FE-2645-06
Distribution Categories UC-90 and UC-90d

DEASPHALTING, DEASHING AND UPGRADING OF COAL LIQUIDS

Quarterly Technical Progress Report
for
The Period January-March, 1980

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Date Published - June, 1980

PREPARED FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Under Contract No. ET-78-C-01-2645

ABSTRACT

Continuing work on deashing SRC-I filter feed has yielded deashed oils containing 0.004 wt-% ash or less. The lowest reject bottoms yield was 18.8 wt-%. This fails to meet the target of 15% maximum rejection.

A summary of the deashing work on SRC-I filter feed has also shown that rejection decreased with use of higher boiling point solvents, with addition of up to 10% light aromatic component to the solvent, and with increased operating temperature.

The hydrotreatment of the deashed oil derived from SRC-I filter feed yielded oils containing 9.99 wt-% and 10.17 wt-% hydrogen. Recoveries of oil ranged from 99.20 to 99.65 wt-%. Hydrogen consumption was 1080-1090 SCFB hydrogen.

Two deashed oils derived from UOP coal liquefaction product have been catalytically cracked. Conversions ranged from 44 to 60 vol-%.

Work Accomplished

Task 2.0

The deashing of two drums of SRC-I filter feed, 3777-3 and 3777-4, (Tables 1 and 2) was continued in UOP Research Plant 633.

UOP deashing proceeds as follows: preheated SRC-I filter feed is combined with preheated solvent upstream of the deasher. The combined feed is passed downflow through the in-line mixer into the deasher (Figure 1). Phase separation takes place in the deasher. The oil-rich upper phase flows to the stripper for removal of solvent. The solid rich bottom phase, containing the ash, is removed through a lock hopper system, which is controlled by a capacitance sensing interface detector. Both deashed oil and deasher bottoms are weighed and analyzed. The percent deashed oil and percent reject bottoms are calculated on the basis of the total solvent-free effluent.

Solvents used in this study included a light paraffin, designated "Paraffin A"; a higher boiling paraffin, designated "Paraffin B"; and a light aromatic. The aromatic was used both neat and at 10% concentration in the paraffin.

Four runs are reported covering effects of solvent type and residence time on deashing the SRC-I filter feed. This solvent study was done to determine the best solvent to achieve the objective of a maximum 15 wt-% bottoms rejection.

Plant 633, Run 97

A summary of deashing Run 97 is presented in Table 3. This was the initial work on SRC-I filter feed. The in-line mixer was not used for this run. No change in rejection was noted when the deashing temperature was increased. When the residence time was increased by 100%, only a slight decrease in bottoms rejection, from 48.3% to 40.9%, was observed.

For comparison, data are presented from a subsequent operation, Run 116, reported in FE-2645-05. The in-line mixer had been reinserted prior to Run 116 after mechanical problems were resolved. The rejection dropped from 48.3% to 24.5%. The major part of this reduction is attributed to the insertion of the mixer, rather than the addition of a light aromatic component to the solvent.

Inspections of the deashed oil from Run 97 show a low C_7 insoluble content. This would be expected in view of the high rejection. The ash content of the deashed oil was less than 10 ppm. Inspection of the reject bottoms shows the effect of the dilution with SRC solvent. Both the ash and toluene insoluble contents, 4.96 wt-% and 30.0 wt-% respectively, are low when compared to the reject bottoms from Run 116 which are 19.8 wt-% and 94.3 wt-% respectively.

Plant 633, Run 120

A summary of deashing Run 120 is given in Table 4. The solvent used in this operation was a light aromatic. The high ash content of the deashed oil and the low rejection show the operation to be essentially one of settling. A doubling of the residence time showed a minor decrease in rejection, from 7.8 down to 6.2 wt-%. A decrease in temperature did not result in an increased rejection as expected, but decreased rejection from 6.2 to 0.5 wt-%. The ash content of the deashed oil did not change with the drop in temperature. These results are consistent with deashing by settling, rather than phase separation.

Plant 633, Run 122

A summary of deashing Run 122 is given in Table 5. The solvent was changed to a higher boiling point paraffin B. The operating temperature was also increased slightly to 55°C above base temperature. Up to 26 hours on stream, feedstock was 3777-3 (Table 1). Thereafter, feedstock 3777-4 (Table 2) was used. The rejection was 22.5 wt-% as compared to 24.5 wt-% using paraffin A in Run 116 (Table 3). This deashed oil contained 30 ppm ash and had a low toluene insoluble content of 0.17 wt-%.

