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SRC-II PROCESSING OF PITTSBURGH SEAM (ROBINSON RUN AND
POWHATAN MINES) COAL IN PROCESS DEVELOPMENT UNIT P99

Interim Report for the Period August—November 1978

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The Pittsburg & Midway Coal Mining Co.
Denver, Colorado



U. S. DEPARTMENT OF ENERGY

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VOLUME VI - PROCESS DEVELOPMENT UNIT STUDIES
PART 1 - SRC-II PROCESSING OF PITTSBURGH SEAM
COAL FROM ROBINSON RUN AND POWHATAN MINES

FOR THE PERIOD
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THE PITTSBURGH & MIDWAY COAL MINING CO.
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U.S. DEPARTMENT OF ENERGY

Division of Coal Conversion and Utilization

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ABSTRACT

This report presents the results of seven SRC-II runs on Process Development Unit P99 feeding Pittsburgh Seam coal. Four of these runs (Runs 41-44) were made feeding coal from the Robinson Run Mine and three (Runs 45-47) were made feeding a second shipment of coal from the Powhatan No. 5 Mine. This work showed that both these coals are satisfactory feedstocks for the SRC-II process. Increasing dissolver outlet hydrogen partial pressure from approximately 1300 to about 1400 psia did not have a significant effect on yields from Robinson Run coal, but simultaneously increasing coal concentration in the feed slurry from 25% to 30 wt% and decreasing the percent recycle solids from 21% to 17% lowered distillate yields. With the Powhatan coal, a modest increase in the boiling temperature (approximately 35°F at the 10% point) of the process solvent had essentially no effect on product yields, while lowering the average dissolver temperature from 851°F to 842°F reduced gas yield.

I. SUMMARY

This report covers work on the SRC-II processing in Process Development Unit P99 of two samples of Pittsburgh Seam coal, one from the Robinson Run Mine and the other from the Powhatan No. 5 Mine. This work has shown that satisfactory distillate yields can be produced from Pittsburgh Seam coal from the Robinson Run Mine under typical SRC-II conditions (851°F, 2000 psig, 1 hour slurry residence time, and 30 wt% coal in the feed slurry). Yields are comparable to those obtained from Kentucky coal and Pittsburgh Seam coals from the Ireland, Powhatan, and Valley Camp Mines and are better than those obtained from Blacksville Mine coal.

Product yields from the Robinson Run coal were essentially unaffected by increasing dissolver outlet hydrogen partial pressure from 1300 psia to 1400 psia. The yields of distillate and C_1-C_4 gases were significantly reduced and the yield of 900°F+ pyridine solubles was increased by increasing the feed slurry coal concentration from 25% to 30% while decreasing the percent recycle solids from 21% to 17%. Specifically, the $C_5-900^\circ\text{F}$ distillate yield was reduced by 3%, the yield of C_1-C_4 gases was reduced by 1%, and the 900°F+ pyridine solubles yield was increased by 3% on a moisture-free coal basis.

The second shipment of Powhatan coal proved to be less reactive than the first shipment. There were several differences between the two shipments, but the reason for the lower reactivity of the second shipment cannot be definitely determined. Work with this shipment of Powhatan coal indicated that a small increase in the boiling range of the solvent in the feed to the preheater did not have a significant effect on yields, but lowering the average dissolver temperature from 851°F to 842°F reduced the gas yield.

II. INTRODUCTION

This is the fourth in a series of reports⁽²⁻⁴⁾ on the SRC-II processing of Pittsburgh Seam coals in Process Development Unit P99. This report covers work on Robinson Run coal and a second shipment of Powhatan coal. The primary objectives of this work were to assess the suitability of the Robinson Run (Pittsburgh Seam) coal as a feed for the SRC-II process and to learn more about the effects of process conditions on product yields from Powhatan coal.

III. EXPERIMENTAL

This section describes the coals used and the operating conditions for the runs discussed in this report.

A. Coals

The two coals used in this work are of high volatile bituminous (A) rank from the Pittsburgh Seam. The Robinson Run coal (LR-25447) was an unwashed coal from Consolidation Coal Company's Robinson Run Mine near Shinston, West Virginia. It was obtained from the Harrison Power Plant at Heywood, West Virginia, in July, 1978, and was dried and ground to 200 mesh by Empire Coke Company in Alabama. The Powhatan coal (LR-25734) was a washed coal from North American Coal Company's Powhatan No. 5 Mine at Powhatan Point, Ohio. It was obtained in October, 1978, and shipped to the Conoco Coal Research Laboratory at Library, Pennsylvania, where it was dried and ground to approximately 80 mesh. The purchase order for this coal specified that it should contain approximately 12% ash.

It was necessary to use Conoco to grind the Powhatan coal because of a strike at Empire Coke. The grinding and drying procedures used by Empire Coke and Conoco were somewhat different. Conoco used a higher temperature (210°F) than Empire (115°F) at the outlet of the dryer but a lower oxygen concentration (3% vs 15%) and a short residence time (approximately 30 sec).

This same equipment and procedure were used by Conoco for drying subbituminous coals for their liquefaction studies, and they observed no adverse effect on liquefaction yields.

Three analyses were obtained on each coal: two by the Analytical Technology Department of Gulf Science and Technology Company and one by Commercial Testing and Engineers Company. The results are generally in good agreement. Table I gives the analyses for the Robinson Run coal, and Table II gives the results for the Powhatan coal. These tables also give the values used in the data work-up. In general, the values used in the data work-up were close to the average values. However, slight adjustments were made to obtain better overall elemental balances.

In Tables III and IV, these two coals are compared with each other and with Kentucky and other Pittsburgh Seam coals run in P99. Table III gives the elemental and proximate analyses, and Table IV gives maceral compositions. Since maceral analyses were not obtained on the actual batches of Kentucky and Ireland coals run in P99, the maceral composition of the Kentucky coal run at Ft. Lewis, Washington, and that of a sample of Ireland coal directly from the mine are given in Table IV. Comparisons of the coals are discussed in the following sections.

1. Comparison of the First and Second Shipments of Powhatan Coal

Compared to the first shipment of Powhatan coal (LR-24924) which was ground and dried by Empire Coke, the second shipment (LR-25734) contained slightly more oxygen (12.97 vs. 11.62% on a moisture-free basis) and iron (1.89 vs. 1.76%). This can be attributed to the second shipment's higher ash content (12.2 vs. 9.5%). The oxygen contents on a moisture-mineral-free basis are the same for both shipments (see Table III). Therefore, there is no evidence that the coal prepared by Conoco is any more oxidized than that prepared by Empire Coke. However, since very small amounts of surface oxidation may affect reactivity, it is difficult to draw definite conclusions from bulk oxygen analyses.

TABLE I

ANALYSIS OF PITTSBURGH SEAM COAL FROM THE ROBINSON RUN MINE (LR-25447)

Coal Sample	Bin 25 8-9-78	Bin 5 8-9-78	Commercial Testing 10-12-78	Used in Data Work-up
Basis	As Rec'd	As Rec'd	Dry	Dry, Normalized to 100%
Elemental Analysis, wt%				
Carbon	68.72	68.00	69.14	68.30
Hydrogen	4.89	4.77	4.70	4.94
Nitrogen	1.29	1.28	1.35	1.28
Sulfur	3.42	3.68	3.56	3.18
Oxygen	13.3	13.3	-	13.69
Chlorine	0.05	0.05	0.02	-
Metals				8.61
Ash, wt%	16.0	16.8	15.78	16.46
Sulfur, wt% of Ash	2.38	2.36		2.25
Oxygen, wt% of Ash	48.2	47.3		45.4
Moisture, wt%	0.88	1.01	(1.35)	0.95
Spectral Ash Analysis				
Metals, Wt% of Ash				
Al	15	15	10.8	
Ba	Trace	Trace	0.1	
B	0.1	0.09	-	
Ca	3	3	3.7	
Cr	0.03	0.02	-	
Cu	0.006	0.008	-	
Fe	10	10	12.9	
Mg	2	2	0.9	
Mn	0.2	0.1	-	
K	1.3	1.3	2.0	
Si	20	20	20.6	
Na	0.4	0.4	0.5	
Sr	0.2	0.2	-	
Ti	1	1	0.5	
V				
Proximate Analysis, wt% of As Rec'd Coal				
Moisture	0.9	1.0	1.4	
Ash	16.0	16.8	15.6	
Volatile	34.4	34.4	36.1	
Sulfur Types, wt%				
Pyritic Sulfur	2.06	2.31	2.17	
Sulfate Sulfur	0.09	0.10	0.07	
Inorganic Sulfur	2.75	2.41	2.24	
Organic Sulfur	0.67	1.27	1.32	
Total Sulfur	3.42	3.68	3.56	
Particle Size Distribution, wt%				
on 80 mesh	0	0		
thru 80 on 200	4.4	3.4		
thru 200 on 325	21.4	19.9		
thru 325 on 625	35.0	36.4		
thru 625 mesh	39.2	40.3		
Iron, wt%	1.91			

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TABLE II
ANALYSIS OF PITTSBURGH SEAM COAL FROM THE POWHATAN MINE (SECOND SHIPMENT)
(LR-25734)

Coal Sample	10-20-78 Bin 1	11-4-78	Commercial Testing	Used in Data Work-up
Basis	As Rec'd	As Rec'd	Dry	Dry, Normalized to 100%
Elemental Analysis, Wt%				
Carbon	71.64	70.38	70.82	70.96
Hydrogen	5.08	4.93	4.93	4.92
Nitrogen	1.29	1.28	1.52	1.29
Sulfur	3.22	3.17	3.98	3.20
Oxygen	15.8	15.9	-	12.97
Chlorine	-	-	0.03	-
Metals	-	-	-	6.67
Ash, Wt%	10.9	11.4	12.43	12.19
Sulfur, Wt% of Ash	0.9	0.7	-	0.8
Oxygen, Wt% of Ash	52.1	50.7	-	44.5
Moisture, Wt%	0.83	0.78	(1.1)	0.81
Spectral Ash Analysis				
Metals, Wt% of Ash				
Al	15	10	12.0	-
Ba	-	-	-	-
B	-	0.09	-	-
Ca	0.9	0.7	2.0	-
Cr	0.03	0.02	-	-
Cu	0.004	0.005	-	-
Fe	15	10	7.6	-
Mg	0.8	0.6	0.5	-
Mn	0.1	0.007	0.04	-
Ni	0.1	0.01	-	-
P	0.7	-	0.1	-
K	1.2	1.1	1.61	-
Si	25	20	20.7	-
Na	0.3	0.1	0.4	-
Sr	0.09	0.05	-	-
Ti	-	0.7	0.55	-
V	-	0.06	-	-
Zn	-	0.2	-	-
Proximate Analysis, Wt% of As Rec'd Coal				
Moisture	0.6	1.3	1.1	-
Ash	10.8	12.1	12.3	-
Volatile	38.7	37.1	39.1	-
Sulfur Types, Wt%				
Pyritic Sulfur	1.42	1.60	2.14	-
Sulfate Sulfur	0.02	0.08	0.01	-
Inorganic Sulfur	1.44	1.68	2.15	-
Organic Sulfur	1.78	1.49	1.83	-
Total Sulfur	3.22	3.17	3.98	-
Particle Size Distribution, Wt%				
on 80 Mesh	0.7	0.4	-	-
thru 80 on 200	32.9	35.5	-	-
thru 200 on 325	24.9	18.6	-	-
thru 325 on 625	22.1	21.1	-	-
thru 625 mesh	19.4	24.4	-	-
Iron, Wt%	1.89	-	-	-

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TABLE III
PROPERTIES OF COALS RUN IN P99

Coal Sample No., LR-	KY #9 & #14 22366	Blacksville 24001	Ireland 22991	First Powhatan 24924	Valley Camp 24925	Robinson Run 25447	Second Powhatan 25734
Elemental Analyses, Wt% of Moisture-Free Coal							
Carbon	71.16	72.50	67.55	73.41	74.03	68.30	70.96
Hydrogen	5.11	4.63	4.60	5.10	5.19	4.94	4.92
Pyritic Sulfur	1.21	1.48	2.29	1.73	1.54	2.49	1.51
Organic Sulfur	2.03	1.10	2.09	1.64	1.34	0.69	1.69
Total Sulfur	3.24	2.58	4.38	3.37	2.88	3.18	3.20
Nitrogen	1.53	1.46	1.20	1.29	1.43	1.28	1.29
Oxygen	13.80	12.05	14.07	11.62	11.19	13.69	12.97
Metals	5.16	6.77	8.20	5.21	5.28	8.61	6.67
Iron	1.0	0.82	2.14	1.76	1.58	1.91	1.89
H/C Atomic Ratio	0.86	0.77	0.82	0.83	0.84	0.87	0.83
Moisture Content, Wt% of As-Received Coal	2.0	0.7	0.5	0.8	0.7	1.0	0.8
Volatile, Wt% of As-Received Coal	37.0	34.0	34.9	38.1	37.8	34.4	38.7
Ash, Wt% of Moisture-Free Coal	9.1	13.1	15.6	9.5	8.9	16.5	12.2
Analyses of Coal Substance, Wt% Moisture Mineral-Free Coal*							
Volatile	41.3	40.0	42.3	42.9	42.2	42.6	45.0
Carbon	79.5	85.2	82.5	82.7	82.7	84.5	82.5
Hydrogen	5.7	5.4	5.6	5.7	5.8	6.0	5.7
Nitrogen	1.7	1.7	1.5	1.5	1.6	1.6	1.5
Oxygen**	10.8	6.3	7.9	8.3	8.4	7.0	8.3
Sulfur	2.3	1.4	2.5	1.8	1.5	0.9	2.0

*Mineral Matter = 1.08 x ash content + 0.55 x pyritic sulfur content.

**By difference

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TABLE IV
COAL MACERAL AND REFLECTANCE ANALYSES

Coal LR-	Blacksville #2 24001	First Powhatan 24924	Valley Camp 24925	Robinson Run 25447	Second Powhatan 25734	Kentucky* LS-8629-A	Ireland** LS-8628
Vitrinite							
Type 5	-	-	-	-	-	-	-
" 6	-	19.3	26.9	5.8	29.6	26.8	44.2
" 7	17.7	52.3	43.5	45.2	48.2	51.9	34.8
" 8	59.3	8.9	8.7	20.4	-	-	-
" 9	-	-	-	-	-	-	-
	<u>77.0</u>	<u>80.5</u>	<u>79.0</u>	<u>72.9</u>	<u>77.8</u>	<u>78.7</u>	<u>79.0</u>
Exinite							
Exinite	6.1	5.2	6.0	6.9	3.8	7.6	5.3
Resinite	0.5	0.9	0.6	1.7	1.0	0.9	1.2
	<u>6.6</u>	<u>6.1</u>	<u>6.6</u>	<u>8.6</u>	<u>4.8</u>	<u>8.5</u>	<u>6.5</u>
Inertinite							
Semi-Fusinite	3.2	3.2	3.0	5.5	4.1	5.0	5.6
Semi-Macrinite	0.6	0.6	0.5	0.8	0.6	0.2	0.5
Fusinite	4.9	3.0	4.3	2.4	2.7	3.5	4.1
Macrinite	1.9	1.9	1.1	1.8	1.7	0.3	0.9
Micrinite	5.8	4.7	5.2	8.0	8.3	3.8	3.4
	<u>16.4</u>	<u>13.4</u>	<u>14.4</u>	<u>18.5</u>	<u>17.4</u>	<u>12.8</u>	<u>14.5</u>
Mean Max Reflectance of Vitrinite	0.82	0.73	0.73	0.77	0.70	0.71	0.71

* Sample from Fort Lewis
** Sample from Mine

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Comparison of the maceral compositions for these two shipments shows that the second shipment contains less vitrinite (77.8 vs. 80.5%) and less exinite (4.8 vs. 6.1%) but more inertinite (17.4 vs. 13.4%). However, the vitrinite of the second shipment is of lower rank as indicated by its lower mean maximum reflectance (0.70 vs. 0.73) and higher percentage of type 6 vitrinite. One of these factors (higher inertinite content) would indicate lower reactivity for the second shipment; whereas, the other factor (vitrinite being of lower rank) would indicate increased reactivity. Our knowledge of maceral effects on SRC-II yields is not precise enough at this time for estimating which of these effects predominates.

