16.3	7.94	59.53	86.7	76.7		
93-59-015	17.11	19.39	9.26	24.74	6.05	31.23	87.7	77.4		
93-59-016	8.76	9.43	5.92	14.07	6.81	57.16	88.6	76.6		
93-59-017	7.01	7.7	3.67	11.9	6.17	62.87	87.8	77.2		
93-59-018	16.53	18.79	8.94	24.33	6.74	28.23	85.7	76.3		
93-59-019	6.74	7.38	4.19	11.61	3.95	37.04	84.6	75.8		
93-59-021	9.89	11.23	4.16	17.86	4.57	53.11	86.4	78.7		
93-59-022	9.03	10	4.43	14.52	3.49	49.38	85.3	76.5		
93-59-023	3.79	4.28	1.88	5.89	2.08	45.15	84	74.5		
93-59-024	5.18	5.75	3.71	11.97	4.93	43.28	86.9	76.6		
93-59-025	5.2	5.75	3.69	11.93	5.41	48.52	87	76.5		
93-59-026	6.34	7	4.42	13.7	6.7	56.5	87	76.4		
93-59-027	4.65	5.17	2.78	8.68	4.02	46.88	86	75.5		

APPENDIX B

Economic Calculations

March 22, 1994

M. M. Schwartz
Mail Station H-4

INFORMATION:

CATALYTIC CRACKING OF FISCHER-TROPSCH LIQUIDS TO TRANSPORTATION FUELS PRODUCT VALUE CALCULATIONS -- PROJECT 70-6184-45

As requested by the U.S. Department of Energy, this letter details additional information and sample calculations used in determining the values of refining intermediates. This information was previously used in the economic evaluation of the catalytic cracking of Fischer-Tropsch liquids to transportation fuels. Sample calculations for propylene value as a feedstock to a di-isopropyl ether (DIPE) unit and iso-butylene value as a feedstock to an MTBE unit are given.

Barring any additional questions from the DOE, this concludes economic analysis work for this DOE contract.

SUMMARY

A breakdown of the costs for DIPE, MTBE and TAME are shown in Table I, attached. Details for DIPE and MTBE costs follow.

BASIC PRICE AND PROPERTY INFORMATION

The pertinent price and product quality information that was assumed is shown in the table below:

Component	price, cpg	RVP, psi	Octane, (R+M)/2
Unleaded regular gasoline (ULR)	55.7	9.0	87.0
MTBE	86.0	9.0	108.0
n-Butane	29.8	65.0	90.55
Methanol	50.0		

OCTANE AND RVP VALUE

To value refinery intermediates, it is necessary to limit properties from which to determine value. In this study, octane and RVP properties were chosen. Using the price difference between ULR and MTBE, one can calculate the value of octane, by solving for x in the equation below:

$$86.0-55.7=(108.0-87.0)*x$$

Solving the above equation for x gives an octane value of 1.44 ¢/octane-gallon.

From the price difference between n-butane and ULR, and using the octane value calculated above, a value for RVP can be determined from the equation:

$$29.8-55.7=(90.55-87)*1.44+(65-9)*x$$

Solving for x gives an RVP value of -0.55 ¢/RVP-gallon.

These two values are used in subsequent calculations to determine the value of refining intermediates.

DIPE VALUE CALCULATION

From the May 25, 1992 issue of the *Oil and Gas Journal*, the following information was obtained for DIPE production from propylene:

Item	value
DIPE RVP, psi	5.0
DIPE RON	110
DIPE MON	97
DIPE R+M/2	103.5
DIPE density, lb/gallon	6.4
operating costs, cpg	30.0

Using the values for octane and RVP that were previously calculated, a value for DIPE can be calculated by solving for x in the equation below:

$$x=55.7+(103.5-87)*1.44+(5-9)*(-0.55)$$

yielding a DIPE value of 81.7 cpg.

To determine the value of propylene to a DIPE plant, the kinetics of the chemical reaction must be considered. The equation for producing DIPE from propylene is shown below:

$$2C_3H_6+H_2O\rightarrow C_3H_7OC_3H_7$$

From molecular weights, 84 pounds of propylene plus 18 pounds of water yield 102 pounds of DIPE. On a volume basis, 1.211 gallons of propylene yield 1.0 gallon of DIPE. To calculate propylene value to a DIPE unit, consider DIPE value and operating costs and solve for x in the equation shown below:

$$1.211*x+30=81.7$$

The above equation yields 42.7 cpg for propylene value to a DIPE unit.

ISO-BUTYLENE VALUE TO AN MTBE UNIT

From the assumed price structure, MTBE has a value of 86 cpg. The kinetics of the iso-butylene to MTBE reaction are:

M. M. Schwartz
Page 3
March 22, 1994

$$C_4H_8 + CH_3OH \rightarrow CH_3OC(CH_3)_3$$

From molecular weights, 56.1 pounds of iso-butylene plus 32.0 pounds of methanol produce 88.1 pounds of MTBE. On a volume basis, 0.792 gallons of iso-butylene plus 0.341 gallons of methanol are required to produce one gallon of MTBE. Operating costs for an MTBE unit were obtained from the November 1992 issue of ***Hydrocarbon Processing***, and are shown in the table below:

Utility	consumption/bbl of ether produced	utility price
Electricity, KW-hr	1.0	2.28 ¢/kw-hr
all steam, pounds	296.0	$2.0/MM BTU

Using the above information gives an MTBE operating unit cost of 1.28 cpg of ether produced. Note that this does not include the methanol cost. To determine the value of iso-butylene to an MTBE unit, consider MTBE value and all operating costs, and solve for x in the equation below:

$$0.792*x+0.341*50+1.28=86$$

The value for iso-butylene determined from the above equation is 85.4 cpg.

Values for other refinery intermediates was determined by a similar method. Please advise if you have any questions.

Jim Nicholas

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Attachment

C. D. Sorrentino, H-4
File 240.1.008

TABLE I--SUMMARY OF ETHER COSTS

Ether	Value/cost to gasoline, cpg	Refining Intermediate	Methanol	Operating Cost, cpg
DIPE	81.7	Source: Propylene Amount/gallon of ether: 1.211 Unit price, cpg: 42.7 Cost/gallon of ether: 51.7	Amount/gallon of ether: 0.0 Unit Price, cpg: 50.0 Cost/gallon of ether: 0.0	30.0
MTBE	86.0	Source: iso-butylene Amount/gallon of ether: 0.792 Unit price, cpg: 85.4 Cost/gallon of ether: 67.6	Amount/gallon of ether: 0.341 Unit Price, cpg: 50.0 Cost/gallon of ether: 17.1	1.3
TAME	84.0	Source: 2-methyl-1-butene Amount/gallon of ether: 0.785 Unit price, cpg: 86.5 Cost/gallon of ether: 67.9	Amount/gallon of ether: 0.296 Unit Price, cpg: 50.0 Cost/gallon of ether: 14.8	1.3