The recovery in Run 122 was 80.4 wt-%. All losses were assigned to reject bottoms, which remained in the deashing reactor when both the level control and lock hopper systems malfunctioned. The 22.5% rejection reported is the difference between the recovered overhead and 100 wt-%.

Plant 633, Run 123

A summary of deashing Run 123 is given in Table 5. The solvent was modified by addition of 10 vol-% light aromatic to the higher boiling paraffin B solvent. The operation was started at 44°C above base temperature to obtain an initial rejection value of 21.4 wt-%. The deashing temperature was raised to 81°C above base and the plant was run out to 108 hours. This 37°C increase in temperature resulted in a modest decrease in rejection from 21.4 wt-% down to 18.8 wt-%. The 15 wt-% rejection level was not reached.

A summary of the solvent study at a 1.0 residence time is given below.

Conditions

Run	97[a]	116	122	123	123	120[b]
Test, hrs.	64-88	12-29	12-25	12-28	28-108	4-20
T-T(base), °C	49	48	55	44	81	45
Solvent Type	Paraffin A	90% Paraffin A 10% Light Aromatic	Paraffin B	90% Paraffin B 10% Light Aromatic		100% Light Aromatic
Rejection, Wt-%	48.3	24.5	22.5	21.4	18.8	7.8
Reject Bottoms Ash, Wt-%	4.96	19.80		21.0	22.3	∿100
Deashed Oil Ash, Wt-%	∿0.001	0.001	0.003	0.002	0.004	1.18

[a]No in-line mixer used

[b]Settling occurred in this run

Comparison of Runs 116 and 123 at corresponding temperatures indicates that the desired lowering of rejection was obtained by replacing paraffin A with the heavier paraffin B in the solvent blend. Comparison of Runs 122 and 123 indicates that rejection is also lowered by addition of 10% aromatic. The temperature effect shown in Run 123 is opposite that displayed in petroleum deasphalting, where rejection increases with increase in temperature.

While ash content of the DAO was consistently low under deashing conditions, the target rejection of 15 wt-% maximum could not be met.

Task 3.0

Hydrotreating the deashed oil obtained from deashing SRC-I filter feed was completed in UOP Plant 638 (Figure 2).

The deashed oil was processed with hydrogen, downflow, over a fixed bed of 630 cc of UOP black oil conversion catalyst. Water was injected into the reactor effluent line to pick up ammonia. The water was then removed in a 3-phase separator. The hydrotreated deashed oil was sent to a stripper and debutanizer column for removal of light gases and hydrogen sulfide.

Two feed blends of deashed oil were made, based on the extent of deashing rejection. The first blend, 3777-47 (Table 6), consisted of oil from deashing operations where rejections ranged from 19 to 25 wt-%. The second feed blend, 3777-48 (Table 7), consisted of oil from deashing operations having rejections ranging from 41 to 48 wt-%. No oil from operations in which settling occurred were hydrotreated.

Plant 638, Run 48

The deashed oils were processed over the commercial black oil conversion catalyst at 20°C below base temperature, 300 psi below base pressure and at 2.0 LHSV relative to base over a period of 244 hours. Deashed oil 3777-47 was processed for the first 184 hours, deashed oil 3777-48 was processed from 184-244 hours. A summary of the operation is shown in Table 8. Product samples taken from the plant during the run were sent for C_7 insoluble, and carbon and hydrogen analyses. The operation ran well with only a slight catalyst deactivation, as measured by the product hydrogen content, over the first 184 hours of operation.

Liquid products from the line-out through period 16, ending at 184 hours, were blended and designated hydrotreated deashed oil 3777-50. Inspections of this product are shown in Table 9. Liquid products from periods 17 through 22 (184-244 hrs.) were also blended and designated hydrotreated deashed oil 3777-51. Inspections of this product are shown in Table 10.

Product distributions, hydrogen consumption and distribution of hydrogen consumptions were calculated for each of the feedstocks. The data are presented in Tables 11 and 12 for feedstock 3777-47 and in Tables 13 and 14 for feedstock 3777-48. High yields, 99.2 and 99.65 wt-% of hydrotreated oil were achieved.

Task 5.0

Two additional FCC runs were made on deashed oils in UOP Research Plant 593. Feedstock for Run 303 (Table 15) was deashed oil 3777-42, described in Table 10, Report FE-2645-04. Feedstock for Run 304 (Table 16) was hydrotreated deashed oil 3777-46, described in Table 18, Report FE-2645-04. Both these stocks, as well as that fed in the previously reported FCC Run 302 (Table 19, FE-2645-05) were derived from liquefaction of Illinois No. 6 coal, using deashed oil as solvent. Cracking conditions were as follows:

$$\begin{aligned} &\text{P-P(base)} && = -10 \text{ psi} \\ &\text{T-T(base)} && = 3 \text{ and } 31^\circ\text{C} \\ &\frac{\text{Cat/Oil}}{\text{Cat/Oil(base)}} && = 1 \text{ and } 1.4 \end{aligned}$$

Due to a feedstock shortage, only two tests (at the lower temperature condition) could be made on deashed oil 3777-42. Four tests were made at each temperature on the hydrotreated deashed oil 3777-46. Only the acceptable tests are listed in the tables.

