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UPGRADING OF COAL LIQUIDS

Interim Report

Hydrotreating and Reforming H-Coal Process Derived Naphthas

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ABSTRACT

The objective of this work was to evaluate the applicability of commercial UOP hydrotreating and reforming processes to naphthas derived from the H-Coal process. Three naphthas were studied. One was the primary naphtha generated from the H-Coal syncrude operation. The other two products were from hydrocracking H-Coal gas oil.

The primary H-Coal naphtha was rerun in a laboratory column to remove color materials and heavy ends generated during storage. Because of the high contents of nitrogen, sulfur and oxygen, this naphtha was catalytically hydrotreated at moderate conditions to bring the heterocyclics content within the limits acceptable as a Platformer charge stock.

The upgraded H-Coal naphtha and the two hydrocracked naphthas were reformed over a commercial Platforming® catalyst in bench scale continuous units. Data were obtained at base pressure, 1.5 x base space velocity, and a range of temperatures for the purpose of constructing yield octane curves. Since all these feeds were highly naphthenic, reforming was successfully carried out at high space velocity and relatively low temperatures with high gasoline yields.

In addition to routine analyses, mass spectroscopy (MS) analyses were carried out on the primary H-Coal naphtha, Platformer feeds, and selected reformates.

1. INTRODUCTION

The objective of this program was to determine the applicability of commercial UOP conversion processes to coal liquid distillates generated by two ERDA sponsored processes: H-Coal and Exxon Donor Solvent (EDS).

Four tasks are identified under this program. Each of these tasks covers coal distillate liquids from both the H-Coal process and the EDS process. The first task involves two stage continuous hydrocracking of coal liquid distillates. The second task entails processing of distillates through continuous hydrotreating and fluid catalytic cracking units. The third task covers processing of coal derived naphthas through continuous hydrotreating-reforming bench scale units. The fourth task involves all data correlation.

This report covers work under Task 3 on hydrotreating and reforming H-Coal process derived naphthas. Investigation was carried out on three distinct naphthas. One was a primary naphtha produced directly in the H-Coal process. The other two were hydrocracked napthas prepared under work in Task 1 for H-Coal gas oil.

Hydrotreating and reforming of EDS process derived naphthas will be covered in a separate report.

2. EQUIPMENT

Naphtha hydrotreating was carried out in a bench scale continuous unit (UOP Research Plant 629). A simplified flow diagram of this plant

is shown in Figure 1. Hydrogen and primary coal naphtha were passed concurrently downflow over a fixed bed (100 ml) of commercial hydrotreating catalyst. The catalyst was a composite of Group VI and Group VIII metals on a high surface area refractory support.

Reforming of upgraded H-Coal naphtha was conducted in UOP Research Plant 636 while reforming of the hydrocracked naphthas was carried out in another similar reforming plant (Plant 508). Figure 2 is a simplified flow diagram of a bench scale reforming plant. The reforming reactor was loaded with 50 ml of a commercial Platforming catalyst.

3. CHARGE STOCKS

3.1 Naphtha Hydrotreating

One small drum of primary naphtha (LO-364, UOP No. 96-3336) from H-Coal syncrude operation was received at Des Plaines in October, 1976. The content was found to be nine gallons. This was rerun in two batches (Table 1) in a laboratory column to remove color bodies and heavy ends generated during storage. Analysis of a blend (No. 3531-1) of the overheads from the two batches showed 1200 wt-ppm sulfur, 2176 wt-ppm nitrogen and 7100 wt-ppm oxygen. These are quite high compared to petroleum-derived naphthas.

In accordance with current UOP procedures for evaluating Platformer charge stocks, it was necessary to hydrotreat the naphtha to bring the heterocyclics content within acceptable limits. Since the hydrotreating conditions required were not known, it was decided to rerun two batches

of an earlier shipment (December, 1975) of H-Coal primary naphtha (LO-200, UOP No. 125-4358) to ensure adequate supply of feedstock in case problems arose during hydrotreating operation. Data from all four batch distillation operations are summarized in Table 1. The last two IBP-400°F fractions were blended with the first blend (3531-1) to give 15 gallons of hydrotreating feedstock. Tables 2 and 3 show the inspections and MS analyses of the rerun primary H-Coal naphtha (3531-1-2).

3.2. Naphtha Reforming

Platforming runs were carried out on the upgraded naphtha and two hydrocracked naphthas.

The upgraded naphtha was prepared by hydrotreating the rerun primary naphtha. Inspections of this Platformer feed (3531-4) are shown in Table 2.

The hydrocracked naphthas were products from work under Task 1 for H-Coal gas oil. The first hydrocracked naphtha (designated as H-Coal Hydrocrackate A) was a blend of products from the second-stage hydrocracking of H-Coal gas oil studies (Plant 601, Runs 749 and 751) conducted at 500 psig below base pressure. Similarly the second hydrocracked naphtha (H-Coal Hydrocrackate B) was a blend of products from studies (Plant 601, Runs 756 and 757) conducted at 500 psig above base pressure. Inspections of these two feedstocks are given in Tables 4 and 5.

4. RESULTS AND DISCUSSION

4.1. Naphtha Hydrotreating

The primary objective in the hydrotreating of the H-Coal primary

naphtha was the reduction of the nitrogen, sulfur, and oxygen contents to the levels acceptable as a Platformer charge stock. Hydrotreating was carried out over a commercial hydrotreating catalyst in a bench scale continuous unit (UOP Research Plant 629). In Run 215 processing conditions were briefly explored during the first two days of operation to reach target levels of 30 wt-ppm oxygen and less than 1 ppm nitrogen and sulfur. These targets were reached at moderate severity of operation. No attempt was made to optimize hydrotreating conditions. The run was on stream for 325 hours. Results are summarized in Table 6. At 300 hours on stream a 60-psia pressure drop was observed across the reactor. This increased to 75 psia at 323 hours. The run was terminated when the pressure drop jumped up to 105 psia at 325 hours on stream.

Upon disassembling the reactor, plugging was located at the preheating section. Excessive deposit of carbonaceous material was found on the spiral preheater (Figure 3). This problem was attributed to the presence of gum in the feed. Analysis showed that nitrogen jet gum content in the primary naphtha was 40 mg/100 ml (Table 2). Significant amounts of white substance, which was suspected to be ammonium chloride, were found deposited on the reactor wall and the spacers at the outlet side (bottom) of the catalyst bed. This substance was confirmed by chemical analysis to be mainly ammonium chloride. Analysis of the feedstock showed that Cl content was 23 wt-ppm (Table 2).

A new run (Run 216) was started with fresh catalyst and with the preheater replaced by 15 inches of No. 9 quartz chips. The run was carried out under similar conditions to continue the processing of Platformer feedstock and subsequently to rerun products from Runs 215 and 216 which contained more than 1 ppm nitrogen. Data obtained are summarized in Table 7. During the run no significant pressure drop

across the reactor was observed.

Table 8 is a summary of an overall material balance made for the hydrotreating operation for the purpose of obtaining product distribution data. Total over 100% represents hydrogen added to the feedstock. Since moderate conditions were used, only a trace amount of gas (C_1-C_4) was produced. The yield of upgraded naphtha was 99.9%.

Similarly a hydrogen balance was made to obtain distribution of hydrogen consumed. Results are summarized in Table 9. The table shows that 13.8% of the hydrogen consumed was required for the reduction of nitrogen, sulfur, and oxygen contents to acceptable levels. As might be expected, a major portion of this amount of hydrogen was used in oxygen removal. The bulk (86.2%) of the total hydrogen consumed effected an increase in hydrogen content from 12.80 to 13.59% (Table 2). This amount of hydrogen is "recoverable" via dehydrogenation of naphthenes in the subsequent reforming operation.

4.2. Naphtha Reforming

The three Platformer feeds were reformed over a commercial Platforming catalyst in bench scale continuous units. Each run was carried out at base pressure and 1.5 x base space velocity. A range of temperatures was employed for the purpose of obtaining yield-octane curves. Since these were high naphthene feedstocks, the required reforming temperatures were relatively low. As naphthene dehydrogenation is a fast reaction, a high space velocity was adequate. At these low severity conditions the yield of gasoline of a given octane number is generally very high.