Another difference between the two shipments is the particle size distribution. The second shipment contains about 35% of particles larger than 200 mesh (75 microns), while the first shipment contains only 4% larger than 200 mesh (see Table V).

2. Comparison of Robinson Run and Powhatan Coals

Table III shows that the Robinson Run coal contains considerably more ash (16.5 vs 9.5 and 12.2%) but only slightly more iron (1.91 vs. 1.76 and 1.89%) than the two shipments of Powhatan coal. Although the hydrogen-to-carbon ratio is slightly higher (0.87 vs. 0.83) for the Robinson Run coal than for the Powhatan coal, the Robinson Run coal contains more carbon (84.5 vs 82.5%), less oxygen (7.0 vs 8.3%), and less sulfur (0.9 vs 2.0%) than the Powhatan coal on a moisture-mineral-free basis. Therefore, the Robinson Run coal appears to be of higher rank than the Powhatan coal. Based on the above analyses, Robinson Run coal would be expected to be somewhat less reactive in SRC-II processing. This conclusion is also substantiated by the comparison of the maceral compositions of the two coals. The Robinson Run coal contains considerably less vitrinite, types 6 and 7 in particular, slightly more exinite, and significantly more inertinite than the Powhatan coal (see Table IV).

TABLE V
PARTICLE SIZE DISTRIBUTION OF POWHATAN COAL SHIPMENTS

Size Distribution, Wt%	First Shipment (LR-24924)	Second Shipment (LR-25734)
On 60 mesh	0	0.1
Thru 60 on 80 mesh	0	0.3
Thru 80 on 200 mesh	3.9	35.5
Thru 200 on 325 mesh	20.6	18.6
Thru 325 on 625 mesh	35.7	21.1
Thru 625 mesh	39.8	24.4

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3. Comparison to Kentucky Coal

Both the Robinson Run coal and the second shipment of Powhatan coal contain more ash and iron than the Kentucky coal. On a moisture-mineral-free basis, their carbon contents are higher, and their oxygen contents are lower than those of the Kentucky coal (see Table III).

Table IV indicates that the Powhatan coal contains about as much vitrinite as the Kentucky coal. It contains less exinite but more inertinite. The mean maximum reflectances for the two coals are about the same. The Robinson Run coal contains substantially less vitrinite and more inertinite than the Kentucky coal; in addition, the vitrinite is of higher rank as indicated by the higher mean maximum reflectance. Based on the above considerations, it is estimated that the Powhatan coal should have a reactivity similar to that of the Kentucky coal, while the Robinson Run coal should be less reactive.

4. Comparison to Other Pittsburgh Seam Coals

Compared to Pittsburgh Seam coals from other mines, the second shipment of Powhatan coal is similar to the Ireland and Valley Camp coals in elemental analyses on a moisture-mineral-free basis, while its ash and iron contents lie between those of the Ireland and Valley Camp coals. The second shipment of Powhatan coal contains significantly less vitrinite and more inertinite than the Ireland and Valley Camp coals; however, the vitrinite is of slightly lower rank. The second shipment of Powhatan coal is of lower rank than the Blacksville coal; its carbon content is lower and its hydrogen-to-carbon ratio is higher. In addition, the vitrinite is mainly of types 6 and 7, while that of the Blacksville coal is mainly of type 8.

The Robinson Run coal is similar to the Blacksville coal in elemental analyses based on moisture-mineral-free coal except for slightly higher hydrogen and lower oxygen. Accordingly, the hydrogen-to-carbon ratio is higher for the Robinson Run coal (0.87) than for the Blacksville coal (0.77). The Robinson Run coal also contains more ash (16.7% vs. 13.1%) and iron (1.91%

vs. 0.82%) than the Blacksville coal. In addition, the majority of the vitrinite in the Robinson Run coal is of types 6 and 7 rather than types 7 and 8 as in the Blacksville coal. Therefore, the Robinson Run coal, in spite of a slightly higher inertinite content, should be more reactive than the Blacksville coal in SRC-II processing.

Both elemental and maceral analyses show that the Robinson Run coal is of higher rank than the Ireland and Valley Camp coals. It contains considerably less vitrinite, types 6 and 7 in particular, and more inertinite. Therefore, the Robinson Run coal should be less reactive than the Ireland and Valley Camp coals, in spite of its higher exinite, ash, and iron contents.

B. Process Flow

Process flow was unchanged from that described in detail in Reference 4.

C. Data Work-up

As with process flow, the method of data work-up was discussed in detail in Reference 4. At each run condition, several material balance periods were obtained, and the yields for each period were calculated. Run average yields were calculated for each run condition by adding together all the hours from all the acceptable periods for that run, as if it were one long period, and using average values of the analytical data from the individual periods for that run.

D. Description of Runs

Four runs were made on the Robinson Run coal (Runs 41, 42, 43 and 44) and three runs on the second shipment of Powhatan coal (Runs 45, 46 and 47). The operating conditions for these runs are summarized in Table VI.

TABLE VI
SUMMARY OF OPERATING CONDITIONS

Run No. P99-	<u>41</u>	<u>42</u>	<u>43</u>	<u>44</u>	<u>45</u>	<u>46</u>	<u>47</u>
Temperature, °F							
Dissolver	851	851	851	851	851	851	842
Preheater Outlet	730	734	738	730	745	732	730
Pressure, psig	2000	2000	2000	2000	2000	2000	2000
WHSV, lb/hr/ft ³							
Slurry	75.6	75.6	76.2	75.6	76.1	75.5	75.5
As-Received Coal	22.5	18.7	18.7	22.5	22.5	22.5	22.5
Nominal Slurry Residence time, hr	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Slurry Composition, Wt%							
Coal (moisture-free)	29.4	24.5	24.4	29.5	29.4	29.7	29.5
Distillate	35.8	32.5	32.7	32.8	32.4	33.3	33.5
900°F+ Pyridine Solubles	18.8	22.1	21.8	20.4	23.8	23.7	23.9
Pyridine Insolubles	16.0	20.9	21.1	17.3	14.4	13.3	13.1
Dissolver Gas							
10 ³ SCF/Ton Slurry	14.8	12.5	11.8	13.5	14.8	14.8	14.8
10 ³ SCF/Ton Feed Coal	50.3	50.8	48.1	45.8	50.5	50.1	50.2
Hydrogen Content, Vol%	94.1	94.2	90.1	90.1	90.2	90.1	89.8
H ₂ Partial Pressure at Dissolver Outlet, psia ⁽⁵⁾	1428	1401	1296	1298	1310	1316	1342

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1. Robinson Run Coal

The four runs on the Robinson Run coal constitute a 2^2 factorial experiment (see Table VII), varying slurry feed coal concentration (25 and 30% by wt) and dissolver outlet hydrogen partial pressure (approximately 1300 and 1400 psia). Since the total solids level in the feed slurry was kept approximately constant, the percentage of recycle solids in the feed slurry varied concurrently with coal concentration; thus, these two factors are confounded. The other operating conditions were:

Temperature:	851°F
Dissolver Pressure:	2000 psig
Nominal Slurry Residence Time:	1 hour

2. Second Shipment of Powhatan Coal

Operating conditions for Runs 45 and 46 on the second shipment of Powhatan coal differed only in the boiling range of the recycled process solvent. For Run 45 the 10% boiling point of the recycled solvent was about 35°F higher than for Run 46 (see Figure 1). The higher boiling temperature of the recycled process solvent in Run 45 was accomplished by raising the atmospheric flash tower temperature by 49°F and the fractionator reflux control temperature by 13°F. Because this was the first attempt to alter the boiling range of the recycle solvent, there was no previous experience to guide operations, and the increase in boiling range was not as high as desired. However, the distillation columns operated quite satisfactorily at the higher cut points. Run 47 was made at the same conditions as Run 46, except that dissolver temperature was lowered to 842°F from 851°F. The other conditions for the Powhatan runs were 30% coal in the feed slurry, one hour nominal slurry residence time, and 2000 psig pressure.

TABLE VII
DESIGN FOR 2² FACTORIAL EXPERIMENT^a

	<u>Factors</u>			<u>Levels</u>
	Feed Slurry Coal Concentration ^b , % by wt Dissolver Outlet H ₂ Partial Pressure, psia			30 and 25 1300 to 1400
Run No. P99-	<u>41</u>	<u>42</u>	<u>43</u>	<u>44</u>
Coal Concentration	+	-	-	+
H ₂ Partial Pressure	+	+	-	-

- indicates lower value of level

+ indicates higher value of level

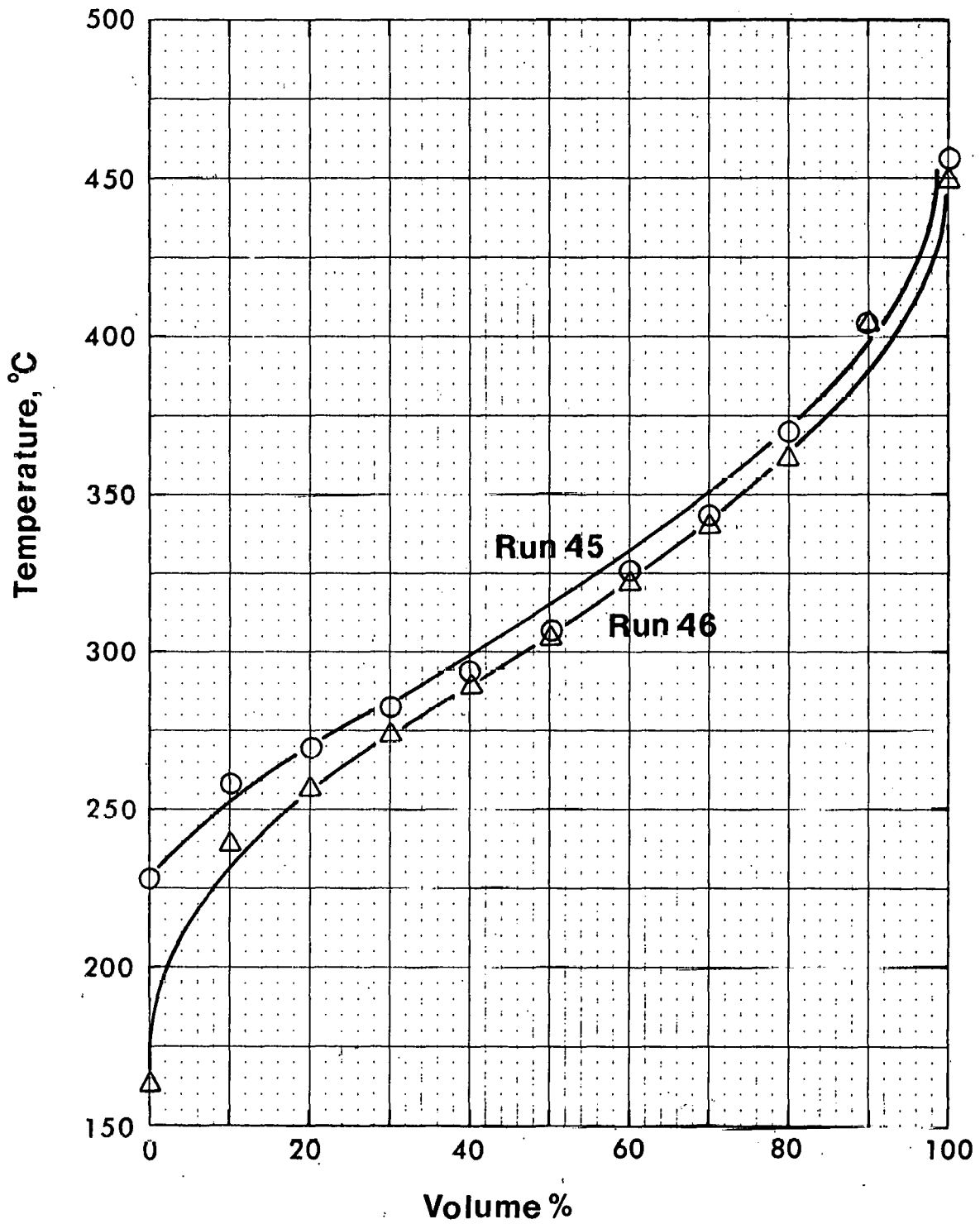
^a Temperature of 851°F, nominal slurry residence time of 1 hr.

^b Pyridine insolubles (recycle solids) in feed slurry approximately 17% for 30% coal concentration and 21% for 25% coal concentration.

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Figure 1

CUSHMAN DISTILLATION OF PROCESS SOLVENT
FROM P99 FOR RUNS 45 & 46



IV. DISCUSSION

The average yields for Runs 41 to 47 are summarized in Tables VIII (Robinson Run) and IX (Powhatan). Average data for these runs are given in Appendix A, and the detailed results for the individual periods are given in Appendix B for the Robinson Run coal and in Appendix C for the second shipment of Powhatan coal. The average data were calculated as described in Section III.C.

Before discussing the experimental results, some comments on the reliability of the data are given below.

A. Reliability of Data

Several operating problems were encountered while running the Robinson Run coal (See Appendix D). In particular, considerable difficulties were experienced with operation of the fractionation system. During Run 41, cut points were not at desired levels. Part way into the on-stream period, it was found that the primary condenser on the vacuum column was partially plugged and not functioning properly. (This was discovered when condensate began appearing in the trap downstream of the secondary condenser. The material from this trap was taken into account when calculating solvent yields.) Later, the condenser plugged completely and had to be replaced. Shortly thereafter, the demister pad in the vacuum column plugged, forcing replacement of the column. Flash column level control was upset on several occasions. Also, there were problems with the debutanizer off gas meter during Run 41, which prevented obtaining accurate rates for this stream. Therefore, debutanizer gas rates for Run 41 were estimated based on values obtained for Runs 42 to 44.

For the reasons mentioned above, the data from the Robinson Run runs may be less reliable than that from most of the other runs on Pittsburgh Seam coal. This is borne out by the error mean squares based on yield differences among periods for the same run, which are considerably greater for the Robinson Run coal than for runs on Kentucky⁽¹⁾, Blacksville⁽²⁾, Ireland⁽³⁾, Powhatan and Valley Camp⁽⁴⁾ coals (see Table X).