The cut point of the plant fractionator was set too low during Run 304. The yield data and gravities for the gasolines and cycle oils have been adjusted, based on a 380°F temperature at the 90 vol-% point of the Engler distillation.

The volume percent conversion of these feedstocks is abstracted from the tables and shown below. Conversion data from the first hydrotreated deashed oil 3777-43 presented in Report FE-2645-05 are also presented for comparison:

Feed No.	3777-42	3777-43	3777-46
Hydrogen, Wt-%	9.77	10.19	10.57
	Volume % Conversion		
T-T(base)°C			
3	44.2	49.4	57.5
31		55.7	60.2

The data show the expected increasing conversion with increasing hydrogen content of the feed. Overall conversions appear to be low, and reflect the low hydrogen contents of the feeds.

This completes Task 5 for the UOP coal liquefaction product.

Work Forecast

Task 4.0

Task 4.0 (Hydrocracking) cannot reasonably be performed for SRC-I filter feed, because of lack of success in obtaining deashed oil from this stock at a reasonably low rejection.

Since the filter feed comprises about two parts recycle solvent and one part SRC, rejections above 15% represent less than 50% recovery of SRC.

In the case of UOP coal liquefaction product, supply of feedstock was exhausted in FCC experiments. Preparation of additional feedstock, using hydrotreated deashed oils 3777-50 and 3777-51 as solvent, will be necessary.

Task 5.0

Task 5.0 (FCC) cannot reasonably be performed for SRC-I filter feed for reason noted above.

Table 1

Inspections of SRC-I Filter Feed 3777-3

Drum No.	1
°API @ 60°F	-4.4
Sp. Gr. @ 60°F	1.1133
Distillation ASTM D-86	
IBP°F	445
5%	490
10%	515
20%	551
30%	586
40%	622
50%	675
60%	741
70%	830
80%	
90%	
95%	
EP	
% Over	70.0
% Bottoms	30.0
Hydrogen, Wt-%	7.55
Carbon, Wt-%	83.85
Sulfur, Wt-ppm	8300
Nitrogen, Wt-ppm	12670
Oxygen, Wt-ppm	22700
Ash ASTM, Wt-%	3.42
C_7 Insoluble, Wt-%	25.4
Toluene Insoluble, Wt-%	14.9
Pour Point, °F	+50
Viscosity SUS @ 210°F sec	125.1
Furol @ 122°F sec	230.0

Table 2

Inspections of SRC-I Filter Feed 3777-4

Drum No.	2
°API @ 60°F	-5.9
Sp. Gr. @ 60°F	1.1266
Distillation ASTM D-86	
IBP°F	439
5%	491
10%	521
20%	565
30%	599
40%	635
50%	680
60%	739
70%	850
80%	
90%	
95%	
EP	
% Over	70.0
% Bottoms	30.0
Hydrogen, Wt-%	7.37
Carbon, Wt-%	83.39
Sulfur, Wt-ppm	8650
Nitrogen, Wt-ppm	11800
Oxygen, Wt-ppm	21400
Ash ASTM, Wt-%	4.19
C_7 Insoluble, Wt-%	24.75
Toluene Insoluble, Wt-%	14.78
Pour Point, °F	+45
Viscosity SUS @ 210°F sec	126.6
cSt @ 210°F sec	26.44

Table 3

Solvent Deashing of SRC-I Filter Feed 3777-3

Plant 633

Solvent	100% Light Paraffin A			10% Light Aromatic 90% Light Paraffin A
Run	← 97 →			116
Hours on Stream	8-64	64-88	96-139	12-29
Conditions				
P-P(base), psi	430	480	465	480
T-T(base), °C	31	49	43	48
Solvent/Feed Ratio	base	base	base	base
Residence Time, hr. / Residence Time(base), hr.	1.0	1.0	2.0	1.0
Feed Total, g	27732	11467	11775	7806
Product Recovered				
Deashed Oil, g	14479	5947	6826	5741
Reject Bottoms, g	13423	5563	4718	1864
Total, g	27902	11510	11544	7605
Recovery, Wt-%	100.6	100.4	98.0	97.4
Deashed Oil				
Recovered, Wt-%	51.9	51.7	59.1	75.5
C_7 Insol., Wt-%	2.49	2.87	2.19	10.1
Ash, Wt-%	<0.001	<0.001	<0.001	0.001
Toluene Insol., Wt-%			0.02	0.04
Reject Bottoms				
Recovered, Wt-%	48.1	48.3	40.9	24.5
Ash, Wt-%		4.96	12.61	19.80
Toluene Insol., Wt-%		30.0	52.5	94.3
C_7 Insol., Wt-%			68.3	99.5