In addition to routine analyses, MS analyses were made on feedstocks and selected C_6+ reformates.

4.2.1. Reforming Upgraded Naphtha.

The upgraded H-Coal naphthas from Plant 629, Runs 215 and 216 were blended to provide a Platformer feedstock. Inspection data for this upgraded naphtha are given in Table 2. Table 10 shows the product distribution of C_6- and C_6+. These results were obtained by fractionation and gas liquid chromatography analysis. The table also shows the results obtained from MS analysis of the C_6+ fraction.

The upgraded naphtha was reformed at base pressure, 1.5 x base space velocity, and over a range of temperatures to obtain data for constructing a yield octane curve. Data obtained are summarized in Table 11. This table shows the reforming conditions, product yields, and inspections of the C_5+ product (stabilized reformates). The table also includes the Research octane number (RON) of the C_5+ products obtained at various conditions. Figure 4 is the yield octane curve constructed from data shown in Table 11.

Mass spectroscopy analyses were made on three selected C_6+ reformates. These results, as well as the corresponding product distribution data, are shown in Tables 12, 13, and 14. These tables were arranged in the order of increasing temperature. The relative temperature [T-T(base),°C] corresponding to data shown in Tables 12, 13, and 14 are -88, -66, and -18°C. Since increasing the temperature results in increased rate of reaction , these tables also appear in the order of increasing RON of the

C_5+ reformate. Table 12 shows results for product with the lowest RON (94.2), while Table 14 shows results for product with the highest RON (102.6).

Since the run was made at constant pressure and space velocity, the increase in reforming temperatures was solely responsible for the increase in the reformate RON. An inspection of Tables 12, 13, and 14 shows that dehydrogenation was the primary reaction. The product distribution data show that hydrogen yields at relative temperatures of -88, -66, and -18°C were 2.5, 3.0, and 3.4%, respectively. Inspection of the MS results for hydrocarbon types (P, N, and A) showed that in Tables 12 and 13 the aromatics in the reformates increased solely at the expense of the naphthenes. Table 14 shows that at the highest temperature studied, aromatics increased drastically not only at the expense of the naphthenes, but also, to a lesser degree, at the expense of the C_9+ paraffins. At this temperature dehydrocyclization became significant.

4.2.2. Reforming Hydrocracked Naphthas

Similar Platforming runs were carried out for Hydrocrackates A and B. Hydrocrackate A was a blend of hydrocracked naphthas obtained at 500 psig below base pressure, while Hydrocrackate B was a similar blend of hydrocracked naphthas obtained at 500 psig above base pressure. Inspections of these two feedstocks are given in Tables 4 and 5. These tables show that the hydrogen content of Hydrocrackate A was 13.09%, and that of Hydrocrackate B was slightly higher (13.47%). Tables 15 and 16 give the distribution of C_6- and C_6+, and the MS analysis of the C_6+ fractions of these charge stocks.

Platforming runs were carried out at identical pressure and space velocity, as used for the upgraded primary naphtha. Studies were conducted over a range of temperatures to obtain yield-octane correlations. Results are summarized in Tables 17 and 18. Figures 5 and 6 are the corresponding yield octane curves constructed from these data.

Since these feeds are highly naphthenic, temperature requirement is relatively low. As in the reforming of upgraded primary naphtha, naphthene dehydrogenation was the primary reaction. These data show that in producing a reformate of a given RON, Hydrocrackate A generally required a lower reforming temperature than Hydrocrackate B. Also, the yield of stabilized reformate of a given RON is higher with Hydrocrackate A. These results reveal that at a given reformate RON, the hydrocracked naphtha obtained at 500 psig below base hydrocracking pressure gave a higher yield of gasoline, and required a lower reforming temperature than a hydrocracked naphtha obtained at a pressure 1000 psig higher.

Tables 19-21 show MS analysis of the selected C_6+ reformate from processing Hydrocrackate A, while Tables 22-26 show those from reforming Hydrocrackate B.

Table 1

Distillation of H-Coal Naphtha

I. LO-364
UOP No. 96-3336

1.	Cut No.	Temp., °F	Wt., g	Wt-%
	1[(a)]	IBP-400°	13,230	94.0
	Botts.	400°+	843	6.0
			14,073	100.0
2.	1[(a)]	IBP-400°	11,945	94.3
	Botts.	400°+	725	5.7
			12,670	100.0

II. LO-200
UOP No. 125-4358

1.	Cut. No.	Temp., °F	Wt., g	Wt-%
	1[(a)]	IBP-400°	11,184	77.5
	Botts.	400°+	3,238	22.5
			14,422	100.0
2.	1[(a)]	IBP-400°	11,043	78.3
	Botts.	400°+	3,061	21.7
			14,104	100.0

[(a)] Cut No. 1 from these 4 batch distillations were blended to give a hydrotreater feedstock designated as 3531-1-2.

Table 2

Inspection Data of H-Coal Naphthas

	Rerun Naphtha	Upgraded Naphtha
Sample No.	3531-1-2	3531-4
°API @ 60°F	43.7	46.8
Sp. Gr. @ 60°F	0.8076	0.7936
Distillation, ASTM D-86		
IBP, °F	132	153
5%	170	185
10%	189	199
20%	215	217
30%	233	231
40%	251	246
50%	260	263
60%	292	284
70%	312	306
80%	328	329
90%	251	352
95%	373	367
EP	396	393
% Over	99.0	99.0
Hydrogen, Wt-%	12.80	13.59
Carbon, Wt-%	85.90	86.45
Sulfur, Wt-ppm	1289	3.9
Nitrogen, Wt-ppm	1930	0.63
Oxygen, Wt-ppm	5944	34
Chloride, Wt-ppm	23	4
FIA, Vol-%		
A	24.7	18.9
O	5.2	0.0
P&N	70.1	81.1
M S Hydrocarbon Types, Vol-%		
A	18.6	17.6
N	55.5[b]	63.4
P	16.2	19.0
Bromine Index	19.3[a]	296
RON, Clear	80.3	66.8
N_2 Jet Gum, mg/100 ml	40.0	

[a] Bromine number.

[b] Vol-% of polars and olefins are 4.2 and 5.5, respectively (Table 3).

Table 3

MS Analysis of H-Coal Naphtha 3531-1-2

Hydrocarbon Types	Vol-%
Paraffins	16.2
Naphthenes	
Monocycloparaffins	48.1
Bi, Dicycloparaffins	7.2
Tricycloparaffins	0.2
Aromatics	
Alkylbenzenes	12.7
Indanes/tetralins	5.8
Naphthalenes	0.1
Polars	
Phenols	3.1
Pyridines	0.8
Thiophenes	0.3
Olefins*	
Monoolefins	1.3
Diolefins or Monocycloolefins	3.7
Triolefins or Dicyclomonoolefins	0.5
Total	100.0

Carbon No.	Aromatics			Polars	
	J=6	J=8	J=12	$J=6^O$	$J=5^N$
5					0.4
6	0.45			0.8	0.2
7	2.84			1.6	0.2
8	4.04	0.10		0.7	
9	2.96	1.67			
10	1.68	3.31	0.1		
11	0.68	0.71			
12	0.03	0.02			
Total	12.68	5.81	0.1	3.1	0.8

* The total olefin number was obtained by SiO_2 separation, but the split is estimated since no calibration coefficients are available.