TABLE VIII
SUMMARY OF SRC-II YIELDS WHEN FEEDING PITTSBURGH SEAM COAL
FROM THE ROBINSON RUN MINE (LR-25447)

Run No. P99-	<u>41</u>	<u>42</u>	<u>43</u>	<u>44</u>
Nominal Operating Conditions				
Dissolver Temperature, °F	851	851	851	851
Pressure, psig	2 000	2 000	2 000	2 000
Residence Time, hr	1.0	1.0	1.0	1.0
Coal in Feed Slurry, wt%	30	25	25	30
Pyridine Insolubles in Feed Slurry, wt%	16	21	21	17
H ₂ Partial Pressure at Dissolver Outlet, psia	1 430	1 400	1 300	1 300
Yield, Wt% Moisture Free Coal				
Hydrogen	-3.7	-4.0	-4.0	-3.5
Methane	5.1	5.3	5.3	4.8
Ethane	3.7	3.8	3.8	3.5
Propane	3.7	3.9	3.9	3.5
Isobutane	0.2	0.2	0.2	0.2
N-Butane	2.0	2.1	2.1	1.8
Total C ₁ to C ₄	<u>14.7</u>	<u>15.3</u>	<u>15.3</u>	<u>13.8</u>
Ammonia	0.5	0.5	0.5	0.4
Hydrogen Sulfide	1.7	1.9	1.9	1.8
Carbon Dioxide	0.7	0.6	0.8	0.8
Carbon Monoxide	0.2	0.2	0.2	0.2
Total Other Gases	<u>3.1</u>	<u>3.2</u>	<u>3.4</u>	<u>3.2</u>
Water	4.8	5.3	5.4	4.3
C ₅ - 380°F	8.7	9.5	8.7	7.6
380 - 550°F	11.8	15.7	14.3	14.3
550 - 900°F	12.7	11.1	13.9	12.0
Total C ₅ + Distillate	<u>33.2</u>	<u>36.3</u>	<u>36.9</u>	<u>33.9</u>
900°F+ Pyridine Solubles	23.9	21.3	20.6	24.9
Insoluble Organic Matter	7.5	6.1	5.9	6.9
Ash	16.5	16.5	16.5	16.5
Total 900°F+ Product	<u>47.9</u>	<u>43.9</u>	<u>43.0</u>	<u>48.3</u>
380-900°F	24.5	26.8	28.2	26.3

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TABLE IX
SUMMARY OF SRC-II YIELDS WHEN FEEDING PITTSBURGH SEAM COAL
FROM THE POWHATAN MINE (SECOND SHIPMENT) (LR-25734)

Run No. P99-	<u>45</u>	<u>46</u>	<u>47</u>
Nominal Operating Conditions			
Dissolver Temperature, °F	851	851	842
Pressure, psig	2000	2000	2000
Residence Time, hr	1.0	1.0	1.0
Coal in Feed Slurry, wt%	30	30	30
Pyridine Insolubles in Feed Slurry, wt%	14	13	13
H ₂ Partial Pressure at Dissolver Outlet, psia	1310	1316	1342
Yield, Wt% Moisture Free Coal			
Hydrogen	-3.8	-3.8	-3.5
Methane	5.3	5.3	4.8
Ethane	3.7	3.8	3.4
Propane	3.4	3.5	3.0
Isobutane	0.2	0.2	0.2
N-Butane	1.6	1.7	1.5
Total C ₁ to C ₄	<u>14.2</u>	<u>14.5</u>	<u>12.9</u>
Ammonia	0.4	0.4	0.4
Hydrogen Sulfide	2.0	2.0	1.9
Carbon Dioxide	1.2	1.0	1.0
Carbon Monoxide	0.2	0.2	0.2
Total Other Gases	<u>3.8</u>	<u>3.6</u>	<u>3.5</u>
Water	6.2	5.8	6.0
C ₅ - 380°F	10.0	8.0	7.5
380 - 550°F	12.0	13.9	13.5
550 - 900°F	11.0	11.6	11.8
Total C ₅ + Distillate	<u>33.0</u>	<u>33.5</u>	<u>32.8</u>
900°F+ Pyridine Solubles	28.0	28.7	31.1
Insoluble Organic Matter	6.4	5.5	5.0
Ash	12.2	12.2	12.2
Total 900°F+ Product	<u>46.6</u>	<u>46.4</u>	<u>48.3</u>
380-900°F	23.0	25.5	25.3

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TABLE X

ERROR MEAN SQUARES BASED ON YIELD
DIFFERENCES AMONG PERIODS WITHIN THE SAME RUN

Runs Covered, P99-	41-44	15-39	45-47	15-47
Degrees of Freedom	17	59	10	86
H ₂ Consumption	0.02	0.01	0.01	0.01
C ₁ -C ₄	0.08	0.33	0.06	0.25
CO, CO ₂ , H ₂ S, NH ₃	0.02	0.01	0.01	0.01
Water	0.21	0.05	0.06	0.08
C ₅ -380°F	1.59	0.35	0.92	0.66
380-550°F	3.30	0.66	1.33	1.26
550-900°F	6.87	1.03	1.29	2.22
900°F+ Pyridine Solubles	2.49	1.45	2.23	1.74
IOM	1.35	0.45	0.67	0.65
C ₅ -900°F	3.26	1.65	2.33	2.05
380-900°F	4.69	1.79	1.95	2.38
Total 900°F+ Product	4.33	1.55	2.45	2.20

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The runs feeding the second shipment of Powhatan coal were relatively trouble-free until a leak in a high pressure line caused a premature termination of Run 47. No problems were encountered that could be attributed to operating with the larger coal particle size.

The chronology of operations and the problems which occurred during Runs 41 to 47 are detailed in Appendix D.

B. Analysis of Robinson Run Coal Runs

The process variables examined in the 2^2 factorial experiment on the Robinson Run coal were coal concentration in the feed slurry and hydrogen partial pressure. The two levels of coal concentration in the feed slurry were 25 and 30 wt %, and the two levels of hydrogen partial pressure were approximately 1300 psia and 1400 psia at the dissolver outlet. Since the total solids level in the feed slurry was kept fairly constant, the recycled solids (pyridine insolubles in the slurry recycle stream) were reduced from about 21% to about 17% as the coal concentration was increased from 25% to 30%. Therefore, the effect of coal concentration is confounded with the effect of recycle solids level.

The effects of coal concentration and hydrogen partial pressure on yields were analyzed by the Yates technique. In order to estimate whether these effects were significant, it was necessary to have estimates of the error mean squares. These were calculated from within the run sums of squares divided by the appropriate degrees of freedom. The error mean squares for the four runs on Robinson Run coal were considerably greater than those for previous runs on P99 (see Table X). The pooled error mean squares for all runs made on P99 (last column of Table X) are believed to be the best estimates of the experimental error and were, therefore, used in the F-tests of the Yates analysis to determine the significance of the effects.

1. Effect of Coal/Recycle Solids Concentration in the Feed Slurry

As shown by Table XI, the confounded effect of coal and recycle solids concentrations in the feed slurry had a significant effect on yields. In general, increasing the coal concentration from 25% to 30% while simultaneously decreasing the recycle solids from 21% to 17% resulted in reduced conversion. Hydrogen consumption was reduced about 0.4%, C_1 - C_4 gases yield was reduced about 1%, and C_5 -900°F distillate yield was decreased about 3%. The total 900°F+ product was increased almost 5%, as a result of a 3.5% increase in 900°F+ pyridine solubles and a 1.2% increase in IOM (pyridine insoluble organic matter.)

2. Effect of Hydrogen Partial Pressure

Increasing hydrogen partial pressure from 1300 to 1400 psia had essentially no effect on yields. This result is somewhat surprising, since in most previous work, increasing the partial pressure of hydrogen had a beneficial effect on yields. As mentioned above, some operating problems were encountered, particularly with the higher partial pressure runs, but the material balancing procedures used should have compensated for these problems, and they should not have had a significant effect on yields. A possible explanation for these results is that the partial pressure effect may not be linear or it may be coal dependent; some coals may respond better to increases in hydrogen partial pressure than other coals.

The coal concentration-hydrogen partial pressure interaction was found to be insignificant and is, therefore, omitted from Table XI.

C. Analysis of Powhatan Coal Runs

The two process variables investigated in the work reported here on the second shipment of Powhatan coal are the boiling range of the process solvent and the average dissolver temperature.

TABLE XI
YATES ANALYSIS OF 2² FACTORIAL EXPERIMENT
(RUNS 41, 42, 43 AND 44)

Change in Yield, wt% Moisture Free Coal		
	Coal and Recycle Solids ^a Concentration	H ₂ Partial Pressure ^b
H ₂ Consumption ^c	0.4***	-0.1
C ₁ -C ₄	-1.1**	0.5
CO, CO ₂ , H ₂ S, NH ₃	-0.2	-0.2
Water	-0.8***	0.2
C ₅ -380°F	-1.0	1.0
380-550°F	-2.0*	-0.6
550-900°F	-0.2	-1.1
900°F+ Pyridine Solubles	3.5**	-0.2
IOM	1.2	0.4
C ₅ -900°F	-3.1**	-0.7
380-900°F	-2.1***	-1.6
Total 900°F+ Product	4.7***	0.3

* Significant at 90% confidence level

** Significant at 95% confidence level

*** Significant at 99% confidence level

^a Increasing feed slurry coal concentration from 25% to 30% and simultaneously decreasing recycle solids concentrations from 21% to 17%.

^b Increasing dissolver outlet hydrogen partial pressure from 1300 to 1400 psia.

^c Because H₂ consumption is shown as a negative number, a negative difference in the Yates analysis indicates an increase in consumption.

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1. Effect of Recycle Solvent Boiling Range

As explained in Section III.D.2, the 10% boiling point of the recycle process solvent for Run 45 was about 35°F higher than that for Run 46. This difference in boiling range appears to have had little effect on yields. A comparison of Runs 45 and 46 indicates that slightly more naphtha and less middle distillate were produced when using the higher boiling recycle solvent. The IOM yield might also be slightly higher for Run 45; however, these differences are almost within normal analytical error and may not be real effects.

2. Effect of Average Dissolver Temperature

The main difference in operating conditions between Runs 46 and 47 was the 9°F lower average dissolver temperature (842 vs. 851°F) for Run 47; however, the dissolver outlet hydrogen partial pressure was also slightly higher for Run 47 (1342 vs. 1316 psia). Slightly less hydrogen was consumed (3.5 vs. 3.8%) in Run 47. The gas yield for Run 47 also appears to be lower, but the 900°F+ pyridine solubles yield appears to be higher (see Table IX). These results indicate that more hydrogen was consumed at the higher temperature and that it was used predominantly in the conversion of 900°F+ pyridine solubles to gas.

D. Comparison of SRC-II Yields from Various Coals

This section compares the SRC-II yields from the Robinson Run coal and the second shipment of Powhatan coal with those from other coals run in P99. It should be kept in mind that discussions of the effect of coal properties on yields are speculative, since our understanding of coal liquefaction chemistry is not sufficiently precise to be certain of these effects.

1. The Second Shipment vs. the First Shipment of Powhatan Coal

Run 46 on the second shipment of Powhatan coal and Run 36 on the first shipment are compared in Table XII. These two runs were made at the

TABLE XII
COMPARISON OF SRC-II YIELDS FROM VARIOUS COALS RUNS IN P99

Run No., P99-	15	Est ^a	31	33	35	36	38	41	44	45	46
Coal	Kentucky	Kentucky	Ireland	Blacksville	First Powhatan	First Powhatan	Valley Camp	Robinson Run	Robinson Run	Second Powhatan	Second Powhatan
Nominal Operating Conditions											
Dissolver Temperature, °F	860	860	860	851	851	851	851	851	851	851	851
Pressure, psig	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Residence Time, hr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Coal in Feed Slurry, wt%	33	30	30	30	30	30	30	30	30	30	30
Recycle Solids, wt% of Slurry	7	12	12	13	13	13	13	16	17	14	13
Dissolver Gas, 10 ³ SCF/T feed coal	77	80	72	70	70	49	50	50	46	50	50
H ₂ Content, Vol%	85	85	85	85	85	94	94	94	90	90	90
Hydrogen Partial Pressure, psia	1236	1300	1323	1298	1325	1334	1378	1430	1300	1310	1316
Feed coal, 95% thru mesh size	200	200	200	200	200	200	200	200	200	80	80
Yields, Wt% of Moisture-Free Coal											
H ₂ Consumption	-4.9	-4.6	-4.2	-3.5	-4.3	-4.3	-4.2	-3.7	-3.5	-3.8	-3.8
C ₁ -C ₄	17.9	17.6	16.6	14.6	16.7	16.5	16.7	14.7	13.8	14.2	14.5
Other Gases	4.0	4.5	4.6	3.0	4.0	4.0	3.5	3.1	3.2	3.8	3.6
Water	7.9	8.2	4.9	4.8	5.9	5.9	5.3	4.8	4.3	6.2	5.8
C ₅ -380°F	5.7	6.3	9.3	8.5	8.9	9.4	8.0	8.7	7.6	10.0	8.0
380-550°F	16.2	15.4	15.0	10.9	13.6	13.9	16.6	11.8	14.3	12.0	13.9
550-900°F	13.0	11.1	10.1	9.6	15.0	13.8	12.8	12.7	12.0	11.0	11.6
C ₅ -900°F	34.9	32.8	34.4	29.0	37.5	37.1	37.4	33.2	33.9	33.0	33.5
900°F+ Pyridine Solubles	24.2	23.3	22.1	28.7	25.3	26.0	24.9	23.9	24.9	28.0	28.7
104 ^(b)	6.8	9.0	6.0	9.8	5.4	5.3	7.5	7.5	6.9	6.4	5.5
Ash	9.2	9.2	15.6	13.6	9.5	9.5	8.9	16.5	16.5	12.2	12.2
Total 900°F+ Product	40.2	41.5	43.7	52.1	40.2	40.8	41.3	47.9	48.3	46.6	46.4
380-900°F	29.2	26.5	25.1	20.5	28.6	27.7	29.4	24.5	26.3	23.0	25.5
Yields, Wt% of Moisture-Mineral-Free Coal ^(d)											
H ₂ Consumption	-5.5	-5.2	-5.2	-4.2	-4.8	-4.9	-4.7	-4.6	-4.3	-4.4	-4.4
C ₁ -C ₄	20.0	19.7	20.3	17.3	18.8	18.6	18.7	18.1	17.0	16.5	16.9
Other Gases	4.5	5.0	5.6	3.5	4.5	4.5	3.9	3.8	4.0	4.4	4.2
Water	8.8	9.2	6.0	5.7	6.6	6.6	5.9	5.9	5.3	7.2	6.7
C ₅ -380°F	6.4	7.0	11.3	10.0	10.0	10.6	9.0	10.8	9.4	11.6	9.3
380-550°F	18.1	17.2	18.3	12.8	15.3	15.7	18.5	14.6	17.7	14.0	16.1
550-900°F	14.5	12.4	12.3	11.6	17.0	15.6	14.3	15.7	14.8	12.8	13.5
Total C ₅ -900°F	39.0	36.6	41.9	34.4	42.3	41.9	41.8	41.1	41.9	38.4	38.9
900°F+ Pyridine Solubles	27.0	26.0	27.0	33.9	28.4	29.2	27.8	29.5	30.8	32.6	33.4
104 ^(b)	6.9	9.4	5.6	10.2	5.2	5.0	7.5	7.6	6.8	6.2	5.2
Total 900°F+ product	33.9	35.4	32.6	44.1	33.6	34.2	35.3	37.1	37.6	38.8	38.6
380-900°F	32.6	29.6	30.6	24.4	32.3	31.3	32.8	30.3	32.5	26.8	29.6

(a) Estimated from the 2² factorial experiment (see Reference 1).

(b) When yields are expressed on a mineral matter basis, 104 is defined as vacuum column bottoms pyridine insolubles minus mineral matter; when yields are expressed on an ash basis, 104 is defined as vacuum column bottoms pyridine insolubles minus ash.

(c) Mineral Matter = Coal Mineral Matter - 0.5 x Coal Pyritic Sulfur.

(d) Yields add up to more than 100% because the pyrites in the coal mineral matter are converted to sulfides during processing and the resultant H₂S appears in the products.

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same operating conditions except that the hydrogen partial pressure at the dissolver outlet was slightly lower for Run 46 (1316 psia) than for Run 36 (1334 psia). The yield data show that the second shipment of Powhatan coal was less reactive than the first. About 2% less C_1 - C_4 gases, 3% less distillate, and 4% more 900°F+ product on a moisture-mineral-free basis were produced in Run 46. The yields of water and other gases, CO_2 and CO in particular, are very similar for Runs 46 and 36. This is additional indication that the second shipment of Powhatan coal which was ground and dried by Conoco was no more oxidized than the first shipment which was prepared by Empire Coke, but again it might not be possible to detect small, but significant, amounts of surface oxidation by differences in yields of oxygenated products.