Table 4

Solvent Deashing of SRC-I Filter Feed 3777-3

Plant 633

Solvent	100% Light Aromatic		
Run	120		
Hours on Stream	4-20	20-24	32-40
Conditions			
P-P(base), psi	555	595	425
T-T(base), °C	45	45	10
Solvent/Feed Ratio	base	base	base
Residence Time, hr.	1.0	2.0	2.0
Residence Time(base), hr.			
Feed Total, g	7775	1054	1919
Product Recovered			
Deashed Oil, g	7040	1057	1882
Reject Bottoms, g	593	70	10
Total, g	7633	1127	1892
Recovery, Wt-%	98.2	106.9	98.1
Deashed Oil			
Recovered, Wt-%	92.2	93.8	99.5
C_7 Insol., Wt-%	15.30	15.1	18.2
Ash, Wt-%	1.18	0.79	0.78
Reject Bottoms			
Recovered, Wt-%	7.8	6.2	0.5
Ash, Wt-%			

Table 5

Solvent Deashing of SRC-I Filter Feed 3777-4

Plant 633

Solvent	100% Light Paraffin B	90% Light Paraffin B 10% Light Aromatic	
Run	122	123	123
Hours on Stream	12-44	12-28	28-108
Conditions			
P-P(base), psi	555	545	545
T-T(base), °C	55	44	81
Solvent/Feed Ratio	base	base	base
Residence Time, hr. / Residence time(base), hr.	1.0	1.0	1.0
Feed Total, g	15255	7626	38036
Product Recovered			
Deashed Oil, g	11828	5869	30600
Reject Bottoms, g	430	1604	7102
Total, g	12258	7473	37702
Recovery, Wt-%	80.4	98.0	99.1
Deashed Oil			
Recovered, Wt-%	77.5	78.6	81.2
C_7 Insol., Wt-%	8.65	9.84	10.75
Ash, Wt-%	0.003	0.002	0.004
Toluene Insol., Wt-%	0.17	0.41	0.30
Reject Bottoms			
Recovered, Wt-%	22.5	21.4	18.8
Ash, Wt-%		21.0	22.3
Softening Point, °F		420	479

Table 6

Inspections of Deashed Oil 3777-47

°API @ 60°F	2.2
Sp. Gr. @ 60°F	1.0583
Distillation ASTM D-86	
IBP°F	461
5%	502
10%	528
20%	558
30%	590
40%	622
50%	662
60%	709
70%	761
80%	867
84%	950
EP	
% Over	84.0
% Bottoms	16.0
Hydrogen, Wt-%	8.25
Carbon, Wt-%	88.18
Sulfur, Wt-ppm	4700
Nitrogen, Wt-ppm	9900
Oxygen, Wt-ppm	21900
Ash ASTM, Wt-%	0.009
C_7 Insoluble, Wt-%	9.68
Toluene Insoluble, Wt-%	0.12
Viscosity SUS @ 210°F sec	48.9
cSt @ 210°F sec	6.93
Conradson Carbon, Wt-%	9.16
Molecular Weight, kg/kmol	245

Table 7

Inspections of Deashed Oil 3777-48

°API @ 60°F	4.3
Sp. Gr. @ 60°F	1.0420
Distillation ASTM D-86	
IBP°F	442
5%	489
10%	513
20%	542
30%	569
40%	600
50%	635
60%	678
70%	729
80%	799
87%	901
95%	
EP	
% Over	87.0
% Bottoms	13.0
Hydrogen, Wt-%	8.74
Carbon, Wt-%	88.05
Sulfur, Wt-ppm	4600
Nitrogen, Wt-ppm	8400
Oxygen, Wt-ppm	16300
Ash ASTM, Wt-%	0.002
C_7 Insoluble, Wt-%	2.80
Toluene Insoluble, Wt-%	0.02
Pour Point, °F	+35
Viscosity SUS @ 210°F sec	41.5
cSt @ 210°F sec	4.63
Conradson Carbon, Wt-%	6.01
Molecular Weight, kg/kmol	240