Table 4

Inspections of H-Coal Hydrocrackate A

Sample No.	3531-15
°API @ 60°F	49.7
Sp. Gr. @ 60°F	0.7809
Distillation, ASTM D-86	
IBP, °F	120
5%	148
10%	162
20%	184
30%	202
40%	218
50%	233
60%	250
70%	269
80%	289
90%	319
95%	336
EP °F	400
% Over	99.0
% Bottoms	1.0
Hydrogen, Wt-%	13.09
Carbon, Wt-%	86.52
Sulfur, Wt-ppm	0.1
Nitrogen, Wt-ppm	0.1
Oxygen, Wt-ppm	40.9
Chloride, Wt-ppm	1.0
FIA, Vol-%	
A	33.6
P&N	66.4
M.S Hydrocarbon Types, Vol-%	
A	34.43
N	52.35
P	13.22
RON, Clear	84.2
Bromine Index	298

Table 5

Inspections of H-Coal Hydrocrackate B

Sample No.	3531-18
°API @ 60°F	49.4
Sp. Gr. @ 60°F	0.7822
Distillation, ASTM D-86	
IBP, °F	127
5%	156
10%	172
20%	194
30%	213
40%	231
50%	248
60%	262
70%	288
80%	311
90%	342
95%	375
EP °F	518
% Over	98.5
% Bottoms	1.5
Hydrogen, Wt-%	13.47
Carbon, Wt-%	86.13
Sulfur, Wt-ppm	8.2
Nitrogen, Wt-ppm	0.13
Oxygen, Wt-ppm	40.9
Chloride, Wt-ppm	<1
FIA, Vol-%	
A	23.3
P&N	76.7
M S Hydrocarbon Types, Vol-%	
A	23.26
N	62.05
P	14.69
RON, Clear	80.2
Bromine Index	126.0

Table 6

Upgrading H-Coal Naphtha

Plant 629, Run 215

LHSV/LHSV (base): 0.125; P-P (base),psig: 450

Period No.	Hours on Stream	T-T(base), °C	S,ppm	N,ppm[(a)]	O, ppm
Feed			1289	1930	5944
LO	32	18	∿0.7	1.3	25
4	93	23	∿0.7	1.4	13
6	128	23	0.72	-	-
8	153	23	1.4	3.2	33
9	182	28	0.38	3.2	-
11	200	33	0.51	1.0	20
15	272	33	0.51	3.0	22
17	296	33	-	0.76	-
19	323	33	-	0.76	-

(a) Products which contain more than 1 ppm N are to be reprocessed in Run 216 in order to reduce N content to 1 ppm.

Table 7

Upgrading H-Coal Naphtha

Plant 629, Run 216

P-P (base), psig: 450

Period No.	Hours on Stream	T-T (base), °C	LHSV/LHSV(base)	S,ppm	N,ppm[a]	O,ppm
Feed				1289	1930	5944
LO	20	33	0.125		0.76	23
5	88	33	0.125		0.76	33
8	135	33	0.125		2.1	
10[b]	160	42	0.125		0.13	
11	183	43	0.125		0.13	10
13	206	43	0.188			
18	257	43	0.188		0.13	

[a] Products which contain more than 1 ppm N are to be reprocessed.

[b] Began to reprocess products with more than 1 ppm N.

Table 8

Upgrading H-Coal Naphtha 3531-1-2
Product Distribution

Plant 629, Runs 215 and 216

Product Distribution, Wt-% of Feed	
Liquid Product[(a)]	99.9
Gas (C_1-C_4)	<0.1
H_2O	0.7
H_2S	0.1
NH_3	0.2
Total	100.9
H_2 Consumption, Wt-% of Feed	0.9
H_2 Consumption, SCF/bbl	480

(a) Designated as upgraded H-Coal naphtha 3531-4.

Table 9

Upgrading of H-Coal Naphtha 3531-1-2
Distribution of Hydrogen Consumption

Plant 629, Runs 215 and 216

Hydrogen Consumption, Wt-%	
Liquid Product[(a)]	86.2
Gas (C_1-C_4)	<0.1
H_2O	8.3
H_2S	0.9
NH_3	4.6
Total	100.0
Total Hydrogen Consumption, SCF/bbl	480

[(a)] Designated as upgraded H-Coal naphtha 3531-4.

Table 10

Distribution of Upgraded H-Coal Naphtha

Product Distribution	Wt-%	Vol-%
n-Butane, Isopentane, n-Pentane	1.4	2.0
Cyclopentane	0.4	0.4
C_6 Plus	98.2	97.6
Total	100.0	100.0

MS Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	15.96
Naphthenes	
Monocycloparaffins	55.02
Bi, Dicycloparaffins	9.49
Tricycloparaffins	0.09
Aromatics	
Alkylbenzenes	16.54
Indans, Tetralins	2.83
Naphthalenes	0.07
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J=6	Aromatics J=8	Aromatics J=12
6	3.47	9.71	1.34		
7	2.46	15.57	4.77		
8	2.45	12.53	5.06	0.0	
9	5.99	9.85	3.09	0.76	
10	0.93	5.27	1.65	1.68	0.07
11	0.66	2.00	0.63	0.33	0.00
12	0.00	0.09	0.00	0.06	0.00
13	0.00	0.00	0.00	0.00	0.00
Total	15.96	55.02	16.54	2.83	0.07

Table 11

Platforming® Upgraded H-Coal Naphtha 3531-4

Plant 636, Run 220

Period No.	Feed		1		2		4		5	
Reforming Conditions										
P-P (base), psig			0		0		0		0	
T-T (base), °C			-52		-52		-59		-66	
LHSV/LHSV (base)			1.43		1.49		1.48		1.51	
Product Yields	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%
H_2			3.4		3.2		3.1		3.0	
C_1-C_3			0.8		0.7		0.5		0.3	
n-C_4	0.4	0.5	0.4	0.5	0.6	0.9	0.5	0.6	0.4	0.6
i-C_4			0.2	0.2	0.2	0.2	0.1	0.2	0.0	
C_5+	99.6	99.5	95.2	89.6	95.3	89.4	95.8	90.1	96.3	91.1
Total	100.0	100.0	100.0	90.3	100.0	90.5	100.0	90.9	100.0	91.7
Product (C_5+) Inspection										
°API @ 60°F	46.8		36.0		35.3		35.8		36.9	
SP.Gr. @ 60°F	0.7936		0.8448		0.8483		0.8458		0.8403	
Distillation, ASTM D-86										
IBP, °F	153		161		156		165		164	
5%	185		188		186		191		190	
10%	199		201		200		202		204	
30%	231		238		239		240		240	
50%	263		272		274		276		277	
70%	306		311		316		318		321	
90%	352		367		370		370		372	
95%	367		393		396		391		395	
EP	393		462		453		444		425	
RON, Clear	66.8		99.8		99.8		98.7		97.7	
Elemental Analysis										
Hydrogen, Wt-%									10.74	
Carbon, Wt-%									88.92	

Table 11 (Cont'd.)

Period No.	6		7		8		9		10	
Reforming Conditions										
P-P (base), psig	0		0		0		0		0	
T-T (base), °C	-66		-78		-78		-88		-88	
LHSV/LHSV (base)	1.53		1.49		1.45		1.43		1.49	
Product Yields	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%
H_2	3.0		2.8		2.8		2.6		2.5	
C_1-C_3	0.3		0.2		0.2		0.2		0.2	
n-C_4	0.4	0.5	0.3	0.4	0.3	0.4	0.2	0.3	0.2	0.2
i-C_4										
C_5+	96.3	91.1	96.7	91.9	96.7	92.0	97.0	92.5	97.1	92.5
Total	100.0	91.6	100.0	92.3	100.0	92.4	100.0	92.8	100.0	92.7
Product (C_5+) Inspection										
°API @ 60°F	36.6		37.5		37.8				38.2	
Sp. Gr. @ 60°F	0.8418		0.8373		0.8358				0.8338	
Distillation, ASTM D-86										
IBP, °F	166		169		160				169	
5%	188		192		188				194	
10%	201		204		201				206	
30%	237		238		237				239	
50%	274		275		272				275	
70%	310		312		312				317	
90%	358		368		367				366	
95%	397		392		387				384	
EP	452		435		438				418	
RON, Clear	97.7		96.0		95.9		94.4		94.2	
Elemental Analysis										
Hydrogen, Wt-%									11.76	
Carbon, Wt-%									88.20	

Table 11 (Cont'd.)