As mentioned previously, there are three major differences between the two shipments: (1) although they are from the same mine, they were obtained at different times; (2) they were dried and ground by different contractors; and (3) they were ground to different particle sizes. As discussed in Section III.A.1, there is little in the maceral or elemental analyses that would suggest lower reactivity for the second shipment of Powhatan coal. There is also little in the elemental analyses and yields of water, CO_2 and CO that would suggest more oxidation for the second shipment of Powhatan coal.

Thus, the lower distillate yield in Run 46 is puzzling and appears to be contrary to the mechanism of coal liquefaction proposed by Neavel⁽⁶⁾. His work showed that when coal particles were subjected to liquefaction conditions, they rapidly (within 5 min) disintegrated in the solvent to form pyridine soluble products. This rapid physical disintegration was then followed by slow reactions converting the pyridine soluble products into oils and gases. Hydrogen-donor and nondonor solvents were found to be equally effective in achieving physical dispersion of coal particles in the solvent. Therefore, no effect of particle size (up to 20 mesh) on conversion to oils and gases was observed, at least for low-ranking coals, such as sub-bituminous and high volatile bituminous C and B. Other reported work⁽⁷⁾ also confirms

that particle size (at least in the range of interest in this work) has essentially no effect on reactivity.

Either surface oxidation occurred which is not detectable within the accuracy of coal elemental analyses or the particle size effect is more complex than previous experience would indicate or there is some other effect which cannot be determined without further experimental work.

2. Robinson Run Coal vs. Powhatan Coal

A comparison of Runs 44 and 35 indicates that the Robinson Run coal is a slightly less desirable feed to the SRC-II process than the first shipment of Powhatan coal (see Table XII). About 4% less C_5 -900°F distillate, 3% less C_1 - C_4 gases and 1.5% less water on a moisture-free-coal basis were produced from the Robinson Run coal than from the Powhatan coal. Since the Robinson Run coal contained more total oxygen (see Table III), the lower water yield indicates lower oxygen removal (33% vs. 52%) from the Robinson Run coal (see Table XIII). Accordingly, the vacuum bottoms from the Robinson Run coal contained more oxygen (15% vs. 9%) than that obtained from the Powhatan coal (see Table XIII). This may be attributed to the higher mineral oxygen content of the Robinson Run coal. However, the possibility that the organic oxygen in the Robinson Run coal is more difficult to remove cannot be ruled out.

Since the Robinson Run coal had a higher ash content than the first batch of Powhatan coal (16.5% vs. 9.5%), a comparison of coal reactivity is better reflected by moisture-mineral-free yields. Based on these yields, about 2% less C_1 - C_4 , 1% less water, and 4% more 900°F+ product were produced from Robinson Run coal than from Powhatan coal. The total distillate yields were approximately the same except that more middle distillate was produced from the Robinson Run coal and more heavy distillate from the Powhatan coal. Thus, a satisfactory distillate yield was produced from the Robinson Run coal in spite of its vitrinite being of higher rank than that of the Powhatan coal.

TABLE XIII
COMPARISON OF CONVERSIONS AND PRODUCT QUALITY IN
SRC-II PROCESSING OF VARIOUS COALS

Run No. P99-	35	36	31	33	41	44	15	45	46
Nominal Operating Conditions	First	First			Robinson	Robinson		Second	Second
Coal	Powhatan	Powhatan	Ireland	Blacksville	Run	Run	Kentucky	Powhatan	Powhatan
Dissolver Temperature, °F	850	851	860	851	851	851	860	851	851
Pressure, psig	2000	2000	2000	2000	2000	2000	2000	2000	2000
Residence Time, hr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Recycle Solids, wt% of Slurry	13	13	12	13	16	17	7	14	13
Dissolver Gas, 10 ³ SCF/T Coal	70	49	71	70	50	46	77	50	
H ₂ Partial Pressure, psia	1330	1334	1320	1290	1430	1300	1240	1310	1316
Conversions, wt% MF Coal									
Hydrocracking	67.5	68.5	69.4	56.7	61.3	59.6	69.6	63.5	61.2
Desulfurization	63.4	63.4	63.6	51.7	50.9	53.4	64.0	58.4	58.9
Denitrogenation	25.9	27.3	31.0	22.9	28.2	26.0	31.2	24.7	25.1
Oxygen Removal	52.4	53.9	37.4	39.6	35.8	33.1	62.8	50.0	46.2
Product Quality, wt%									
Debutanizer Bottoms									
Nitrogen	0.75	0.75	0.75	0.77	0.58	0.77	0.85	0.65	0.67
Sulfur	0.19	0.22	0.24	0.28	0.19	0.20	0.15	0.24	0.31
Oxygen	4.23	3.97	3.85	3.59	3.05	3.23	3.49	4.07	4.10
Process Solvent									
Nitrogen	1.02	1.03	1.00	1.02	1.01	1.05	1.00	1.03	0.99
Sulfur	0.25	0.28	0.37	0.27	0.16	0.31	0.28	0.26	0.41
Oxygen	2.41	2.21	2.38	2.02	2.71	2.00	2.61	2.13	2.47
Vacuum Tower Bottoms									
Nitrogen	1.44	1.43	1.18	1.46	1.26	1.27	1.77	1.42	1.43
Sulfur	2.49	2.49	3.11	2.18	2.79	2.61	2.53	2.44	2.37
Oxygen	9.44	9.31	15.91	11.84	14.62	15.34	9.60	10.50	11.53

SCT:als,6/26/79,251-8370

3. Robinson Run Coal vs. Valley Camp Coal

Generally speaking, the Robinson Run coal is less reactive than the Valley Camp coal. Comparing Runs 41 and 38 (see Table XII) shows that more 900°F+ total product, more naphtha and less fuel oil were produced from Robinson Run coal in spite of a slightly higher hydrogen partial pressure. The total distillate yields on a moisture-mineral-free basis for the two coals are about the same.

4. Robinson Run Coal vs. Ireland Coal

In spite of a small difference in average dissolver temperature (851 vs. 860°F) Run 44 on Robinson Run coal and Run 31 on Ireland coal should provide a reasonably valid basis of comparison for these two coals. The yields based on moisture-free coal for the two runs show that about 3% less C₁-C₄ gases, 1% less other gases, 3% more 900°F+ pyridine soluble product and 1% more pyridine insoluble organic matter were produced in Run 44 than in Run 31. The total distillate yield was less than 1% lower, but the fuel oil yield was about 1% higher for Run 44. The lower gas yield could be a result of a lower temperature in Run 44. The yields of water and other gases are lower for Run 44 on the Robinson Run coal indicating lower percent desulfurization, denitrogenation and oxygen removal (see Table XIII).

5. Robinson Run Coal vs. Blacksville Coal

Comparing the yields from Run 44 on Robinson Run coal and Run 33 on Blacksville coal (see Table XII), one sees that Robinson Run coal is more reactive and, therefore, constitutes a more desirable feed for the SRC-II process than Blacksville coal. Based on moisture-free coal, 5% more distillate, 4% less 900°F+ pyridine solubles and 3% less IOM were produced from Robinson Run coal than from Blacksville coal. The increased distillate was mainly in the fuel oil range.

6. Robinson Run Coal vs. Kentucky Coal

No runs at identical conditions were made for the Kentucky and Robinson Run coals. However Run 15 differs only in being at a slightly higher dissolver temperature (860 vs. 851°F) and a slightly higher coal concentration in the feed slurry (33% vs. 30%). Therefore, data from Run 15 are presented in Table XII for comparison. In addition, yields for the Kentucky coal were estimated by interpolating the data from Runs 20, 21, 22, and 23 using the effects calculated from the Yates analysis of the 2^2 factorial experiment run on this coal.⁽¹⁾ These estimated yields are also given in Table XII. From this table, it can be seen that the yields on a moisture-free basis from the Robinson Run coal are similar to those from the Kentucky coal except for lower hydrogen consumption and lower gas and water yields. The lower water yield from the Robinson Run coal is a result of its lower organic oxygen content (see Table III), but oxygen removal was also lower (see Table XIII). On the other hand, the moisture-mineral-free yields indicate that about 3% less total 900°F+ product and about 3% more naphtha were produced from the Robinson Run coal.

E. Product Quality

Generally speaking, the distillates obtained from Robinson Run and the second shipment of Powhatan coal appear to be of similar quality to those from other coals run in P99. As shown in Table XIII, the debutanizer bottoms contain 0.2 to 0.3% sulfur, 0.6 to 0.8% nitrogen, and 3.1 to 4.1% oxygen. The process solvents contain 0.2 to 0.4% sulfur, 1.0 to 1.1% nitrogen, and 2.0 to 2.7% oxygen. The sulfur and nitrogen contents of the vacuum tower bottoms are also about the same (2.4 to 2.8% sulfur and 1.3 to 1.8% nitrogen). The oxygen content of the vacuum tower bottoms from Robinson Run coal is similar to that from Ireland coal but significantly higher than those of other coals. This is most likely due to its higher ash content, but a contributing factor could be that the Robinson Run coal contains more heterocyclic oxygen, which is more difficult to remove. The latter explanation is consistent with the fact that Robinson Run coal is of higher rank than other coals (except Blacksville coal) run in P99.

V. CONCLUSIONS

This work has shown that satisfactory distillate yields can be produced from Pittsburgh Seam coal from the Robinson Run Mine. Yields are comparable to those obtained from Kentucky coal and Pittsburgh Seam coals from the Ireland, Powhatan, and Valley Camp Mines and are better than those obtained from Pittsburgh Seam coal from the Blacksville Mine.

Product yields from Robinson Run coal appear to be little, if at all, affected by increasing hydrogen partial pressure from 1300 psia to 1400 psia. The yields of distillate, 900°F+ pyridine solubles, and C₁-C₄ gases are significantly reduced by increasing the coal concentration from 25% to 30% (or decreasing the percent recycle solids from 21% to 17%).

Considerably lower distillate and gas yields were produced from the second shipment of Powhatan coal than from the first shipment. There is no obvious explanation for this, but it may be due to some subtle effect of particle size, coal preparation conditions, maceral composition, or operating conditions. With the second shipment of Powhatan coal, a modest increase in the boiling temperature (approximately 35°F in the 10% point) of the process solvent had essentially no effect on product yields, while lowering the average dissolver temperature from 851°F to 842°F significantly reduced gas yield.

REFERENCES

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2. H. G. McIlvried, W. Gall, and S. C. Tsai, "SRC-II Processing of Pittsburgh Seam (Blacksville No. 2 Mine) Coal in Pilot Plant P99," Report No. 624RJ038, File FT07-30-30, November 20, 1978.
3. H. G. McIlvried, W. Gall, and S. C. Tsai, "SRC-II Processing of Pittsburgh Seam Coal (Ireland Mine) in Pilot Plant P99," Report No. 624RJ043, File FT07-30-30, January 29, 1979.
4. Solvent Refined Coal (SRC) Process, Annual Technical Progress Report for the Period January-December 1978, The Pittsburgh & Midway Coal Mining Co., FE/496-170, November 1979.
5. Private communication from J. L. Stephenson, Technology and Materials Department.
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APPENDIX A

COMPUTER PRINTOUT OF RUN AVERAGE YIELDS FOR
ROBINSON RUN COAL AND THE SECOND SHIPMENT OF POWHATAN COAL

SRC-II RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-41AVG	P99-42AVG	P99-43AVG	P99-44AVG	P99-45AVG	P99-46AVG	P99-47AVG
DATE (START OF PERIOD)	9-3-78	9-21-78	10-3-78	10-19-78	11-9-78	11-17-78	11-25-78
TIME & DATE CODE (START & END OF PERIOD)	0815 2468 0415 2538	0815 2648 0415 2718	0815 2768 0415 2808	1215 2928 0415 2958	815 3138 415 3188	815 3218 415 3268	815 3298 415 3328
RUN HOURS INCLUDED IN PERIOD	158-321	52-215	124-215	133-200	181-296	66-181	58-125
COAL CHARGE	RUB RUN LR-25447	ROB RUN LR-25447	RUB RUN LR-25447	ROB RUN LR-25447	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-25734
OPERATING CONDITIONS							
RECYCLE SLURRY/MF COAL RATIO	2.40	3.08	3.09	2.39	2.40	2.37	2.39
OIL TO SOLIDS RATIO	1.20	1.20	1.19	1.13	1.28	1.33	1.35
SLURRY COMPOSITION, W-%							
COAL (MOISTURE FREE)	29.4	24.5	24.4	29.5	29.4	29.7	29.5
DISTILLATE	35.7	32.4	32.6	32.8	32.4	33.3	33.5
482 C+ (900 F+) PYRIDINE SOL.	18.8	22.1	21.8	20.3	23.8	23.7	23.9
PYRIDINE INSOLUABLES	16.0	20.9	21.1	17.3	14.4	13.3	13.1
TOTAL RX PRESSURE, MPA	13.79	13.79	13.79	13.79	13.80	13.79	13.79
PRESS X XH2 IN INLET GAS, MPA	12.97	12.99	12.43	12.42	12.44	12.43	12.38
OUTLET H2 PARTIAL PRESS, MPA	9.85	9.66	8.94	8.94	9.03	9.07	9.24
DISSOLVER TEMPERATURES, C							
ZONE 4 (TOP)	457	457	457	457	457	457	453
ZONE 3	456	456	456	456	456	456	452
ZONE 2	455	455	455	455	455	455	450
ZONE 1 (BTM)	452	453	452	452	451	451	446
AVERAGE	455	455	455	455	455	455	450
PREHEATER OUTLET	388	390	392	388	396	389	388
NOMINAL SLURRY RES. TIME, HR	0.99	0.99	0.99	0.99	0.99	1.00	0.99
WHSV, KG/HR/DM3							
SLURRY	1.21	1.21	1.22	1.21	1.22	1.21	1.21
COAL (MOISTURE FREE)	0.36	0.30	0.30	0.36	0.36	0.36	0.36
DISSOLVER GAS							
DM3/KG SLURRY	462	389	368	423	463	463	462
DM3/KG MF FEED COAL	1570	1587	1504	1431	1577	1562	1567
HYDROGEN CONTENT, VOL%	94.1	94.2	90.1	90.1	90.2	90.1	89.8
FLUSH H2O, % OF PRODUCT H2O	204.2	226.2	226.5	202.8	201.5	232.2	234.9

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER	P99-41AVG	P99-42AVG	P99-43AVG	P99-44AVG	P99-45AVG	P99-46AVG	P99-47AVG
WATER IN THE FEED COAL ASSUMED							
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WEIGHT BALANCE, O/I, WT%	96.6	98.6	97.7	97.7	99.8	98.6	100.2