Table 8

Hydrotreating Deashed Oils 3777-47 and 48

Plant 638, Run 48

Operational Summary

P-P(base) psi = -300, LHSV/LHSV(base) = 2.0

Period No.	Hrs. on Stream	Feed-stock	T-T(base), °C	Product Analysis, Wt-% H	C	C_7 Insolubles
Line Out	12-24	3777-47				
1	24-34	↓	-20	10.08	88.09	2.17
2	34-44		-19	9.79	88.27	
3	44-54		-19	9.74	88.18	
4	54-64		-22			1.22
5	64-74		-18			
6	74-84		-22	9.75	87.96	
7	84-94		-18			
8	94-104		-21			1.47
9	104-114		-20			
10	114-124		-20			
11	124-134		-20	9.72	88.10	1.20
12	134-144		-16			
13	144-154		-18			
14	154-164		-24	9.77	87.99	
15	164-174		-31	9.90	87.96	
16	174-184	↓	-20			
17	184-194	3777-48	-20			
18	194-204	↓	-27	10.06	88.16	0.33
19	204-214		-24			
20	214-224		-26			
21	224-234		-23	10.12	88.39	0.22
22	234-244	↓	-22			

Table 9

Inspections of Hydrotreated Deashed Oil 3777-50

Sample No.	3777-50
°API @ 60°F	10.4
Sp. Gr. @ 60°F	0.9972
Distillation ASTM D-86	
IBP°F	270
5%	418
10%	477
20%	519
30%	550
40%	580
50%	611
60%	651
70%	701
80%	785
89%	952
95%	
EP	
% Over	89.0
% Bottoms	11.0
Hydrogen, Wt-%	9.99
Carbon, Wt-%	88.45
Sulfur, Wt-ppm	598
Nitrogen, Wt-ppm	5800
Oxygen, Wt-ppm	7900
C_7 Insoluble, Wt-%	1.91
Toluene Insoluble, Wt-%	0.03
Viscosity SUS @ 210°F sec	35.8
cSt @ 210°F sec	2.867
Conradson Carbon, Wt-%	3.95
Molecular Weight, kg/kmol	243

Table 10

Inspections of Hydrotreated Deashed Oil 3777-51

Sample No.	3777-51
°API @ 60°F	12.4
Sp. Gr. @ 60°F	0.9833
Distillation ASTM D-86	
IBP°F	250
5%	412
10%	468
20%	514
30%	550
40%	577
50%	608
60%	641
70%	691
80%	760
90%	920
92%	970
EP	
% Over	92.0
% Bottoms	8.0
Hydrogen, Wt-%	10.17
Carbon, Wt-%	87.93
Sulfur, Wt-ppm	436
Nitrogen, Wt-ppm	4500
Oxygen, Wt-ppm	6610
C_7 Insoluble, Wt-%	0.42
Toluene Insoluble, Wt-%	<0.01
Viscosity SUS @ 210°F sec	34.3
cSt @ 210°F	2.436
Conradson Carbon, Wt-%	2.33
Molecular Weight, kg/kmol	237

Table 11

Hydrotreating Deashed Oil 3777-47

Overall Product Distribution

Plant 638, Run 48, Periods L.O.-16

Product Distribution	Wt-%
C_1-C_4	0.46
C_5-C_6 (in Debut. Gas)	0.34
Combined Product[a]	99.65
H_2O	0.50
NH_3	0.44
H_2S	0.33
Total	101.72
Total Hydrogen Consumption SCFB	1082

[a]Designated as Hydrotreated Deashed Oil 3777-50

Table 12

Hydrotreating Deashed Oil 3777-47

Distribution of Hydrogen Consumption

Plant 638, Run 48, Periods L.O.-16

Hydrogen Distribution	Wt-%
C_1-C_4	3.28
C_5-C_6 (in Debut. Gas)	1.56
Combined Product[a]	86.94
H_2O	3.01
NH_3	4.19
H_2S	1.02
Total	100.00
Total Hydrogen Consumption SCFB	1082

[a] Designated as Hydrogenated Deashed Oil 3777-50

Table 13

Hydrotreating Deashed Oil 3777-48

Overall Product Distribution

Plant 638, Run 48, Periods 17-22

Product Distribution	Wt-%
C_1-C_4	0.44
C_5-C_6 (in Debut. Gas)	0.43
Combined Product[a]	99.20
H_2O	0.75
NH_3	0.44
H_2S	0.47
Total	101.73
Total Hydrogen Consumption SCFB	1088