Period No.	11		12		13		14	
Reforming Conditions								
P-P (base), psig	0		0		0		0	
T-T (base), °C	-33		-33		-18		-18	
LHSV/LHSV (base)	1.56		1.40		1.55		1.50	
Product Yields	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%
H_2	3.3		3.6		3.2		3.4	
C_1-C_3	0.9		1.0		1.2		1.2	
n-C_4	0.4	0.6	0.5	0.6	0.5	0.7	0.4	0.6
i-C_4	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
C_5+	95.3	89.2	94.7	88.6	94.9	88.6	94.8	88.1
Total	100.0	90.0	100.0	89.4	100.0	89.5	100.0	88.9
Product (C_5+) Inspection								
°API @ 60°F								33.7
Sp. Gr. @ 60°F								0.8565
Distillation, ASTM D-86								
IBP, °F								162
5%								188
10%								204
30%								241
50%								276
70%								317
90%								372
95%								394
EP								452
RON, Clear	100.9		101.3		102.3			102.6
Elemental Analysis								
Hydrogen, Wt-%								10.11
Carbon, Wt-%								88.96

Table 12

Platforming Upgraded H-Coal Naphtha 3531-4

Product Distribution and M S Analysis

Plant 636, Run 220, Period 10

Product Distribution	Wt-%	Vol-%
H_2	2.5	
C_1-C_3	0.2	
n-C_4	0.2	0.2
i-C_4	0.0	0.0
n-C_5	1.9	2.4
i-C_5	0.5	0.6
C_6 Plus	94.7	89.5
Total	100.0	92.7

Reformate (C_5 Plus)

Yield, Vol-%	92.5
RON, Clear	94.2

M S Analysis of C_5 Plus Fraction, Vol-%

I. Hydrocarbon Types	
Paraffins	17.84
Naphthenes	
Monocycloparaffins	14.90
Bi, Dicycloparaffins	1.45
Tricycloparaffins	0.00
Aromatics	
Alkylbenzenes	55.78
Indans, Tetralins	8.41
Naphthalenes	1.62
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	3.54	5.20	9.79		
7	4.26	4.34	17.63		
8	3.59	2.71	13.67	0.0	
9	2.74	1.61	8.27	2.83	
10	2.24	0.77	4.30	4.27	1.05
11	1.47	0.27	1.84	1.18	0.52
12	0.0	0.0	0.28	0.13	0.05
13	0.0	0.0	0.0	0.0	0.0
Total	17.84	14.90	55.78	8.41	1.62

Table 13

Platforming Upgraded H-Coal Naphtha 3531-4

Product Distribution and M S Analysis

Plant 636, Run 220, Period 5

Product Distribution	Wt-%	Vol-%
H_2	3.0	
C1- C3	0.3	
n-C_4	0.4	0.6
i-C_4	0.0	0.0
n-C_5	2.6	3.3
i-C_5	0.8	1.0
C_6 Plus	92.9	86.8
Total	100.0	91.7

Reformate (C_5 Plus)

Yield, Vol-%	91.1
RON, Clear	97.7

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types	
Paraffins	18.85
Naphthenes	
Monocycloparaffins	8.80
Bi, Dicycloparaffins	0.63
Tricycloparaffins	0.0
Aromatics	
Alkylbenzenes	61.99
Indans, Tetralins	7.72
Naphthalenes	2.01
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	3.30	4.00	13.30		
7	4.15	1.40	20.60		
8	3.77	1.80	14.77	0.0	
9	2.94	1.13	8.05	3.09	
10	2.60	0.39	3.71	3.73	1.28
11	1.66	0.08	1.38	0.84	0.64
12	0.43	0.0	0.18	0.06	0.09
13	0.0	0.0	0.0	0.0	0.0
Total	18.85	8.80	61.99	7.72	2.01

Table 14

Platforming Upgraded H-Coal Naphtha 3531-4
Product Distribution and M S Analysis
Plant 636, Run 220, Period 14

Product Distribution	Wt-%	Vol-%
H_2	3.4	
$C_1 - C_3$	1.2	
n-C_4	0.4	0.6
i-C_4	0.2	0.2
n-C_5	1.6	2.0
i-C_5	0.8	1.0
C_6 Plus	92.4	85.1
Total	100.0	88.9

Reformate (C_5 Plus)	
Yield, Vol-%	88.1
RON, Clear	102.6

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types	
Paraffins	11.71
Naphthenes	
Monocycloparaffins	4.63
Bi, Dicycloparaffins	0.32
Tricycloparaffins	0.0
Aromatics	
Alkylbenzenes	74.38
Indans, Tetralins	6.33
Naphthalenes	2.63
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	3.43	2.30	13.96		
7	3.61	0.98	24.65		
8	2.46	0.89	18.20		
9	1.25	0.39	10.60	2.86	
10	0.70	0.07	4.89	2.87	1.59
11	0.26	0.0	1.82	0.55	0.86
12	0.0	0.0	0.26	0.05	0.16
13	0.0	0.0	0.0	0.0	0.02
Total	11.71	4.63	74.38	6.33	2.63

Table 15

Distribution of H-Coal Hydrocrackate A (3531-15)

Product Distribution	Wt-%	Vol-%
n-Butene	-	-
Isopentane	0.6	0.8
n-Pentane	0.1	0.1
Cyclopentane	-	-
C_6 Plus	99.3	99.1
Total	100.0	100.0

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	13.22
Naphthenes	
Monocycloparaffins	43.10
Bi, Dicycloparaffins	9.25
Tricycloparaffins	0.0
Aromatics	
Alkylbenzenes	32.31
Indans, Tetralins	2.12
Naphthalenes	0.0
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-Paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	5.50	6.20	8.88		
7	4.26	12.45	9.87		
8	2.60	11.40	6.67	0.00	
9	0.80	7.34	3.17	2.05	
10	0.00	5.25	3.72	0.07	0.0
11	0.04	0.46	0.00	0.00	0.0
12	0.00	0.00	0.00	0.00	0.0
13	0.00	0.00	0.00	0.00	0.0
Total	13.22	43.10	32.31	2.12	0.0

Table 16

Distribution of H-Coal Hydrocrackate B (3531-18)

Product Distribution	Wt-%	Vol-%
n-Butane	0.6	0.8
Isopentane	5.2	6.5
n-Pentane	0.7	0.9
Cyclopentane	0.3	0.4
C_6 Plus	93.2	91.4
Total	100.0	100.0

MS Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	14.69
Naphthenes	
Monocycloparaffins	48.71
Bi, Dicycloparaffins	13.03
Tricycloparaffins	0.31
Aromatics	
Alkylbenzenes	20.19
Indans, Tetralins	3.01
Naphthalenes	0.06
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	3.17	6.70	3.72		
7	2.36	12.68	6.95		
8	2.77	13.11	5.30	0.0	
9	3.66	8.70	2.97	2.76	
10	1.88	6.11	1.25	0.25	0.06
11	0.85	1.02	0.00	0.00	0.00
12	0.00	0.18	0.00	0.00	0.00
13	0.00	0.21	0.00	0.00	0.00
Total	14.69	48.71	20.19	3.01	0.06

Table 17

Platforming H-Coal Hydrocrackate A (3531-15)
Plant 508, Run 1457

Period No.	Feed		1		2		3		4	
Reforming Conditions										
P-P (base), psig			0		0		0		0	
T-T (base), °C			-78		-103		-118		-133	
LHSV/LHSV (base)			1.50		1.51		1.45		1.45	
Product Yields	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%
H_2			1.7		1.2		0.9		0.6	
C_1-C_3			0.5		0.3		0.2		0.2	
n-C_4			0.5	0.6	0.4	0.6	0.5	0.7	0.6	0.8
i-C_4			0.2	0.3	0.2	0.2	0.1	0.2	0.1	0.2
C_5 Plus	100.0	100.0	97.1	93.4	97.9	95.6	98.3	96.3	98.5	97.0
Total	100.0	100.0	100.0	94.3	100.0	96.4	100.0	97.2	100.0	98.0
Product (C_5^+) Inspection										
°API @ 60°F	49.7		44.3		41.0		45.2		46.2	
Sp.Gr. @ 60°F	0.7809		0.8049		0.8203		0.8008		0.7963	
Distillation, ASTM D-86										
IBP, °F	120		140		152		132		140	
5%	148		160		170		152		162	
10%	162		174		180		165		173	
30%	202		210		216		201		208	
50%	233		245		253		235		241	
70%	269		290		297		277		282	
90%	319		344		351		331		336	
95%	336		380		375		350		362	
EP	400		424		427		410		430	
RON, Clear	84.2		98.9		96.6		93.7		91.6	
Elemental Analysis										
Hydrogen, Wt-%	13.09		11.92		12.33		12.42		12.70	
Carbon, Wt-%	86.52		88.33		87.50		88.26		88.07	
Sulfur, Wt-ppm	0.1		0.1		<0.1		<0.1		<0.1	
Nitrogen, Wt-ppm	0.1		0.1		0.1		0.1		0.1	

Table 17 (Cont'd.)