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WT% FEED COAL

HYDROGEN	-3.60	-3.89	-3.82	-3.52	-3.08	-3.97	-3.49
METHANE	5.05	5.26	5.34	4.81	5.36	5.33	4.83
ETHANE	3.66	3.87	3.86	3.47	3.72	3.74	3.37
PROPANE	3.65	3.91	3.89	3.42	3.43	3.51	3.05
I-BUTANE	0.25	0.25	0.22	0.19	0.17	0.22	0.20
N-BUTANE	2.00	2.10	2.07	1.80	1.64	1.70	1.49
TOTAL C1 TO C4	14.60	15.39	15.39	13.69	14.32	14.50	12.94
AMMONIA	0.46	0.49	0.48	0.41	0.38	0.41	0.36
HYDROGEN SULFIDE	1.78	1.75	1.77	1.87	1.99	2.04	1.96
CARBON DIOXIDE	0.70	0.59	0.81	0.82	1.25	0.98	1.01
CARBON MONOXIDE	0.22	0.24	0.20	0.21	0.20	0.22	0.18
TOTAL OTHER GASES	3.16	3.07	3.26	3.31	3.81	3.66	3.51
WATER	4.87	5.19	4.98	4.86	5.40	6.01	6.01
DEBUTANIZER LIQUID	10.62	21.51	19.45	18.45	18.96	18.24	18.35
PROCESS SOLVENT	16.73	11.54	13.49	10.18	9.82	10.56	9.09
TOTAL C5+ DISTILLATE	27.35	33.06	32.94	28.63	28.78	28.80	27.44
VACUUM TOWER BOTTOMS	53.61	47.19	47.25	53.04	51.37	50.99	53.60
CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE							
DM3/KG FEED COAL	422	456	448	413	432	465	410
CONVERSIONS, WT% FEED COAL							
HYDROCRACKING	61.5	65.6	66.6	59.9	63.2	61.2	57.1
DESULFURIZATION	51.1	54.5	55.2	53.7	58.1	58.8	57.6
DENITROGENATION	28.5	31.8	30.7	26.6	24.2	25.1	22.6
OXYGEN REMOVAL	36.5	38.9	39.9	33.8	50.2	46.5	47.8

RUN NUMBER

P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

GAS RATES, DM3/KG FEED COAL

DISSOLVER INLET GAS	1068.8	985.9	936.3	926.9	1055.4	1160.2	1248.8
TOTAL QUENCH GAS	556.3	623.0	603.8	536.7	525.0	424.2	314.7
TOTAL DISSOLVER GAS	1625.1	1608.8	1540.1	1463.7	1580.4	1584.4	1563.5
MAKEUP GAS TO DISSOLVER	553.3	507.4	353.9	368.1	411.4	439.6	362.5
MAKEUP GAS TO SEP. SPARGE	111.3	114.0	76.2	64.7	78.2	90.0	84.6
MAKEUP GAS TO INSTRUMENT TAPS	267.5	313.3	316.0	263.2	257.3	260.4	256.2
TOTAL MAKEUP GAS	932.1	934.7	746.2	696.0	746.9	790.0	703.3
DISSOLVER OUTLET GAS	1354.6	1310.6	1251.3	1195.4	1305.5	1274.8	1295.7
GAS LEAVING SCRUBBERS	1802.3	1819.3	1731.3	1573.4	1717.3	1715.1	1774.4
SEPARATOR SPARGE GAS	326.8	361.5	331.5	257.3	300.3	324.4	364.8
PRODUCT GASES							
BLEED OFF GAS	507.0	462.4	283.7	275.5	318.5	327.7	283.2
DEBUTANIZER GAS	53.5	60.1	62.2	52.4	58.9	58.2	55.0
AMINE REACTIVATOR GAS	12.0	11.6	11.8	12.5	13.5	13.0	13.1
NAPHTHA REACTIVATOR GAS	81.2	94.5	93.5	77.7	73.5	73.3	74.0
CHROMATOGRAPH BLEED GAS	7.9	7.9	6.1	5.8	7.7	8.1	10.0

ELEMENTAL BALANCES

WATER IN THE FEED COAL ASSUMED							
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CARBON, D/I	1.00	1.00	1.01	0.99	1.01	1.00	1.00
HYDROGEN, D/I	1.01	1.01	1.02	1.00	1.01	0.98	1.00
NITROGEN, D/I	1.01	1.00	1.00	1.00	1.00	1.01	1.00
SULFUR, D/I	1.02	0.97	0.97	1.02	1.00	1.01	1.00
OXYGEN, D/I	1.00	0.99	0.98	1.03	0.95	1.01	1.00
METALS, D/I	1.01	0.99	0.98	1.00	1.01	0.98	0.95
ASH, D/I	1.01	0.99	0.98	1.00	1.01	0.98	0.95

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

YIELDS, WT% MOISTURE FREE COAL

HYDROGEN (BY H BALANCE)	-3.69	-4.02	-3.96	-3.48	-3.80	-3.80	-3.51
METHANE	5.07	5.25	5.31	4.84	5.32	5.32	4.82
ETHANE	3.68	3.86	3.84	3.49	3.69	3.74	3.36
PROPANE	3.66	3.91	3.87	3.45	3.41	3.51	3.04
I-BUTANE	0.25	0.25	0.22	0.19	0.17	0.22	0.20
N-BUTANE	2.01	2.09	2.06	1.81	1.63	1.70	1.48
TOTAL C1 TO C4	14.66	15.35	15.30	13.79	14.22	14.49	12.90
AMMONIA (BY N BALANCE)	0.44	0.50	0.48	0.41	0.39	0.39	0.36
HYDROGEN SULFIDE (BY S BAL)	1.72	1.85	1.87	1.80	1.99	2.00	1.96
CARBON DIOXIDE	0.71	0.59	0.80	0.83	1.24	0.93	1.00
CARBON MONOXIDE	0.22	0.24	0.20	0.22	0.20	0.22	0.18
TOTAL OTHER GASES	3.09	3.17	3.36	3.25	3.81	3.60	3.50
WATER (BY OXYGEN BALANCE)	4.79	5.34	5.38	4.29	6.16	5.80	6.02
DEBUTANIZER LIQUID	10.66	21.46	19.34	18.58	18.83	18.23	18.28
PROCESS SOLVENT	16.80	11.52	13.41	10.25	9.75	10.58	9.06
TOTAL C5+ DISTILLATE	27.46	32.98	32.75	28.83	28.58	28.79	27.34
VTB PYRIDINE SOLUABLES	29.67	24.59	24.77	29.93	32.47	33.41	36.50
INSOLUABLE ORGANIC MATTER	7.56	6.14	5.95	6.94	6.37	5.51	5.05
ASH	16.46	16.46	16.46	16.46	12.19	12.19	12.19
VACUUM TOWER BOTTOMS	53.68	47.18	47.18	53.32	51.02	51.12	53.75
CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL							
BY HYDROGEN BALANCE	432	471	465	408	446	445	411
CONVERSIONS, WT% MF COAL							
HYDROCRACKING	61.3	65.7	66.8	59.6	63.5	61.2	57.2
DESULFURIZATION	50.9	54.6	55.5	53.4	58.4	58.9	57.7
DENITROGENATION	28.2	31.9	31.1	26.0	24.7	25.1	22.9
OXYGEN REMOVAL	35.8	38.7	40.0	33.1	50.0	46.2	47.6

RUN NUMBER P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

GAS COMPOSITIONS, VOL%

REACTOR INLET GAS

HYDROGEN	94.06	94.25	90.13	90.07	90.17	90.13	89.79
METHANE	5.16	5.12	8.79	8.66	8.60	8.57	8.98
ETHANE	0.75	0.61	0.98	1.12	1.16	1.20	1.14
PROPANE	0.00	0.00	0.00	0.01	0.00	0.01	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.03	0.01	0.10	0.15	0.07	0.09	0.08
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00

REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)

HYDROGEN	77.63	76.51	70.96	71.48	71.80	70.71	72.00
METHANE	11.14	11.59	16.23	15.66	15.59	15.78	15.36
ETHANE	2.91	2.94	3.48	3.49	3.47	3.59	3.24
PROPANE	1.40	1.55	1.62	1.49	1.37	1.41	1.21
I-BUTANE	0.10	0.11	0.12	0.11	0.09	0.09	0.08
N-BUTANE	0.58	0.62	0.64	0.59	0.49	0.52	0.44
HYDROGEN SULFIDE	0.87	0.88	0.93	1.03	1.00	1.04	0.99
CARBON MONOXIDE	0.16	0.16	0.24	0.31	0.20	0.24	0.21
CARBON DIOXIDE	0.27	0.23	0.33	0.35	0.49	0.39	0.39
AMMONIA	0.45	0.49	0.51	0.45	0.38	0.42	0.36
WATER	4.49	4.92	4.95	5.04	5.13	5.80	5.72

BLEED OFF GAS

HYDROGEN	88.39	88.25	83.81	83.46	82.65	83.05	84.15
METHANE	9.68	10.01	13.96	13.99	14.67	14.17	13.49
ETHANE	1.46	1.25	1.59	1.85	2.01	2.00	1.75
PROPANE	0.10	0.05	0.05	0.05	0.14	0.20	0.07
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.37	0.44	0.60	0.64	0.52	0.58	0.53
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RUN NUMBER

P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

GAS COMPOSITIONS, VOL%

AMINE REACTIVATOR GAS

HYDROGEN	17.97	15.58	12.47	10.43	8.90	10.41	9.39
METHANE	0.63	1.84	2.52	2.10	1.89	1.76	1.87
ETHANE	0.07	0.37	0.43	0.36	0.38	0.37	0.32
PROPANE	0.00	0.01	0.00	0.00	0.00	0.00	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	60.17	58.26	57.91	60.58	57.93	58.28	59.16
CARBON MONOXIDE	0.11	0.05	0.04	0.03	0.03	0.01	0.02
CARBON DIOXIDE	21.05	23.90	26.63	26.49	30.87	29.18	29.24

NAPHTHA REACTIVATOR GAS

HYDROGEN	27.12	28.43	22.36	22.07	21.02	22.18	23.35
METHANE	22.81	24.44	29.59	27.87	29.42	28.89	30.14
ETHANE	21.80	21.74	22.46	22.53	23.85	23.50	22.48
PROPANE	18.56	17.06	17.15	18.20	17.85	17.69	16.27
I-BUTANE	1.20	1.06	1.08	1.19	1.09	1.03	0.99
N-BUTANE	6.44	5.66	5.70	6.23	5.22	5.25	4.90
PENTANES	1.71	1.39	1.47	1.67	1.40	1.28	1.27
HYDROGEN SULFIDE	0.16	0.00	0.00	0.05	0.00	0.00	0.00
CARBON MONOXIDE	0.00	0.01	0.01	0.00	0.00	0.01	0.00
CARBON DIOXIDE	0.20	0.22	0.19	0.19	0.15	0.16	0.60

DEBUTANIZER GAS

HYDROGEN	57.13	57.25	52.01	49.35	48.29	47.28	50.67
METHANE	12.92	13.61	18.40	19.37	17.80	18.04	18.30
ETHANE	7.55	7.51	8.57	9.59	9.76	10.05	9.23
PROPANE	8.07	8.37	8.35	8.62	9.01	9.39	7.93
I-BUTANE	0.87	0.84	0.83	0.83	0.85	0.88	0.74
N-BUTANE	5.60	5.43	5.17	4.93	4.98	5.38	4.51
PENTANES	2.63	2.31	2.23	2.05	2.28	2.29	2.07
HYDROGEN SULFIDE	5.19	4.59	4.37	5.07	6.33	6.13	6.05
CARBON MONOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.04	0.09	0.08	0.20	0.69	0.58	0.49

COAL INSPECTIONS

RUN NUMBER P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

FEED COAL

ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)

CARBON, SEMI-MICRO, WTX	68.30	68.30	68.30	68.30	70.96	70.96	70.96
HYDROGEN, SEMI-MICRO, WTX	4.94	4.94	4.94	4.94	4.92	4.92	4.92
NITROGEN, GR11, WTX	1.28	1.28	1.28	1.28	1.29	1.29	1.29
SULFUR, TOTAL, GRM1159, WTX	3.18	3.18	3.18	3.18	3.20	3.20	3.20
SULFUR, ORGANIC, WTX	0.62	0.62	0.62	0.62	1.65	1.65	1.65
SULFUR, PYRITIC, WTX	2.49	2.49	2.49	2.49	1.51	1.51	1.51
SULFUR, SULFATE, WTX	0.07	0.07	0.07	0.07	0.04	0.04	0.04
OXYGEN, GRM1117, WTX	13.69	13.69	13.69	13.59	12.97	12.97	12.97
OXYGEN, ORGANIC, WTX	5.72	5.72	5.72	5.72	7.20	7.20	7.20
OXYGEN, INORGANIC, WTX	7.97	7.97	7.97	7.97	5.78	5.78	5.78
METALS, BY SPEC ASH, WTX	8.61	8.61	8.61	8.61	6.67	6.67	6.67

MINERAL MATTER, WTX*	19.14	19.14	19.14	19.14	14.00	14.00	14.00
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MOISTURE, D271, WTX	0.95	0.95	0.95	0.95	0.81	0.81	0.81
VOLATILE MATTER, WTX	34.40	34.40	34.40	34.40	38.00	38.00	38.00
ASH, D271, WTX	16.46	16.46	16.46	16.46	12.19	12.19	12.19
SULFUR, WTX OF ASH	2.25	2.25	2.25	2.25	0.78	0.78	0.78
OXYGEN, WTX OF ASH	45.40	45.40	45.40	45.40	44.50	44.50	44.50
ALUMINUM, WTX OF ASH	15.0	15.0	15.0	15.0	15.0	15.0	15.0
CALCIUM, WTX OF ASH	3.3	3.3	3.3	3.3	.9	.9	.9
IRON, WTX OF ASH	10.0	10.0	10.0	10.0	15.0	15.0	15.0
MAGNESIUM, WTX OF ASH	2.0	2.0	2.0	2.0	.8	.8	.8
POTASSIUM, WTX OF ASH	1.3	1.3	1.3	1.3	1.2	1.2	1.2
SILICON, WTX OF ASH	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SODIUM, WTX OF ASH	.4	.4	.4	.4	.3	.3	.3
TITANIUM, WTX OF ASH	1.0	1.0	1.0	1.0	.7	.7	.7
TRACE METALS, WTX OF ASH	.1	.1	.1	.1	.4	.4	.4

PARTICLE SIZE DISTRIBUTION, WTX

ON 80 MESH					.3	.3	.3
THRU 80 ON 200 MESH	3.9	3.9	3.9	3.9	35.6	35.6	35.6
THRU 200 ON 325 MESH	20.6	20.6	20.6	20.5	18.6	18.6	18.6
THRU 325 ON 625 MESH	35.7	35.7	35.7	35.7	21.1	21.1	21.1
THRU 625 MESH	39.8	39.8	39.8	39.3	24.4	24.4	24.4

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-41AVG	P99-42AVG	P99-43AVG	P99-44AVG	P99-45AVG	P99-46AVG	P99-47AVG
DEBUTANIZER BOTTOMS							
GRAVITY, D287, API	37.0	28.0	28.8	27.8	28.4	26.7	26.0
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	84.27	84.70	84.54	84.96	84.30	84.36	84.60
HYDROGEN, SEMI-MICRO, WT%	11.91	10.78	10.79	10.84	10.75	10.57	10.54
NITROGEN, GB11, WT%	0.58	0.78	0.76	0.77	0.65	0.67	0.67
SULFUR, GRM1156, WT%	0.19	0.14	0.38	0.20*	0.24	0.31	0.26
OXYGEN, GRM1117, WT%	3.05	3.60	3.53	3.23	4.07	4.10	3.92
VISCOSITY, KIN, D445, CS							
-35C		10.39		10.42	9.66	11.16	
0C	2.61	2.92	2.96	3.24	3.06	3.35	3.57
WATER, G525, PPM	6763	5880	6001	5622	7756	7860	8461
HEAT OF COMB., D240, BTU/LB	17877	17999	17608	17144	17846	17761	17776
POUR POINT, D97, C	-53	-53	-53	-53	-53	-53	-53
DISTILLATION, D86, C							
INITIAL BOILING POINT	59	61	61	57	60	60	61
5 VOL %	72	75	77	73	76	74	78
10 VOL %	91	104	104	103	91	97	101
30 VOL %	125	161	157	159	145	161	162
50 VOL %	148	187	188	192	180	192	194
70 VOL %	166	206	207	215	201	211	215
90 VOL %	189	227	230	242	223	236	236
95 VOL %	205	243	243	257	234	250	254
END POINT	231	259	259	269	260	266	276
WATER (INCLUDES FLUSH WATER)							
TOTAL CARBON, PPM	22764	9200	13238	13800	20000*	13440	12467
ORGANIC CARBON, PPM	19356	8821	10575	10833	14580	10920	10400
NITROGEN, GB11, WT%	2.37	2.18	2.15	2.31	1.60	1.63	1.38
SULFUR, GRM1156, WT%	1.91	1.93	2.00*	2.53	1.60*	1.97	1.61