[a]Designated as Hydrotreated Deashed Oil 3777-51

Table 14

Hydrotreating Deashed Oil 3777-48

Distribution of Hydrogen Consumption

Plant 638, Run 48, Periods 17-22

Hydrogen Distribution	Wt-%
C_1-C_4	3.45
C_5-C_6 (in Debut. Gas)	2.11
Combined Product[a]	82.38
H_2O	5.30
NH_3	4.98
H_2S	1.78
Total	100.00
Total Hydrogen Consumption SCFB	1088

[a]Designated as Hydrotreated Deashed Oil 3777-51

Table 15

Fluid Catalytic Cracking of Deashed Oil 3777-42

Plant 593, Run 303

Test No.	1	2
Operating Conditions		
P-P(base), psig	-10.0	-9.0
T-T(base), °C	-4	6
$\left[\frac{\text{Cat./Oil}}{\text{Cat./Oil(base)}}\right]$	1.02	0.99
Conversion, Vol-%	41.5	46.8
Product Distribution, Wt-%		
C_3-	3.9	5.3
C_4	1.8	1.9
C_5	1.5	1.5
C_6-EP Gasoline	17.3	19.8
Cycle Oil	60.1	55.3
Carbon	9.8	11.6
Wt. Recovery	94.4	95.4
Products, Vol-%		
C_5-EP Gasoline	23.1	26.2
Cycle Oil	58.5	53.2
Inspections of C_5-EP Gasoline		
°API @ 60°F	39.8	40.7
Sp. Gr. @ 60°F	0.8260	0.8217
Distillation, ASTM D-86		
IBP, °F	113	122
5%	145	153
10%	167	167
50%	271	367
90%	390	380
95%	404	403
EP	445	436
RON, Clear	← 97.3 →	
RON, 3 ml TEL/Gallon	← 101.3 →	
FIA, Vol-%		
A	47.2	50.0
O	26.2	20.9
P&N	26.6	29.1

Table 15 (Cont'd.)

Test No.	1	2
Properties of Cycle Oil		
°API @ 60°F	5.0	3.4
Sp. Gr. @ 60°F	1.0366	1.0489
Distillation, UOP No. 1		
IBP, °F	471	458
5%	492	477
10%	504	494
15%	512	504
% Over at 650°F	61.0	63.0
°API of 650°F⁻ @ 60°F	12.7	11.0
Sp. Gr. of 650°F⁻ @ 60°F	0.9813	0.9930
°API of 650°F⁺ @ 60°F	-5.2	-7.3
Sp. Gr. of 650°F⁺ @ 60°F	1.1203	1.1393
C_3-, Mole %		
H_2	52.2	43.0
C_1	17.2	21.4
C_2 (Total)	14.3	16.8
C_3 Olefins	13.0	13.8
C_3	3.3	5.0
Total	100.0	100.0
C_4, Vol-%		
C_4 Olefins	67.7	61.6
i-C_4	18.9	26.0
n-C_4	13.4	12.4
Total	100.0	100.0
C_5, Vol-%		
C_5 Olefins	72.4	59.5
i-C_5	23.8	34.8
n-C_5	3.8	5.7
Total	100.0	100.0

Table 16

Fluid Catalytic Cracking of Hydrotreated Deashed Oil 3777-46

Plant 593, Run 304

Test No.	1	2	3
Operating Conditions			
P-P(base), psig	-10.0	-10.0	-10.0
T-T(base), °C	3	6	4
$\left[\frac{\text{Cat./Oil}}{\text{Cat./Oil(base)}}\right]$	1.05	1.09	1.10
Conversion, Vol-%	58.2	57.0	57.2
Product Distribution, Wt-%			
C_3-	6.3	6.8	6.2
C_4	4.9	5.3	5.3
C_5	3.8	4.0	4.1
C_6-EP Gasoline	29.9	27.3	30.1
Cycle Oil	45.0	46.1	45.9
Carbon	6.3	6.3	6.6
Wt. Recovery	96.2	95.8	98.2
Products, Vol-%			
C_5-EP Gasoline	41.4	38.4	42.3
Cycle Oil	41.8	43.0	42.8
Inspections of C_5-EP Gasoline			
°API @ 60°F	47.2	41.5	47.2
Sp. Gr. @ 60°F	0.7918	0.8179	0.7918
Distillation, ASTM D-86			
IBP, °F	106	136	105
5%	129	168	129
10%	145	184	149
50%	241	262	236
90%	368	360	357
95%	387	375	372
EP	425	428	372
RON, Clear	←	94.8	→
RON, 3 ml TEL/Gallon	←	101.1	→
MON, Clear	←	81.5	→
MON, 3 ml TEL/Gallon	←	89.2	→
FIA, Vol-%			
A	41.4	50.3	40.7
O	11.0	9.3	10.4
P&N	47.6	40.4	48.9

Table 16 (Cont'd.)