Period No.	5		6		7	
Reforming Conditions						
P-P (base), psig	0		0		0	
T-T (base), °C	-78		-58		-38	
LHSV/LHSV (base)	1.49		1.53		1.47	
Product Yields	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%
H_2	1.7		1.8		2.1	
C_1-C_3	0.5		0.8		1.1	
n-C_4	0.6	0.8	0.5	0.7	0.6	0.8
i-C_5	0.1	0.2	0.2	0.2	0.2	0.3
C_5 Plus	97.1	93.6	96.7	92.7	96.0	91.5
Total	100.0	94.6	100.0	93.6	100.0	92.6
Product (C_5+)Inspection						
°API @ 60°F	42.3		41.7		40.5	
Sp.GR. @ 60°F	0.8134		0.8170		0.8227	
Distillation, ASTM D-86						
IBP, °F	138		126		134	
5%	160		150		154	
10%	171		176		167	
30%	209		208		212	
50%	247		245		252	
70%	285		287		289	
90%	346		340		348	
95%	367		360		372	
EP	429		418		448	
RON, Clear	98.3		99.6		101.2	
Elemental Analysis						
Hydrogen, Wt-%	11.50		10.89		10.48	
Carbon, Wt-%	88.81		88.65		88.66	
Sulfur, Wt-ppm	<0.1		<0.1		<0.1	
Nitrogen, Wt-ppm	0.1		0.1		0.1	

Table 18

Platforming H-Coal Hydrocrackate B (3531-18)
Plant 508, Run 1458

Period No.	Feed		1		2		3		4		5	
Reforming Conditions												
P-P (base), psig			0		0		0		0		0	
T-T (base), °C			-118		-98		-78		-53		-13	
LHSV/LHSV (base)			1.48		1.49		1.50		1.49		1.50	
Product Yields	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%	Wt-%	Vol-%
H_2			0.9		1.2		1.5		1.9		2.2	
C_1-C_3			0.2		0.3		0.5		0.9		2.0	
n-C_4			0.4	0.6	0.9	1.2	0.6	0.8	0.7	1.0	0.9	1.2
i-C_5			0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.5
C_5 Plus	100.0	100.0	98.4	96.5	97.5	94.8	97.2	94.1	96.3	92.4	94.5	89.8
Total	100.0	100.0	100.0	97.3	100.0	96.2	100.0	95.1	100.0	92.4	100.0	91.5
Product (C_5+) Inspection												
°API @ 60°F	49.4		45.4		44.1		43.4		41.9		40.0	
Sp.Gr. @ 60°F	0.7822		0.7999		0.8053		0.8090		0.8160		0.8251	
Distillation, ASTM D-86												
IBP, °F	127		134		143		140		132		142	
5%	156		159		165		160		159		169	
10%	172		172		178		175		173		183	
30%	213		214		216		217		217		226	
50%	248		248		252		255		257		260	
70%	288		291		296		299		301		303	
90%	342		342		349		356		354		363	
95%	375		379		399		392		381		420	
EP	518		524		524		510		461		440	
RON, Clear	80.2		90.6		93.6		95.6		98.1		99.8	
Elemental Analysis												
Hydrogen, Wt-%	13.47		12.39		11.99		11.57		11.42		10.95	
Carbon, Wt-%	86.13		87.75		87.86		87.67		88.52		89.26	
Sulfur, Wt-ppm	8.2		< 0.1		<0.1		<0.1		<0.1		<0.1	
Nitrogen, Wt-ppm	0.13		0.1		0.1		0.1		0.1		0.1	

Table 19

Platforming H-Coal Hydrocrackate A (3531-15)
Product Distribution and M S Analysis

Plant 508, Run 1457, Period 1

Product Distribution	Wt-%	Vol-%
H_2	1.7	
C_1-C_3	0.5	
n-C_4	0.5	0.6
i-C_4	0.2	0.3
n-C_5	1.3	1.6
i-C_5	6.0	7.6
C_6 Plus	89.8	84.2
Total	100.0	94.3

Reformate (C_5 Plus)	
Yield, Vol-%	93.4
RON, Clear	98.9

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	15.66
Naphthenes	
Monocycloparaffins	12.58
Bi, Dicycloparaffins	1.26
Tricycloparaffins	0.0
Aromatics	
Alkylbenzenes	65.86
Indans, Tetralins	4.35
Naphthalenes	0.29
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J-12
6	4.53	6.30	7.43		
7	4.28	3.73	20.23		
8	3.58	1.59	19.54	0.0	
9	2.05	0.59	11.85	2.34	
10	1.22	0.37	6.07	2.01	0.29
11	0.0	0.0	0.74	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
Total	15.66	12.58	65.86	4.35	0.29

Table 20

Platforming H-Coal Hydrocrackate A (3531-15)
Product Distribution and M S Analysis

Plant 508, Run 1457, Period 4

Product Distribution	Wt-%	Vol-%
H_2	0.6	
C_1-C_3	0.2	
n-C_4	0.6	0.8
i-C_4	0.1	0.2
n-C_5	1.4	1.8
i-C_5	6.6	8.3
C_6 Plus	90.5	86.9
Total	100.0	98.0

Reformate (C_5 Plus)

Yield, Vol-%	97.0
RON, Clear	91.6

M S Analysis of C_6 Plus Fraction, Vol-%

1. Hydrocarbon Types

Paraffins	9.56
Naphthenes	
Monocycloparaffins	26.69
Bi, Dicycloparaffins	4.20
Tricycloparaffins	0.13
Aromatics	
Alkylbenzenes	52.23
Indans, Tetralins	6.73
Naphthalenes	0.46
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	0.22	7.70	11.17		
7	0.96	2.39	16.33		
8	1.35	4.83	13.42	0.0	
9	3.77	4.74	7.38	4.09	
10	1.87	3.37	3.52	2.31	0.20
11	1.38	2.17	0.41	0.33	0.07
12	0.0	0.98	0.0	0.0	0.08
13	0.01	0.51	0.0	0.0	0.11
Total	9.56	26.69	52.23	6.73	0.46

Table 21

Platforming H-Coal Hydrocrackate A (3531-15)
Product Distribution and M S Analysis

Plant 508, Run 1457, Period 7

Product Distribution	Wt-%	Vol-%
H_2	2.1	
C_1-C_3	1.1	
n-C_4	0.6	0.8
i-C_4	0.2	0.3
n-C_5	2.2	2.8
I-C_5	6.2	7.7
C_6 Plus	87.6	81.0
Total	100.0	92.6

Reformate (C_5 Plus)

Yield, Vol-%	91.5
RON, Clear	101.2

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	13.14
Naphthenes	
Monocycloparaffins	6.08
Bi, Dicycloparaffins	0.59
Tricycloparaffins	0.0
Aromatics	
Alkylbenzenes	75.45
Indans, Tetralins	4.29
Naphthalenes	0.45
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	8.06	4.60	9.02		
7	4.26	1.11	24.22		
8	0.82	0.37	22.37	0.12	
9	0.0	0.0	12.60	2.31	
10	0.0	0.0	6.51	1.86	0.35
11	0.0	0.0	0.73	0.0	0.10
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
Total	13.14	6.08	75.45	4.29	0.45

Table 22

Platforming H-Coal Hydrocrackate B (3531-18)
Product Distribution and M S Analysis

Plant 508, Run 1458, Period 1

Product Distribution	Wt-%	Vol-%
H_2	0.9	
C_1-C_3	0.2	
n-C_4	0.4	0.6
i-C_4	0.1	0.2
n-C_5	1.4	1.7
i-C_5	6.0	7.5
C_6 Plus	91.0	87.3
Total	100.0	97.3

Reformate (C_5 Plus)

Yield, Vol-%	96.5
RON, Clear	90.6

M S Analysis of C_6 Plus Fraction, Vol-%.