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-41AVG	P99-42AVG	P99-43AVG	P99-44AVG	P99-45AVG	P99-46AVG	P99-47AVG
PROCESS SOLVENT							
GRAVITY, D287, API	11.5	8.3	8.6	9.0	7.8	7.7	8.3
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	87.09	88.22	88.10	87.79	88.07	87.67	87.64
HYDROGEN, SEMI-MICRO, WT%	9.02	8.69	8.71	8.86	8.50	8.46	8.60
NITROGEN, G811, WT%	1.01	1.07	1.06	1.05	1.03	0.99	0.97
SULFUR, GRM1156, WT%	0.16	0.22	0.33	0.30*	0.26	0.41	0.39
OXYGEN, GRM1117, WT%	2.71	1.81	1.80	2.00	2.13	2.47	2.39
VISCOSITY, KIN, D445, CS							
25 C	11.03	19.48	19.63	17.87	19.82	15.96	17.46
50 C	4.54	6.80	6.85	6.42	6.83	5.86	6.23
100 C	1.62	2.09	2.12	2.02	2.09	1.90	1.96
WATER, G525, PPM	759	479	570	623	1078	560	388
HEAT OF COMB., D240, BTU/LB	17503	17460	17557	17502	17425		17385
POUR POINT, D97, C	-37	-17	-15	-15	-15	-23	-15
DISTILLATION, CUSHMAN, C							
CORRECTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	199	231	226	196	229	164	200
10 VOL %	226	255	254	246	259	241	246
20 VOL %	235	270	277	260	270	259	262
30 VOL %	244	282	290	275	282	274	278
40 VOL %	255	296	303	292	294	290	290
50 VOL %	269	312	315	310	308	307	303
60 VOL %	295	331	329	323	327	321	318
70 VOL %	317	351	350	344	344	339	338
80 VOL %	343	375	373	369	371	363	362
90 VOL %	379	411	411	400	403	404	410
END POINT	473	470	468	478	457	447	437

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-41AVG	P99-42AVG	P99-43AVG	P99-44AVG	P99-45AVG	P99-46AVG	P99-47AVG
VACUUM TOWER BOTTOMS							
SPECIFIC GRAVITY, D70, G/CC	1.45	1.56	1.51	1.48	1.45	1.44	1.43
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	61.28	53.95	59.56	60.86	68.69	67.98	69.55
HYDROGEN, SEMI-MICRO, WT%	3.89	3.58	3.65	3.76	4.03	3.98	4.04
NITROGEN, GB11, WT%	1.26	1.20	1.22	1.27	1.42	1.43	1.45
SULFUR, TOTAL, D1552, WT%	2.79	2.91	2.72	2.61	2.44	2.37	2.36
SULFUR, SULFIDE, WT%	2.60		2.25		0.54	1.74	1.21
SULFUR, PYRITIC, WT%		0.44	0.61	0.45	0.16	0.17	0.40
OXYGEN, GRM1117, WT%	14.62	15.46	15.18	15.34*	10.50*	11.53	10.81
METALS, WT%	16.16	17.90	17.68	16.15	12.92	12.72	11.79
ASH, G599, WT%	30.87	34.19	33.77	30.85	23.60	23.24	21.55
SULFUR, WT% OF ASH	2.25*	2.25*	2.25*	2.25*	0.78*	0.78*	0.78*
OXYGEN, WT% OF ASH	45.40*	45.40*	45.40*	45.40*	44.50*	44.50*	44.50*
METALS, WT% OF ASH (BY DIFF)	52.35	52.35	52.35	52.35	54.72	54.72	54.72
PYRIDINE INSOLUABLES, WT%	44.5	47.3	46.7	43.5	36.0	34.2	31.5
MELTING POINT, G898, C	109	132	131	127	140	143	136
HEAT OF COMB., D240, BTU/LB	11174	10690	10707	11172	11857	12348	12667
CONCARBON RSD, D189, WT%	74.7	76.7	77.1	73.4	73.7	72.2	69.9
DISTILLATION, CUSHMAN, C							
CONVERTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	363	397	406	397	392	398	396
INTERMEDIATE BOILING POINT					461	451	
END POINT	468	462	474	456	516	490	467
OVER AT INTERMED BP, WT%					5.6	5.8	
RESIDUE, WT%	90.4	94.5	92.1	93.3	85.8	89.6	91.5

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

YIELDS, WT% MOISTURE FREE COAL

HYDROGEN (BY H BALANCE)	-3.69	-4.02	-3.96	-3.48	-3.80	-3.80	-3.51
METHANE	5.07	5.25	5.31	4.84	5.32	5.32	4.82
ETHANE	3.68	3.86	3.84	3.49	3.69	3.74	3.36
PROPANE	3.66	3.91	3.87	3.45	3.41	3.51	3.04
I-BUTANE	0.25	0.25	0.22	0.19	0.17	0.22	0.20
N-BUTANE	2.01	2.09	2.06	1.81	1.63	1.70	1.48
TOTAL C1 TO C4	14.66	15.35	15.30	13.79	14.22	14.49	12.90
AMMONIA (BY N BALANCE)	0.44	0.50	0.48	0.41	0.39	0.39	0.36
HYDROGEN SULFIDE (BY S BAL)	1.72	1.85	1.87	1.80	1.99	2.00	1.96
CARBON DIOXIDE	0.71	0.59	0.80	0.83	1.24	0.98	1.00
CARBON MONOXIDE	0.22	0.24	0.20	0.22	0.20	0.22	0.18
TOTAL OTHER GASES	3.09	3.17	3.36	3.25	3.81	3.60	3.50
WATER (BY OXYGEN BALANCE)	4.79	5.34	5.38	4.29	6.16	5.80	6.02
C5 - 193 C (C5 - 380 F)	8.73	9.44	8.72	7.62	10.00	7.99	7.48
193 - 288 C (380 - 550 F)	11.84	15.70	14.26	14.29	12.00	13.86	13.48
288 - 482 C (550 - 900 F)	12.69	11.13	13.91	11.99	11.02	11.65	11.81
TOTAL C5+ DISTILLATE*	33.26	36.28	36.90	33.90	33.02	33.49	32.77
482 C+ (900 F+) PYRIDINE SOL.	23.87	21.28	20.62	24.86	28.03	28.71	31.07
INSOLUBLE ORGANIC MATTER	7.56	6.14	5.95	6.94	6.37	5.51	5.05
ASH	16.46	16.46	16.46	16.46	12.19	12.19	12.19
TOTAL 482 C+ (900 F+) PROD	47.88	43.88	43.03	48.26	46.58	46.42	48.32

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER P99-41AVG P99-42AVG P99-43AVG P99-44AVG P99-45AVG P99-46AVG P99-47AVG

YIELDS, WT% MOISTURE AND ASH FREE COAL

HYDROGEN (BY H BALANCE)	-4.41	-4.81	-4.74	-4.16	-4.33	-4.33	-3.99
METHANE	6.06	6.28	6.35	5.80	6.06	6.06	5.49
ETHANE	4.40	4.62	4.59	4.18	4.20	4.26	3.82
PROPANE	4.38	4.67	4.63	4.12	3.88	3.99	3.46
I-BUTANE	0.29	0.30	0.26	0.23	0.20	0.25	0.23
N-BUTANE	2.41	2.50	2.47	2.17	1.85	1.94	1.69
TOTAL C1 TO C4	17.55	18.38	18.31	16.50	16.20	16.51	14.69
AMMONIA (BY N BALANCE)	0.53	0.60	0.58	0.49	0.44	0.45	0.41
HYDROGEN SULFIDE (BY S BAL)	2.06	2.21	2.24	2.16	2.26	2.28	2.23
CARBON DIOXIDE	0.85	0.70	0.96	0.99	1.42	1.12	1.14
CARBON MONOXIDE	0.27	0.29	0.24	0.26	0.22	0.26	0.20
TOTAL OTHER GASES	3.70	3.80	4.03	3.89	4.34	4.10	3.99
WATER (BY OXYGEN BALANCE)	5.73	6.39	6.43	5.13	7.02	6.60	6.85
C5 - 193 C (C5 - 380 F)	10.45	11.30	10.44	9.12	11.39	9.09	8.52
193 - 288 C (380 - 550 F)	14.17	14.80	17.07	17.10	13.67	15.78	15.35
288 - 482 C (550 - 900 F)	15.18	13.33	16.65	14.36	12.55	13.27	13.45
TOTAL C5+ DISTILLATE*	39.81	43.42	44.17	40.58	37.61	38.14	37.32
482 C+ (900 F+) PYRIDINE SOL.	28.57	25.48	24.68	29.76	31.92	32.70	35.39
INSOLUBLE ORGANIC MATTER	9.04	7.35	7.13	8.30	7.25	6.28	5.76
TOTAL 482 C+ ORGANIC PROD	37.62	32.82	31.80	38.06	39.17	38.98	41.14

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

APPENDIX B

**COMPUTER PRINTOUTS OF
INDIVIDUAL PERIODS FOR ROBINSON RUN COAL**

SRC-II RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
DATE (START OF PERIOD)	9-3-78	9-4-78	9-5-78	9-6-78	9-7-78	9-8-78	9-9-78
TIME & DATE CODE (START & END OF PERIOD)	0815 2468	0815 2478	0815 2488	0815 2498	0815 2508	0815 2518	0815 2528
RUN HOURS INCLUDED IN PERIOD	158-177	182-201	206-225	230-249	254-273	278-297	302-321
COAL CHARGE	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447
OPERATING CONDITIONS							
RECYCLE SLURRY/MF COAL RATIO	2.43	2.37	2.37	2.41	2.41	2.40	2.41
OIL TO SOLIDS RATIO	1.27	1.19	1.22	1.24	1.18	1.17	1.14
SLURRY COMPOSITION, WT%							
COAL (MOISTURE FREE)	29.2	29.7	29.7	29.4	29.4	29.4	29.3
DISTILLATE	36.5	34.7	36.8	40.4	34.9	33.9	32.6
482 C+ (900 F+) PYRIDINE SOL.	19.4	19.5	18.1	14.9	19.2	20.0	20.7
PYRIDINE INSOLUABLES	14.9	16.1	15.4	15.3	16.5	16.7	17.5
TOTAL RX PRESSURE, MPA	13.80	13.80	13.79	13.79	13.77	13.81	13.80
PRESS X XH2 IN INLET GAS, MPA	13.00	13.01	12.94	12.93	12.98	12.96	13.00
OUTLET H2 PARTIAL PRESS, MPA	9.85	9.85	9.85	9.85	9.85	9.85	9.85
DISSOLVER TEMPERATURES, C							
ZONE 4 (TOP)	458	458	457	457	457	457	457
ZONE 3	456	456	456	456	456	456	456
ZONE 2	455	455	455	455	455	454	455
ZONE 1 (BTM)	453	453	452	452	452	452	452
AVERAGE	456	455	455	455	455	455	455
PREHEATER OUTLET	387	389	391	389	387	387	388
NOMINAL SLURRY RES. TIME, HR	1.00	1.00	1.00	0.99	0.99	0.99	0.99
WHSV, KG/HR/DM3							
SLURRY	1.20	1.20	1.19	1.21	1.21	1.21	1.22
COAL (MOISTURE FREE)	0.35	0.36	0.35	0.36	0.36	0.36	0.36
DISSOLVER GAS							
DM3/KG SLURRY	455	459	467	467	468	456	461
DM3/KG MF FEED COAL	1560	1547	1573	1591	1593	1552	1572
HYDROGEN CONTENT, VOL%	94.2	94.3	93.9	93.8	94.2	93.9	94.2
FLUSH H2O, % OF PRODUCT H2O	308.0	269.2	153.7	146.6	167.4	205.9	180.7

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
WATER IN THE FEED COAL ASSUMED							
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WEIGHT BALANCE, O/I, WT%	94.1	94.4	97.3	98.1	96.5	97.8	98.0

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WT% FEED COAL

HYDROGEN	-3.72	-3.59	-3.57	-3.58	-3.62	-3.58	-3.53
METHANE	4.94	4.83	5.11	5.17	5.17	5.12	4.98
ETHANE	3.52	3.50	3.74	3.76	3.74	3.73	3.64
PROPANE	3.55	3.53	3.68	3.67	3.69	3.78	3.62
I-BUTANE	0.23	0.25	0.27	0.27	0.25	0.24	0.21
N-BUTANE	1.99	2.02	2.01	1.95	2.07	2.04	1.94
TOTAL C1 TO C4	14.23	14.13	14.81	14.81	14.92	14.90	14.39
AMMONIA	0.49	0.47	0.41	0.46	0.45	0.44	0.43
HYDROGEN SULFIDE	2.10	2.11	1.75	1.61	1.67	1.68	1.63
CARBON DIOXIDE	0.73	0.71	0.65	0.69	0.70	0.70	0.70
CARBON MONOXIDE	0.25	0.26	0.17	0.21	0.21	0.20	0.25
TOTAL OTHER GASES	3.58	3.56	2.97	2.97	3.03	3.02	3.00
WATER	5.14	5.01	5.22	4.53	4.91	4.80	4.65
DEBUTANIZER LIQUID	8.72	9.57	9.08	9.35	8.02	12.12	17.18
PROCESS SOLVENT	16.88	15.43	17.66	19.18	22.03	15.06	10.92
TOTAL C5+ DISTILLATE	25.60	25.00	26.75	28.53	30.05	27.18	28.09
VACUUM TOWER BOTTOMS	55.17	55.89	53.82	52.74	50.71	53.68	53.40
CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE							
DM3/KG FEED COAL	436	421	419	420	425	420	414
CONVERSIONS, WT% FEED COAL							
HYDROCRACKING	59.6	58.5	60.2	63.4	65.4	62.4	61.9
DESULFURIZATION	46.4	48.2	51.1	46.2	58.8	52.8	53.8
DENITROGENATION	28.8	25.8	29.1	28.0	29.7	29.9	28.3
OXYGEN REMOVAL	37.9	40.9	34.6	36.7	37.3	32.1	35.9

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
GAS RATES, DM3/KG FEED COAL							
DISSOLVER INLET GAS	1133.8	1094.6	1059.5	1040.0	1064.1	1044.9	1049.0
TOTAL QUENCH GAS	523.1	545.3	557.9	582.0	586.7	542.4	554.6
TOTAL DISSOLVER GAS	1656.9	1639.9	1617.4	1622.0	1650.8	1587.7	1603.6
MAKEUP GAS TO DISSOLVER	590.6	587.7	560.4	538.8	539.4	509.6	555.3
MAKEUP GAS TO SEP. SPARGE	90.3	84.0	97.2	117.4	130.5	144.3	107.5
MAKEUP GAS TO INSTRUMENT TAPS	278.7	272.2	266.1	262.9	267.2	263.4	263.0
TOTAL MAKEUP GAS	959.6	943.9	923.7	919.1	937.1	917.3	925.9
DISSOLVER OUTLET GAS	1370.6	1367.3	1350.9	1354.8	1380.0	1321.4	1338.6
GAS LEAVING SCRUBBERS	1753.7	1723.6	1749.3	1826.9	1898.2	1890.2	1769.6
SEPARATOR SPARGE GAS	253.5	234.4	280.6	353.4	399.5	449.5	310.6
PRODUCT GASES							
BLEED OFF GAS	519.3	516.4	499.5	498.5	508.7	498.0	509.7
DEBUTANIZER GAS	55.7	54.4	53.2	52.6	53.4	52.7	52.6
AMINE REACTIVATOR GAS	14.2	13.9	11.9	10.7	11.2	11.1	11.1
NAPTHA REACTIVATOR GAS	79.2	82.0	83.2	80.9	83.9	80.4	78.9
CHROMATOGRAPH BLEED GAS	5.0	4.6	9.5	9.2	9.1	8.8	8.6
ELEMENTAL BALANCES							
WATER IN THE FEED COAL ASSUMED							
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CARBON, O/I	0.99	0.99	0.99	1.00	1.01	0.99	1.00
HYDROGEN, O/I	0.97	0.99	1.01	1.02	1.03	1.01	1.03
NITROGEN, O/I	1.03	1.05	0.97	1.01	0.99	0.98	0.99
SULFUR, O/I	1.16	1.14	1.00	1.01	0.91	0.97	0.94
OXYGEN, O/I	1.01	0.97	1.04	0.98	1.00	1.04	0.99
METALS, O/I	1.07	1.07	1.01	0.98	0.95	0.99	1.02
ASH, O/I	1.07	1.07	1.01	0.98	0.95	0.99	1.02