Test. No.	1	2	3
Properties of Cycle Oil			
°API @ 60°F	3.3	3.6	3.7
Sp. Gr. @ 60°F	1.0497	1.0474	1.0466
Distillation, UOP No. 1			
IBP, °F	443	441	444
5%	459	460	460
10%	472	478	471
15%	481	487	480
% Over at 650°F	69.0	68.0	70.0
°API of 650°F$^-$ @ 60°F	9.8	10.2	9.8
Sp. Gr. of 650°F$^-$ @ 60°F	1.0014	0.9986	1.0014
°API of 650°F$^+$ @ 60°F	-8.9	-8.5	-8.4
Sp. Gr. of 650°F$^+$ @ 60°F	1.1542	1.1504	1.1495
C_3^-, Mole %			
H_2	50.5	52.0	51.9
C_1	12.4	12.8	12.2
C_2 (Total)	11.3	10.9	10.9
C_3 Olefins	19.0	18.2	18.6
C_3	6.8	6.1	6.4
Total	100.0	100.0	100.0
C_4, Vol-%			
C_4 Olefins	44.5	48.0	45.2
i-C_4	39.5	36.6	38.9
n-C_4	16.0	15.4	15.9
Total	100.0	100.0	100.0
C_5, Vol-%			
C_5 Olefins	36.3	51.2	38.0
i-C_5	57.4	44.0	56.1
n-C_5	6.3	4.8	5.9
Total	100.0	100.0	100.0

Table 17

Fluid Catalytic Cracking of Hydrotreated Deashed Oil 3777-46

Plant 593, Run 304

Test No.	5	6	7
Operating Conditions			
P-P(base), psig	-10	-9	-10
T-T(base), °C	32	26	31
$\left[\frac{\text{Cat./Oil}}{\text{Cat./Oil(base)}}\right]$	1.43	1.5	1.34
Conversion, Vol-%	59.8	58.4	62.4
Product Distribution, Wt-%			
C_3-	9.0	9.0	9.5
C_4	5.9	6.1	6.1
C_5 / C_6-EP Gasoline	35.9[a]	34.7[a]	35.5[a]
Cycle Oil	41.4[a]	43.0[a]	38.2[a]
Carbon	8.1	7.7	9.0
Wt. Recovery	100.3	100.5	98.3
Products, Vol-%			
C_5-EP Gasoline	43.6[a]	42.2[a]	42.7[a]
Cycle Oil	37.7[a]	39.6[a]	34.9[a]
Inspections of C_5-EP Gasoline			
°API @ 60°F	44.4[a]	45.0[a]	43.3[a]
Sp. Gr. @ 60°F	0.8044[a]	0.8017[a]	0.8095[a]
Distillation, ASTM D-86			
IBP, °F	96	102	104
5%	119	128	129
10%	136	144	143
50%	236	240	235
90%	353	358	350
95%	373	394	373
EP	411	436	415
RON, Clear	←	97.1	→
RON, 3 ml TEL/Gallon	←	101.8	→
MON, Clear	←	83.7	→
MON, 3 ml TEL/Gallon	←	88.5	→
FIA, Vol-%			
A	45.9	44.2	49.0
O	13.9	15.5	11.1
P&N	40.2	40.3	39.9

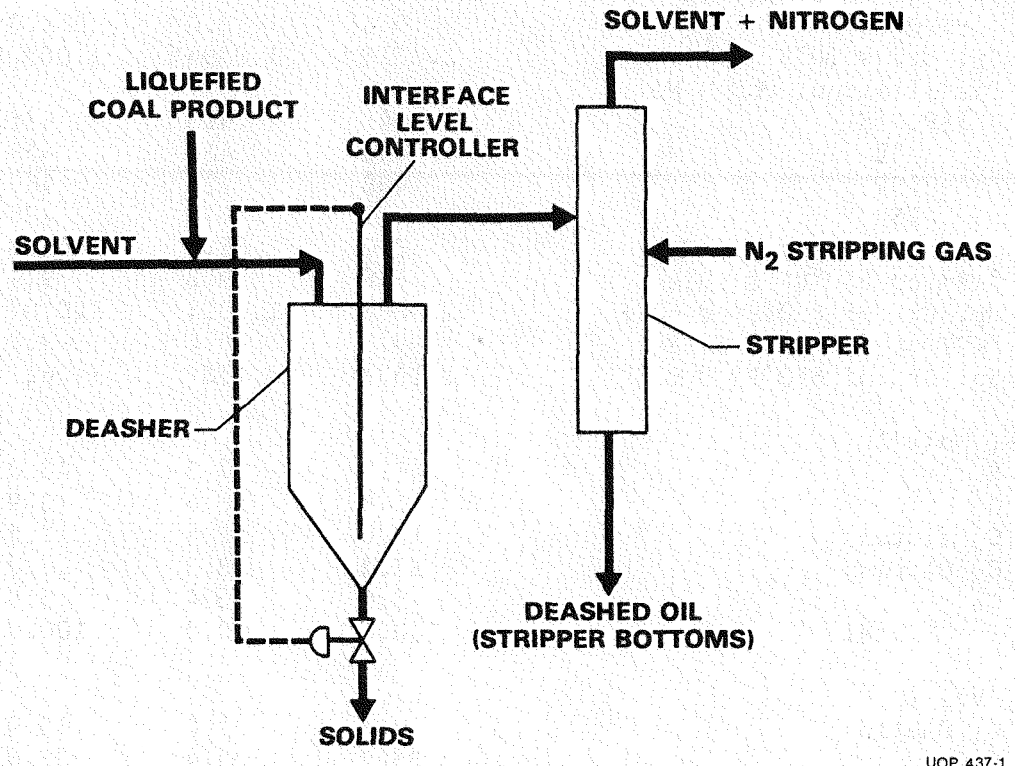
Table 17 (Cont'd.)