I. Hydrocarbon Types

Paraffins	15.03
Naphthenes	
Monocycloparaffins	31.35
Bi, Dicycloparaffins	7.09
Tricycloparaffins	0.0
Aromatics	
Alkylbenzenes	41.76
Indans, Tetralins	4.25
Naphthalenes	0.52
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	6.39	5.70	6.80		
7	4.57	12.12	10.59		
8	3.44	8.33	10.77	0.0	
9	0.51	3.51	7.79	1.90	
10	0.12	1.69	4.93	1.94	0.18
11	0.0	0.0	0.81	0.31	0.14
12	0.0	0.0	0.03	0.05	0.11
13	0.0	0.0	0.04	0.04	0.09
Total	15.03	31.35	41.76	4.25	0.52

Table 23

Platforming H-Coal Hydrocrackate B (3531-18)
Product Distribution and M S Analysis

Plant 508, Run 1458, Period 2

Product Distribution	Wt-%	Vol-%
H_2	1.2	
C_1-C_3	0.3	
n-C_4	0.9	1.2
i-C_4	0.1	0.2
n-C_5	1.2	1.5
i-C_5	5.1	6.3
C_6 Plus	91.2	87.0
Total	100.0	96.2

Reformate (C_5 Plus)	
Yield, Vol-%	94.8
RON, Clear	93.6

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	16.65
Naphthenes	
Monocycloparaffins	25.91
Bi, Dicycloparaffins	4.69
Tricycloparaffins	0.23
Aromatics	
Alkylbenzenes	47.26
Indans, Tetralins	4.70
Naphthalenes	0.56
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	5.14	5.70	6.46		
7	4.36	9.81	13.84		
8	3.94	6.05	13.15	0.00	
9	1.97	2.57	8.22	2.12	
10	1.22	1.49	4.79	2.25	0.22
11	0.02	0.29	0.80	0.35	0.15
12	0.00	0.00	0.00	0.00	0.12
13	0.00	0.00	0.00	0.00	0.07
Total	16.65	25.91	47.26	4.70	0.56

Table 24

Platforming H-Coal Hydrocrackate B (3531-18)
Product Distillation and M S Analysis

Plant 508, Run 1458, Period 3

Product Distribution	Wt-%	Vol-%
H_2	1.5	
C_1- C_3	0.5	
n-C_4	0.6	0.8
i-C_4	0.2	0.2
n-C_5	1.3	1.6
i-C_5	5.4	6.7
C_6 Plus	90.5	85.8
Total	100.0	95.1

Reformate (C_5 Plus)

Yield, Vol-%	94.1
RON, Clear	95.6

M.S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	15.27
Naphthenes	
Monocycloparaffins	21.30
Bi, Dicycloparaffins	3.32
Tricycloparaffins	0.21
Aromatics	
Alkylbenzenes	54.20
Indans, Tetralins	5.05
Naphthalenes	0.65
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	3.97	6.40	7.76		
7	3.89	7.34	14.60		
8	3.83	4.39	14.81	0.0	
9	2.10	1.84	9.83	2.12	
10	1.48	1.10	6.08	2.52	0.25
11	0.0	0.23	1.10	0.41	0.18
12	0.0	0.0	0.02	0.0	0.12
13	0.0	0.0	0.0	0.0	0.10
Total	15.27	21.30	54.20	5.05	0.65

Table 25

Platforming H-Coal Hydrocrackate B (3531-18)
Product Distribution and M S Analysis

Plant 508, Run 1458, Period 4

Product Distribution	Wt-%	Vol-%
H_2	1.9	
C_1-C_3	0.9	
n-C_4	0.7	1.0
i-C_4	0.2	0.3
n-C_5	1.5	1.9
i-C_5	5.2	6.5
C_6 Plus	89.6	84.0
Total	100.0	93.7

Reformate (C_5 Plus)

Yield, Vol-%	92.4
RON, Clear	98.1

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Thpes	
Paraffins	15.13
Naphthenes	
Monocycloparaffins	13.64
Bi, Dicycloparaffins	2.19
Tricycloparaffins	0.00
Aromatics	
Alkylbenzenes	62.94
Indans, Tetralins	5.26
Naphthalenes	0.84
Total	100.00

II. Carbon Numbers Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	6.97	5.20	9.59		
7	5.05	5.45	18.14		
8	2.58	2.37	16.62	0.00	
9	0.53	0.62	10.59	2.12	
10	0.00	0.00	6.69	2.66	0.33
11	0.00	0.00	1.22	0.37	0.25
12	0.00	0.00	0.06	0.07	0.14
13	0.00	0.00	0.03	0.04	0.12
Total	15.13	13.64	62.94	5.26	0.84

Table 26

Platforming H-Coal Hydrocrackate B (3531-18)
Product Distribution and M S Analysis

Plant 508, Run 1458, Period 5

Product Distribution	Wt-%	Vol-%
H_2	2.2	
C_1-C_3	2.0	
n-C_4	0.9	1.2
i-C_4	0.4	0.5
n-C_5	3.8	4.8
i-C_5	4.7	5.9
C_6 Plus	86.0	79.1
Total	100.0	91.5

Reformate (C_5 Plus)	
Yield, Vol-%	89.8
RON, Clear	99.8

M S Analysis of C_6 Plus Fraction, Vol-%

I. Hydrocarbon Types

Paraffins	10.57
Naphthenes	
Monocycloparaffins	7.15
Bi, Dicycloparaffins	0.99
Tricycloparaffins	0.00
Aromatics	
Alkylbenzenes	73.11
Indans, Tetralins	6.24
Naphthalenes	1.94
Total	100.00

II. Carbon Number Distribution

Carbon Number	Paraffins	Monocyclo-paraffins	Aromatics J = 6	Aromatics J = 8	Aromatics J = 12
6	5.41	3.30	9.69		
7	3.78	2.86	19.06		
8	1.38	0.99	18.42	0.02	
9	0.00	0.00	14.61	2.77	
10	0.00	0.00	9.57	2.99	0.93
11	0.00	0.00	1.65	0.40	0.52
12	0.00	0.00	0.07	0.06	0.27
13	0.00	0.00	0.04	0.00	0.22
Total	10.57	7.15	73.11	6.24	1.94