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
YIELDS, WT% MOISTURE FREE COAL							
HYDROGEN (BY H BALANCE)	-3.46	-3.56	-3.66	-3.72	-3.81	-3.67	-3.85
METHANE	5.01	4.87	5.16	5.14	5.12	5.16	4.99
ETHANE	3.57	3.53	3.78	3.74	3.71	3.75	3.65
PROPANE	3.61	3.56	3.71	3.65	3.66	3.80	3.63
I-BUTANE	0.23	0.25	0.27	0.27	0.25	0.24	0.21
N-BUTANE	2.02	2.04	2.03	1.94	2.05	2.06	1.95
TOTAL C1 TO C4	14.44	14.25	14.96	14.74	14.80	15.01	14.42
AMMONIA (BY N BALANCE)	0.43	0.39	0.44	0.44	0.47	0.46	0.44
HYDROGEN SULFIDE (BY S BAL)	1.54	1.61	1.71	1.57	2.00	1.77	1.82
CARBON DIOXIDE	0.74	0.72	0.66	0.68	0.69	0.70	0.70
CARBON MONOXIDE	0.25	0.27	0.17	0.21	0.21	0.20	0.25
TOTAL OTHER GASES	2.97	2.99	2.98	2.90	3.37	3.14	3.20
WATER (BY OXYGEN BALANCE)	4.85	5.38	4.51	4.94	5.04	4.08	4.71
DEBUTANIZER LIQUID	8.85	9.66	9.17	9.31	7.96	12.21	17.22
PROCESS SOLVENT	17.12	15.57	17.83	19.10	21.85	15.17	10.94
TOTAL C5+ DISTILLATE	25.97	25.22	27.00	28.41	29.81	27.38	28.16
VTB PYRIDINE SOLUABLES	31.81	31.62	28.40	28.68	27.97	29.20	30.45
INSOLUABLE ORGANIC MATTER	6.95	7.63	9.34	7.60	6.38	8.41	6.44
ASH	16.46	16.46	16.46	16.46	16.46	16.46	16.46
VACUUM TOWER BOTTOMS	55.22	55.71	54.20	52.73	50.80	54.06	53.35
CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL							
BY HYDROGEN BALANCE	405	418	430	437	447	430	451
CONVERSIONS, WT% MF COAL							
HYDROCRACKING	59.0	58.2	59.8	63.5	65.7	62.1	61.8
DESULFURIZATION	45.7	47.7	50.7	46.4	59.2	52.5	53.7
DENITROGENATION	27.8	25.2	28.4	28.3	30.2	29.4	28.2
OXYGEN REMOVAL	36.5	39.8	33.5	36.6	37.2	31.1	35.3

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
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GAS COMPOSITIONS, VOL%

REACTOR INLET GAS

HYDROGEN	94.22	94.25	93.86	93.79	94.20	93.91	94.16
METHANE	5.02	4.95	5.33	5.41	5.07	5.28	5.06
ETHANE	0.73	0.72	0.76	0.78	0.72	0.80	0.76
PROPANE	0.00	0.01	0.00	0.00	0.00	0.01	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.04	0.07	0.05	0.02	0.00	0.00	0.01
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00

REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)

HYDROGEN	77.77	78.07	77.13	77.52	77.92	77.02	77.92
METHANE	10.82	10.61	11.37	11.57	11.07	11.51	11.05
ETHANE	2.78	2.76	2.96	2.99	2.88	3.06	2.94
PROPANE	1.34	1.34	1.40	1.41	1.39	1.49	1.42
I-BUTANE	0.10	0.10	0.10	0.10	0.10	0.11	0.10
N-BUTANE	0.57	0.57	0.58	0.56	0.59	0.60	0.57
HYDROGEN SULFIDE	1.01	1.02	0.85	0.79	0.80	0.84	0.80
CARBON MONOXIDE	0.19	0.24	0.15	0.15	0.12	0.12	0.16
CARBON DIOXIDE	0.27	0.27	0.25	0.26	0.26	0.27	0.27
AMMONIA	0.48	0.46	0.40	0.45	0.43	0.44	0.42
WATER	4.67	4.57	4.81	4.19	4.44	4.54	4.35

BLEED OFF GAS

HYDROGEN	88.65	88.97	88.44	87.98	88.37	87.95	88.36
METHANE	9.40	9.15	9.78	10.08	9.78	9.96	9.60
ETHANE	1.44	1.36	1.44	1.51	1.43	1.56	1.51
PROPANE	0.12	0.09	0.06	0.08	0.07	0.19	0.12
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.40	0.43	0.28	0.35	0.34	0.34	0.41
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
GAS COMPOSITIONS, VOL%							
AMINE REACTIVATOR GAS							
HYDROGEN	15.19	15.24	16.59	18.39	20.25	19.33	20.79
METHANE	0.49	0.48	0.61	0.79	0.71	0.84	0.51
ETHANE	0.06	0.06	0.08	0.05	0.05	0.06	0.10
PROPANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	66.58	66.59	61.26	57.65	56.54	56.95	55.63
CARBON MONOXIDE	0.09	0.11	0.07	0.16	0.11	0.17	0.07
CARBON DIOXIDE	17.60	17.52	21.39	22.96	22.34	22.66	22.89
NAPHTHA REACTIVATOR GAS							
HYDROGEN	27.36	27.40	26.56	26.72	27.29	26.78	27.71
METHANE	21.77	21.76	23.31	23.42	23.45	23.27	22.68
ETHANE	21.29	21.42	22.17	22.25	21.90	21.78	21.78
PROPANE	18.83	18.76	18.49	18.42	18.21	18.62	18.58
I-BUTANE	1.23	1.23	1.17	1.18	1.17	1.22	1.19
N-BUTANE	6.94	6.92	6.25	5.13	6.12	6.43	6.29
PENTANES	1.92	1.96	1.65	1.60	1.60	1.69	1.58
HYDROGEN SULFIDE	0.43	0.34	0.18	0.08	0.04	0.02	0.01
CARBON MONOXIDE	0.01	0.01	0.01	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.21	0.21	0.21	0.21	0.21	0.19	0.18
DEBUTANIZER GAS							
HYDROGEN	61.80	64.18	56.54	54.61	54.93	52.69	55.19
METHANE	12.63	11.70	13.24	13.18	12.80	13.88	13.01
ETHANE	6.75	6.00	7.67	3.20	7.74	8.47	8.01
PROPANE	7.01	6.23	8.12	3.87	8.50	9.01	8.73
I-BUTANE	0.74	0.73	0.86	0.91	0.96	0.95	0.91
N-BUTANE	4.81	4.79	5.68	5.76	6.28	6.13	5.78
PENTANES	2.36	2.37	2.69	2.70	2.85	2.81	2.60
HYDROGEN SULFIDE	3.89	4.00	5.18	5.75	5.89	5.92	5.71
CARBON MONOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.00	0.00	0.02	0.04	0.05	0.15	0.06

COAL INSPECTIONS

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
FEED COAL							
ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	68.30	68.30	68.30	68.30	68.30	68.30	68.30
HYDROGEN, SEMI-MICRO, WT%	4.94	4.94	4.94	4.94	4.94	4.94	4.94
NITROGEN, GB11, WT%	1.28	1.28	1.28	1.28	1.28	1.28	1.28
SULFUR, TOTAL, GRM1159, WT%	3.18	3.18	3.18	3.18	3.18	3.18	3.18
SULFUR, ORGANIC, WT%	0.62	0.62	0.62	0.62	0.62	0.62	0.62
SULFUR, PYRITIC, WT%	2.49	2.49	2.49	2.49	2.49	2.49	2.49
SULFUR, SULFATE, WT%	0.07	0.07	0.07	0.07	0.07	0.07	0.07
OXYGEN, GRM1117, WT%	13.69	13.69	13.69	13.69	13.69	13.69	13.69
OXYGEN, ORGANIC, WT%	5.72	5.72	5.72	5.72	5.72	5.72	5.72
OXYGEN, INORGANIC, WT%	7.97	7.97	7.97	7.97	7.97	7.97	7.97
METALS, BY SPEC ASH, WT%	8.61	8.61	8.61	8.61	8.61	8.61	8.61
MINERAL MATTER, WT%*	19.14	19.14	19.14	19.14	19.14	19.14	19.14
MOISTURE, D271, WT%	0.95	0.95	0.95	0.95	0.95	0.95	0.95
VOLATILE MATTER, WT%	34.40	34.40	34.40	34.40	34.40	34.40	34.40
ASH, D271, WT%	16.46	16.46	16.46	16.46	16.46	16.46	16.46
SULFUR, WT% OF ASH	2.25	2.25	2.25	2.25	2.25	2.25	2.25
OXYGEN, WT% OF ASH	45.40	45.40	45.40	45.40	45.40	45.40	45.40
ALUMINUM, WT% OF ASH	15.0	15.0	15.0	15.0	15.0	15.0	15.0
CALCIUM, WT% OF ASH	3.3	3.3	3.3	3.3	3.3	3.3	3.3
IRON, WT% OF ASH	10.0	10.0	10.0	10.0	10.0	10.0	10.0
MAGNESIUM, WT% OF ASH	2.0	2.0	2.0	2.0	2.0	2.0	2.0
POTASSIUM, WT% OF ASH	1.3	1.3	1.3	1.3	1.3	1.3	1.3
SILICON, WT% OF ASH	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SODIUM, WT% OF ASH	.4	.4	.4	.4	.4	.4	.4
TITANIUM, WT% OF ASH	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TRACE METALS, WT% OF ASH	.1	.1	.1	.1	.1	.1	.1
PARTICLE SIZE DISTRIBUTION, WT%							
ON 80 MESH							
THRU 80 ON 200 MESH	3.9	3.9	3.9	3.9	3.9	3.9	3.9
THRU 200 ON 325 MESH	20.6	20.6	20.6	20.6	20.6	20.6	20.6
THRU 325 ON 625 MESH	35.7	35.7	35.7	35.7	35.7	35.7	35.7
THRU 625 MESH	39.8	39.8	39.8	39.8	39.8	39.8	39.8

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
DEBUTANIZER BOTTOMS							
GRAVITY, D287, API			38.4	38.5	39.8	37.6	30.7
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	84.42*	84.42*	84.30	84.45	84.43	84.14*	84.03
HYDROGEN, SEMI-MICRO, WT%	11.73*	11.73*	11.96	11.77	12.07	11.69*	11.68*
NITROGEN, G811, WT%	0.54*	0.54*	0.54	0.54	0.49	0.58	0.74
SULFUR, GRM1156, WT%	0.20*	0.20*	0.27	0.13	0.18	0.19*	0.16
OXYGEN, GRM1117, WT%	3.11*	3.11*	2.93	3.11	2.79	3.40	3.39*
VISCOSITY, KIN, D445, CS							
-35C							
0C							2.61
WATER, G525, PPM	5406*	5970*	5406	5970	6391	6354	9695
HEAT OF CUMB., D240, BTU/LB							17877
POUR POINT, D97, C							-53
DISTILLATION, D86, C							
INITIAL BOILING POINT			60	61	54	58	61
5 VOL %			71	71	73	72	73
10 VOL %			89	90	88	93	93
30 VOL %			118	120	116	123	145
50 VOL %			140	142	138	148	171
70 VOL %			154	164	158	166	184
90 VOL %			187	190	182	186	199
95 VOL %			205	202	201	204	210
END POINT			227	217	244	231	232
WATER (INCLUDES FLUSH WATER)							
TOTAL CARBON, PPM	19000	19200	23400	24750	27000	25800	20200
ORGANIC CARBON, PPM	16000	16200	20340	20700	23400	22300	16550
NITROGEN, G811, WT%	1.90	1.86	2.53	2.88	2.48	2.47	2.44
SULFUR, GRM1156, WT%	1.69	1.91	2.00*	2.00*	1.93	2.10	2.00*

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
PROCESS SOLVENT							
GRAVITY, D287, API			11.4	11.5	11.8		11.3
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	87.31*	87.31*	87.09*	87.11*	87.01	86.99*	87.27*
HYDROGEN, SEMI-MICRO, WT%	9.00*	9.00*	8.95	8.96	9.12	9.09	9.00
NITROGEN, GB11, WT%	1.00*	1.00*	1.00	1.02	1.01	1.00	1.04
SULFUR, GRM1156, WT%	0.19*	0.19*	0.17	0.12	0.17	0.14	0.19
OXYGEN, GRM1117, WT%	2.50*	2.50*	2.79	2.79	2.69	2.79	2.50
VISCOSITY, KIN, D445, CS							
25 C							11.03
50 C							4.54
100 C							1.62
WATER, G525, PPM	750*	750*	1106	651	768	651	621
HEAT OF COMB., D240, BTU/LB							17503
POUR POINT, D97, C							-37
DISTILLATION, CUSHMAN, C							
CORRECTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT			193	196	199	193	214
10 VOL %			221	224	221	224	241
20 VOL %			231	231	232	232	249
30 VOL %			239	238	241	242	259
40 VOL %			250	252	251	253	267
50 VOL %			259	259	285	261	281
60 VOL %			288	285	307	293	301
70 VOL %			308	307	333	316	321
80 VOL %			332	332	363	338	349
90 VOL %			378	378	387	367	383
END POINT			456	467	477	465	500

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
VACUUM TOWER BOTTOMS							
SPECIFIC GRAVITY, D70, G/CC	1.48	1.46	1.48	1.43	1.44	1.44	1.46
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	61.36	62.34	60.93	61.01*	61.22	60.87	61.30*
HYDROGEN, SEMI-MICRO, WT%	3.80	4.01	3.90	3.94*	3.94	3.83	3.95*
NITROGEN, G811, WT%	1.24	1.32	1.26	1.27	1.24	1.23	1.24
SULFUR, TOTAL, D1552, WT%	2.97	2.84	2.77	3.16	2.46	2.69	2.63
SULFUR, SULFIDE, WT%							2.60
SULFUR, PYRITIC, WT%							
OXYGEN, GRM1117, WT%	14.01	13.15	15.14	14.76*	15.16	15.58	14.63
METALS, WT%	16.61	16.35	16.00	15.87	15.98	15.80	16.25
ASH, G599, WT%	31.73	31.23	30.57	30.31*	30.52	30.18	31.04
SULFUR, WT% OF ASH	2.25*	2.25*	2.25*	2.25*	2.25*	2.25*	2.25*
OXYGEN, WT% OF ASH	45.40*	45.40*	45.40*	45.40*	45.40*	45.40*	45.40*
METALS, WT% OF ASH (BY DIFF)	52.35	52.35	52.35	52.35	52.35	52.35	52.35
PYRIDINE INSOLUABLES, WT%	42.8	43.6	47.4	45.1	44.0*	45.6	42.7
MELTING POINT, G898, C	125	125	110	82	110	106	108
HEAT OF COMB., D240, BTU/LB							11174
CONCARBON RSD, D189, WT%							74.7
DISTILLATION, CUSHMAN, C							
CONVERTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	372	378	360		364	339	366
INTERMEDIATE BOILING POINT							
END POINT			450	473	483	471	461
OVER AT INTERMED BP, WT%							
RESIDUE, WT%	92.4	92.8	92.0	88.0*	86.9	88.2	90.1