Test No.	5	6	7
Properties of Cycle Oil			
°API @ 60°F	0.6[a]	2.0[a]	1.0[a]
Sp. Gr. @ 60°F	1.0716[a]	1.0596[a]	1.0682[a]
Distillation, UOP - No. 1			
IBP, °F	444	423	438
5%	456	450	459
10%	468	465	469
15%	477	473	478
% Over at 650°F	68.0	67.0	67.0
°API of 650°F$^-$ @ 60°F	8.8	9.8	9.9
Sp. Gr. of 650°F$^-$ @ 60°F	1.0086	1.0014	1.0107
°API of 650°F$^+$ @ 60°F	-9.8	-9.4	-9.7
Sp. Gr. of 650°F$^+$ @ 60°F	1.1627	1.1589	1.1617
C_3-, Mole %			
H_2	48.9	47.3	48.0
C_1	15.8	16.6	16.9
C_2 (Total)	12.0	12.4	12.5
C_3 Olefins	17.3	18.3	16.0
C_3	6.0	5.4	6.6
Total	100.0	100.0	100.0
C_4, Vol-%			
C_4 Olefins	49.7	52.0	45.9
$\underline{i}$-C_4	36.7	35.4	38.6
$\underline{n}$-C_4	13.6	12.6	15.5
Total	100.0	100.0	100.0
C_5, Vol-%			
C_5 Olefins	39.8	42.1	33.9
$\underline{i}$-C_5	54.8	52.7	59.3
$\underline{n}$-C_5	5.4	5.2	6.8
Total	100.0	100.0	100.0

[a]Adjusted

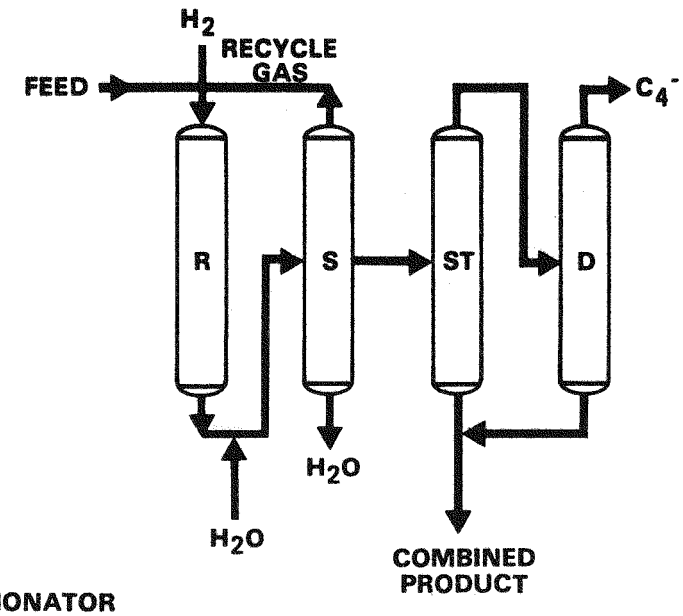
FIGURE 1

UOP DEASHING UNIT



UOP 437-1

FIGURE 2
BENCH-SCALE UNIT FOR HYDROTREATING



LEGEND

D = DEBUTANIZER
R = REACTOR
S = SEPARATORS
ST = STRIPPER
VF = VACUUM FRACTIONATOR

UOP 197D-24

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