FIGURE 1

NAPHTHA HYDROTREATING PLANT

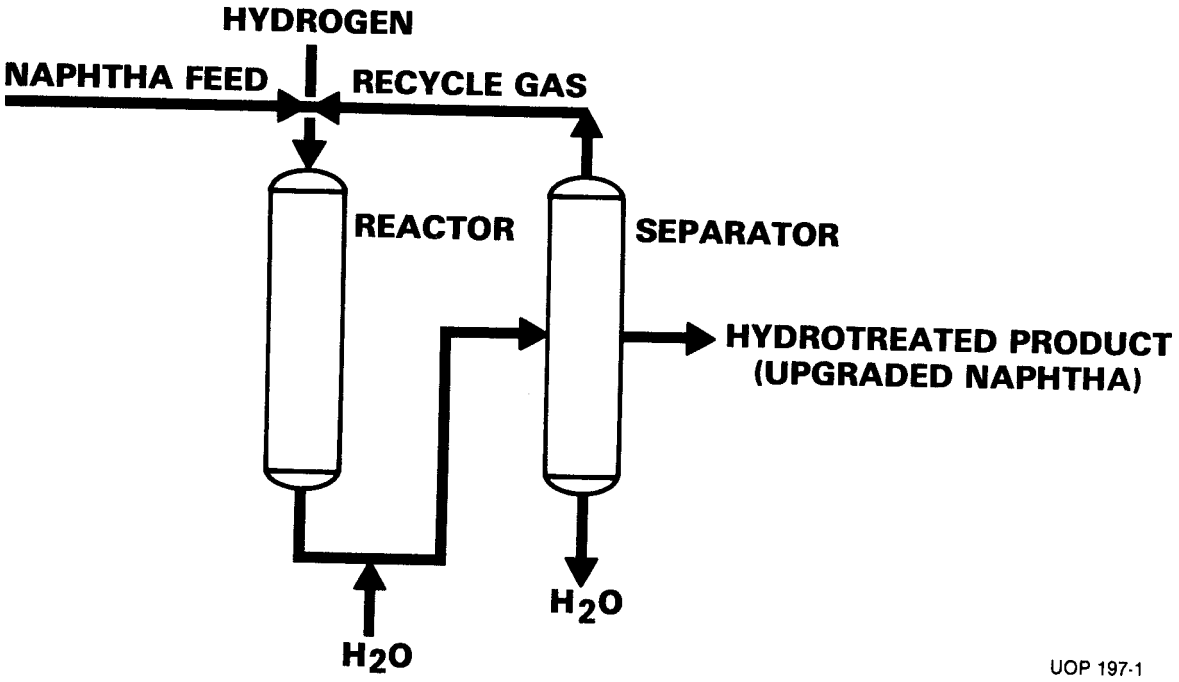


FIGURE 2

NAPHTHA REFORMING PLANT

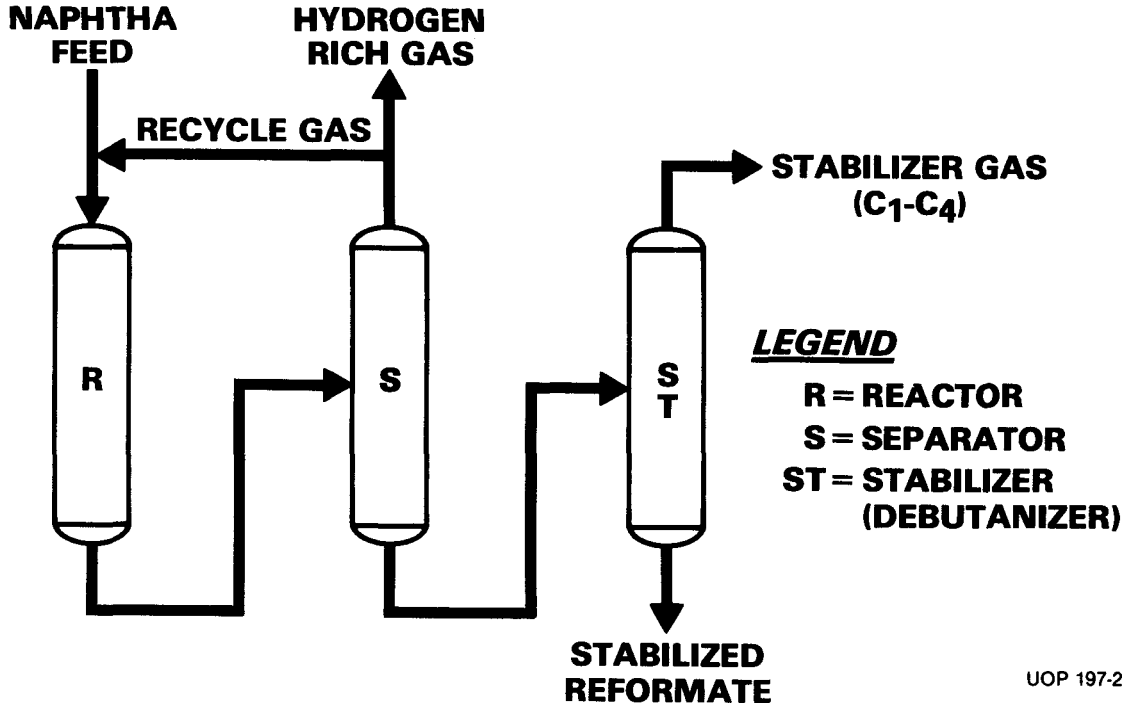
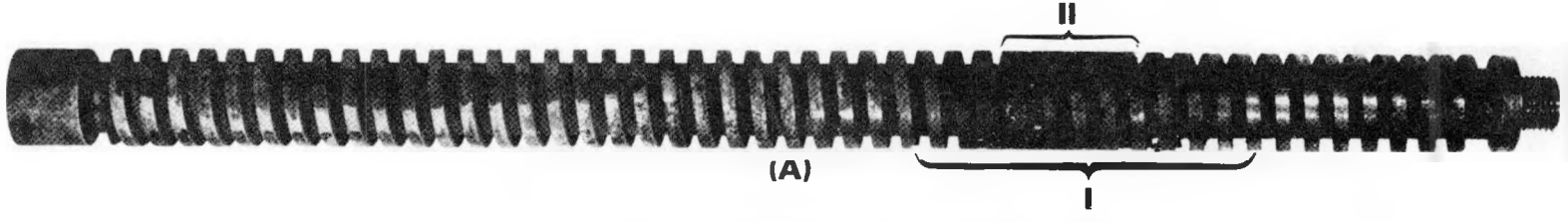


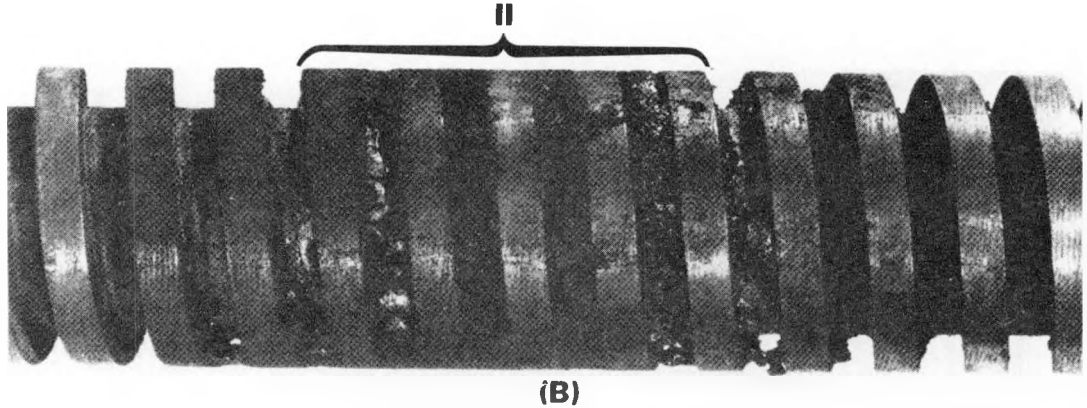
FIGURE 3

DEPOSIT OF CARBONACEOUS MATERIAL ON PREHEATER



(A)

THE 15-INCH SPIRAL PREHEATER



(B)

SECTION I OF THE 15-INCH SPIRAL PREHEATER

UOP 197-3

FIGURE 4

YIELD OCTANE CURVE FOR UPGRADED H-COAL NAPHTHA

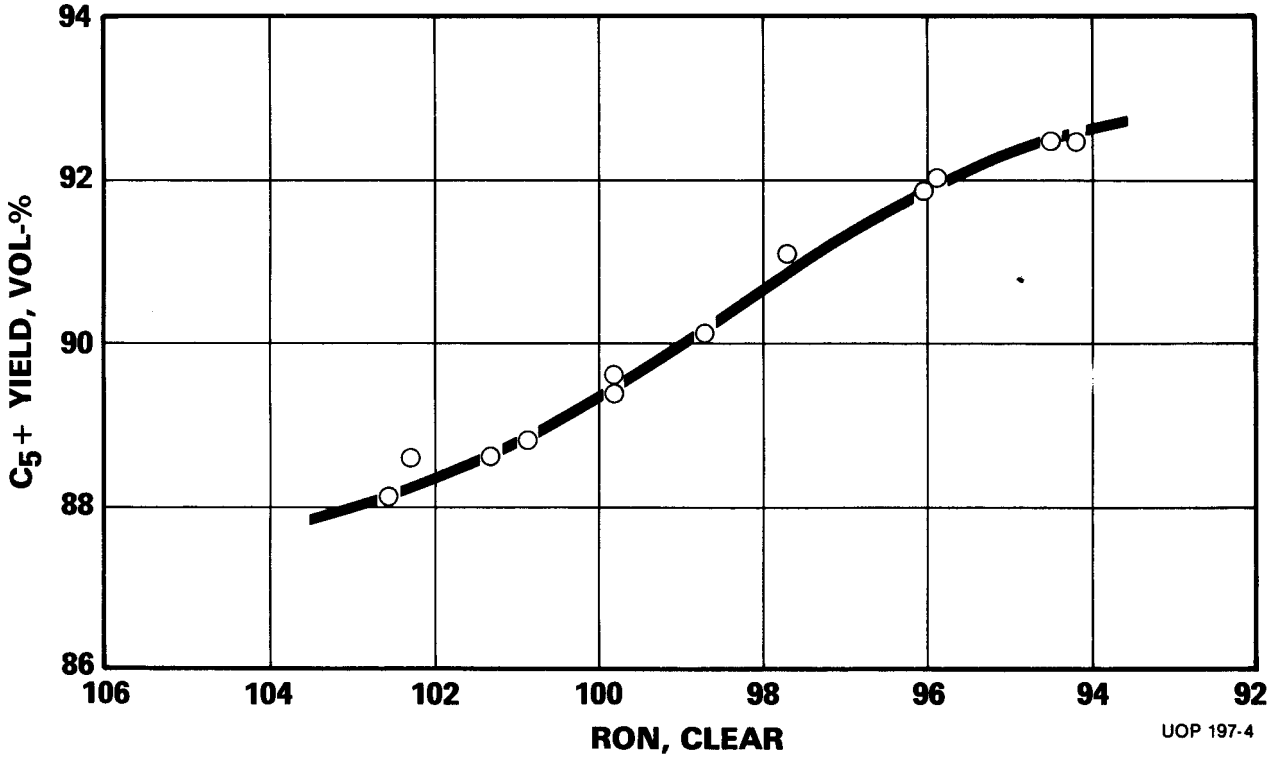


FIGURE 5

YIELD OCTANE CURVE FOR H-COAL HYDROCRACKATE A

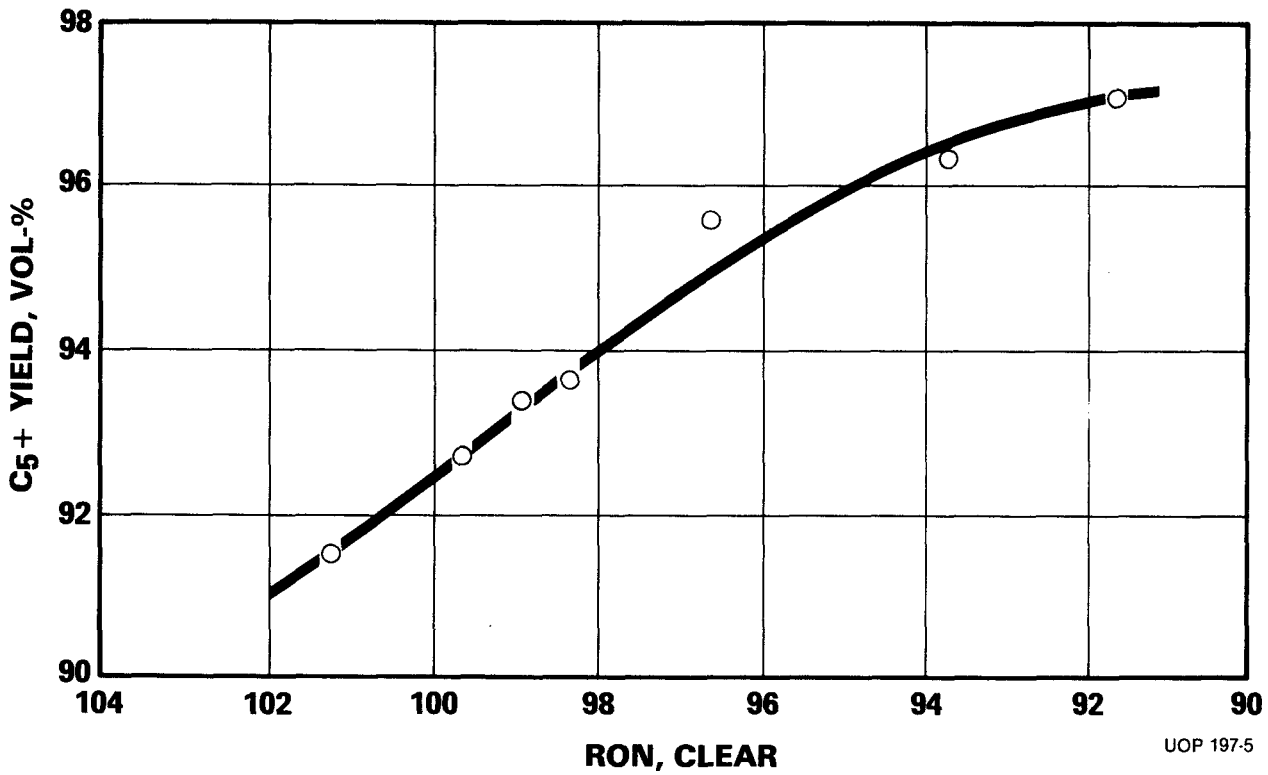
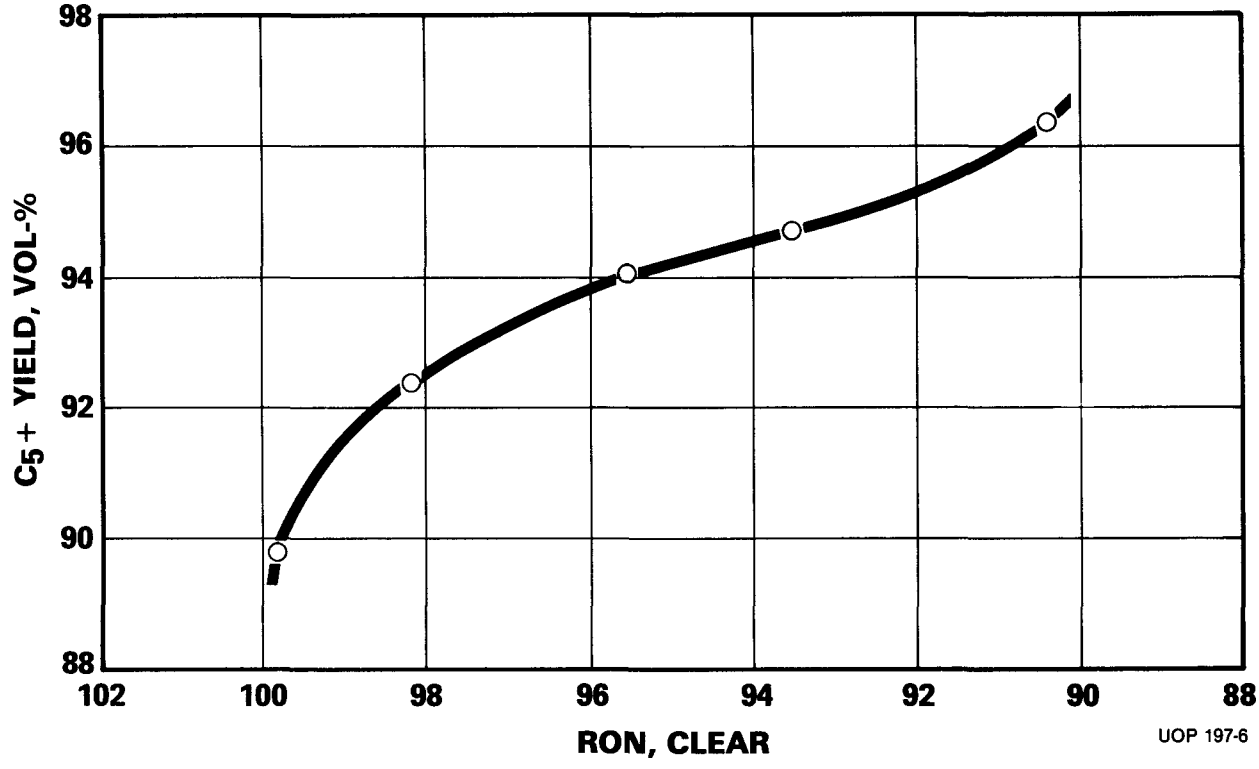


FIGURE 6

YIELD OCTANE CURVE FOR H-COAL HYDROCRACKATE B



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