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
YIELDS, WT% MOISTURE FREE COAL							
HYDROGEN (BY H BALANCE)	-3.46	-3.56	-3.66	-3.72	-3.81	-3.67	-3.85
METHANE	5.01	4.87	5.16	5.14	5.12	5.16	4.99
ETHANE	3.57	3.53	3.78	3.74	3.71	3.75	3.65
PROPANE	3.61	3.56	3.71	3.65	3.66	3.80	3.63
I-BUTANE	0.23	0.25	0.27	0.27	0.25	0.24	0.21
N-BUTANE	2.02	2.04	2.03	1.94	2.05	2.06	1.95
TOTAL C1 TO C4	14.44	14.25	14.96	14.74	14.80	15.01	14.42
AMMONIA (BY N BALANCE)	0.43	0.39	0.44	0.44	0.47	0.46	0.44
HYDROGEN SULFIDE (BY S BAL)	1.54	1.61	1.71	1.57	2.00	1.77	1.82
CARBON DIOXIDE	0.74	0.72	0.66	0.68	0.69	0.70	0.70
CARBON MONOXIDE	0.25	0.27	0.17	0.21	0.21	0.20	0.25
TOTAL OTHER GASES	2.97	2.99	2.98	2.90	3.37	3.14	3.20
WATER (BY OXYGEN BALANCE)	4.85	5.38	4.51	4.94	5.04	4.08	4.71
C5 - 193 C (C5 - 380 F)	7.25	7.92	7.81	7.63	6.58	10.02	12.07
193 - 288 C (380 - 550 F)	11.87	11.08	12.61	13.90	12.94	11.44	11.30
288 - 482 C (550 - 900 F)	13.48	12.91	12.43	13.62	16.79	12.73	11.09
TOTAL C5+ DISTILLATE*	32.60	31.91	32.86	35.15	36.31	34.19	34.45
482 C+ (900 F+) PYRIDINE SOL.	25.19	24.94	22.55	21.93	21.46	22.38	24.16
INSOLUBLE ORGANIC MATTER	6.95	7.63	9.34	7.60	6.38	8.41	6.44
ASH	16.46	16.46	16.46	16.46	16.46	16.46	16.46
TOTAL 482 C+ (900 F+) PROD	48.60	49.03	48.35	45.98	44.30	47.25	47.05

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-41-3	P99-41-4	P99-41-5	P99-41-6	P99-41-7	P99-41-8	P99-41-9
YIELDS, WT% MOISTURE AND ASH FREE COAL							
HYDROGEN (BY H BALANCE)	-4.14	-4.27	-4.39	-4.46	-4.57	-4.39	-4.60
METHANE	6.00	5.83	6.18	6.16	6.13	6.17	5.98
ETHANE	4.28	4.23	4.53	4.48	4.44	4.49	4.36
PROPANE	4.32	4.27	4.44	4.37	4.39	4.55	4.34
I-BUTANE	0.28	0.30	0.33	0.32	0.30	0.28	0.25
N-BUTANE	2.42	2.44	2.42	2.32	2.45	2.46	2.33
TOTAL C1 TO C4	17.29	17.06	17.90	17.65	17.71	17.96	17.27
AMMONIA (BY N BALANCE)	0.52	0.47	0.53	0.53	0.56	0.55	0.53
HYDROGEN SULFIDE (BY S BAL)	1.85	1.93	2.05	1.88	2.39	2.12	2.17
CARBON DIOXIDE	0.89	0.86	0.79	0.82	0.83	0.84	0.84
CARBON MONOXIDE	0.30	0.32	0.20	0.25	0.25	0.25	0.30
TOTAL OTHER GASES	3.56	3.58	3.57	3.48	4.03	3.76	3.83
WATER (BY OXYGEN BALANCE)	5.81	6.44	5.40	5.91	6.03	4.89	5.64
C5 - 193 C (C5 - 380 F)	8.68	9.48	9.35	9.14	7.88	12.00	14.45
193 - 288 C (380 - 550 F)	14.20	13.26	15.09	16.64	15.48	13.69	13.52
288 - 482 C (550 - 900 F)	16.13	15.46	14.88	16.31	20.10	15.23	13.27
TOTAL C5+ DISTILLATE*	39.02	38.19	39.33	42.08	43.46	40.92	41.24
482 C+ (900 F+) PYRIDINE SOL.	30.15	29.85	26.99	26.25	25.69	26.79	28.92
INSOLUBLE ORGANIC MATTER	8.32	9.14	11.18	9.09	7.64	10.06	7.71
TOTAL 482 C+ ORGANIC PROD	38.47	38.99	38.18	35.34	33.33	36.86	36.63

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

SRC-II RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
DATE (START OF PERIOD)	9-21-78	9-22-78	9-23-78	9-24-78	9-25-78	9-26-78	9-27-78
TIME & DATE CODE (START & END OF PERIOD)	0815 2648 0415 2658	0815 2658 0415 2668	0815 2668 0415 2678	0815 2678 0415 2688	0815 2688 0415 2698	0815 2698 0415 2708	0815 2708 0415 2718
RUN HOURS INCLUDED IN PERIOD	52-71	76-95	100-119	124-143	148-167	172-191	196-215
COAL CHARGE	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447
OPERATING CONDITIONS							
RECYCLE SLURRY/MF COAL RATIO	3.09	3.09	3.05	3.09	3.07	3.11	3.05
OIL TO SOLIDS RATIO	1.26	1.22	1.20	1.20	1.15	1.18	1.20
SLURRY COMPOSITION, WT%							
COAL (MOISTURE FREE)	24.4	24.4	24.7	24.5	24.6	24.3	24.7
DISTILLATE	32.5	31.9	31.9	33.0	32.5	33.2	32.0
482 C+ (900 F+) PYRIDINE SOL.	23.3	23.0	22.7	21.4	21.0	21.0	22.6
PYRIDINE INSOLUABLES	19.8	20.7	20.7	21.1	21.9	21.5	20.8
TOTAL RX PRESSURE, MPA	13.79	13.78	13.79	13.79	13.77	13.78	13.79
PRESS X %H ₂ IN INLET GAS, MPA	13.01	13.01	13.02	13.00	12.95	12.98	12.98
OUTLET H ₂ PARTIAL PRESS, MPA	9.66	9.66	9.66	9.66	9.66	9.66	9.66
DISSOLVER TEMPERATURES, C							
ZONE 4 (TOP)	457	457	457	457	457	457	457
ZONE 3	456	456	456	456	456	456	456
ZONE 2	455	455	455	455	455	455	455
ZONE 1 (BTM)	452	453	453	453	453	452	452
AVERAGE	455	455	455	455	455	455	455
PREHEATER OUTLET	393	391	389	390	389	389	388
NOMINAL SLURRY RES. TIME, HR	0.99	0.99	1.00	0.99	0.99	0.98	1.00
WHSV, KG/HR/DM3							
SLURRY	1.22	1.22	1.20	1.21	1.21	1.22	1.20
COAL (MOISTURE FREE)	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DISSOLVER GAS							
DM3/KG SLURRY	390	385	390	379	405	386	388
DM3/KG MF FEED COAL	1596	1577	1581	1549	1649	1584	1572
HYDROGEN CONTENT, VOL%	94.4	94.4	94.4	94.3	94.0	94.2	94.1
FLUSH H ₂ O, % OF PRODUCT H ₂ O	190.6	204.8	253.3	282.8	255.9	198.7	220.3

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
WATER IN THE FEED COAL ASSUMED							
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WEIGHT BALANCE, O/I, WT%	99.4	98.5	97.6	97.1	98.2	99.7	99.9

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WT% FEED COAL

HYDROGEN	-3.73	-3.90	-4.08	-3.95	-3.94	-3.90	-3.73
METHANE	5.26	5.38	5.17	5.23	5.30	5.23	5.23
ETHANE	3.87	3.91	3.73	3.83	3.90	3.92	3.95
PROPANE	3.89	3.93	3.77	3.83	3.94	3.98	4.01
I-BUTANE	0.24	0.26	0.22	0.22	0.23	0.28	0.28
N-BUTANE	2.11	2.08	2.00	2.07	2.10	2.16	2.15
TOTAL C1 TO C4	15.37	15.56	14.90	15.23	15.48	15.57	15.63
AMMONIA	0.48	0.48	0.50	0.50	0.51	0.44	0.48
HYDROGEN SULFIDE	1.79	1.76	1.73	1.74	1.72	1.72	1.74
CARBON DIOXIDE	0.59	0.60	0.59	0.61	0.57	0.57	0.60
CARBON MONOXIDE	0.23	0.24	0.23	0.24	0.27	0.27	0.21
TOTAL OTHER GASES	3.09	3.08	3.06	3.09	3.07	3.00	3.04
WATER	5.33	5.53	5.27	4.89	4.84	5.22	5.25
DEBUTANIZER LIQUID	17.40	24.97	26.93	24.71	20.35	16.22	20.22
PROCESS SOLVENT	20.65	9.67	5.42	4.59	11.26	15.82	13.09
TOTAL C5+ DISTILLATE	38.05	34.64	32.35	29.29	31.61	32.04	33.31
VACUUM TOWER BOTTOMS	41.89	45.09	48.51	51.44	48.94	48.08	46.50
CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE							
DM3/KG FEED COAL	437	457	479	463	462	458	438
CONVERSIONS, WT% FEED COAL							
HYDROCRACKING	68.3	66.6	63.7	63.2	64.8	66.0	66.7
DESULFURIZATION	57.4	52.6	50.4	51.4	54.2	55.5	59.5
DENITROGENATION	33.2	34.5	32.0	30.0	29.5	30.7	32.0
OXYGEN REMOVAL	43.9	41.0	37.2	34.5	36.4	38.8	39.8

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
GAS RATES, DM3/KG FEED COAL							
DISSOLVER INLET GAS	1025.0	977.2	1047.3	1040.5	976.3	895.2	942.5
TOTAL QUENCH GAS	580.4	624.4	572.2	554.1	702.7	693.9	631.1
TOTAL DISSOLVER GAS	1605.4	1601.6	1619.5	1594.6	1679.1	1589.0	1573.6
MAKEUP GAS TO DISSOLVER	518.5	519.3	518.8	477.6	529.5	510.0	479.4
MAKEUP GAS TO SEP. SPARGE	121.1	122.4	133.6	141.6	81.4	91.4	100.2
MAKEUP GAS TO INSTRUMENT TAPS	310.8	313.8	316.7	318.2	314.7	310.0	309.4
TOTAL MAKEUP GAS	950.3	955.5	969.0	937.5	925.5	911.4	895.0
DISSOLVER OUTLET GAS	1326.1	1304.0	1294.8	1288.6	1375.9	1290.2	1294.7
GAS LEAVING SCRUBBERS	1849.7	1831.5	1863.9	1911.6	1780.7	1716.6	1784.1
SEPARATOR SPARGE GAS	374.9	377.5	417.0	472.9	258.1	284.7	348.5
PRODUCT GASES							
BLEED OFF GAS	504.8	489.0	469.5	453.3	445.1	435.7	439.3
DEBJTANIZER GAS	59.2	60.0	59.6	59.1	60.9	60.9	61.0
AMINE REACTIVATOR GAS	11.9	11.7	11.7	11.9	11.5	11.4	11.3
NAPTHA REACTIVATOR GAS	91.1	92.0	93.3	97.1	95.6	96.0	96.2
CHROMATOGRAPH BLEED GAS	4.1	15.1	10.2	10.0	9.2	8.6	8.2
ELEMENTAL BALANCES							
WATER IN THE FEED COAL ASSUMED LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CARBON, O/I	1.02	1.00	0.99	0.99	1.00	1.00	1.00
HYDROGEN, O/I	1.05	1.03	0.98	0.99	1.00	1.00	1.05
NITROGEN, O/I	0.98	0.96	1.00	1.02	1.03	0.98	0.99
SULFUR, O/I	0.95	0.99	1.01	1.00	0.97	0.95	0.92
OXYGEN, O/I	0.95	0.99	1.01	1.02	0.99	0.99	0.99
METALS, O/I	0.90	0.97	1.04	1.04	1.00	1.00	0.98
ASH, O/I	0.90	0.97	1.04	1.04	1.00	1.00	0.98

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
YIELDS, WT% MOISTURE FREE COAL							
HYDROGEN (BY H BALANCE)	-4.15	-4.16	-3.92	-3.86	-3.95	-3.88	-4.19
METHANE	5.16	5.36	5.20	5.27	5.29	5.21	5.21
ETHANE	3.80	3.90	3.75	3.86	3.89	3.91	3.94
PROPANE	3.81	3.92	3.79	3.92	3.93	3.96	4.00
I-BUTANE	0.24	0.26	0.23	0.22	0.23	0.28	0.28
N-BUTANE	2.07	2.07	2.02	2.09	2.10	2.15	2.14
TOTAL C1 TO C4	15.08	15.51	14.99	15.35	15.45	15.51	15.58
AMMONIA (BY N BALANCE)	0.54	0.54	0.49	0.46	0.46	0.48	0.50
HYDROGEN SULFIDE (BY S BAL)	1.97	1.78	1.70	1.72	1.83	1.88	2.02
CARBON DIOXIDE	0.58	0.60	0.59	0.61	0.57	0.57	0.60
CARBON MONOXIDE	0.23	0.24	0.24	0.24	0.27	0.26	0.21
TOTAL OTHER GASES	3.31	3.16	3.01	3.03	3.13	3.20	3.33
WATER (BY OXYGEN BALANCE)	6.27	5.67	5.00	4.56	4.95	5.34	5.50
DEBUTANIZER LIQUID	17.08	24.90	27.09	24.90	20.31	16.16	20.16
PROCESS SOLVENT	20.26	9.64	5.45	4.62	11.24	15.76	13.05
TOTAL C5+ DISTILLATE	37.35	34.54	32.54	29.52	31.54	31.92	33.21
VTB PYRIDINE SOLUABLES	21.86	23.03	25.47	27.17	25.92	24.84	23.96
INSOLUBLE ORGANIC MATTER	3.83	5.79	6.45	7.77	6.50	6.62	6.15
ASH	16.46	16.46	16.46	16.46	16.46	16.46	16.46
VACUUM TOWER BOTTOMS	42.15	45.28	48.37	51.39	48.87	47.91	46.57
CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL							
BY HYDROGEN BALANCE	487	487	460	453	463	455	491
CONVERSIONS, WT% MF COAL							
HYDROCRACKING	68.9	66.7	63.5	62.9	64.9	66.1	66.8
DESULFURIZATION	58.2	52.8	50.1	51.0	54.3	55.7	59.7
DENITROGENATION	34.4	34.7	31.6	29.4	29.7	30.9	32.2
OXYGEN REMOVAL	44.7	40.9	36.6	33.9	36.3	38.8	39.8

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
GAS COMPOSITIONS, VOL%							
REACTOR INLET GAS							
HYDROGEN	94.37	94.37	94.43	94.31	94.01	94.19	94.06
METHANE	4.95	5.01	4.95	5.10	5.35	5.18	5.31
ETHANE	0.67	0.62	0.58	0.59	0.62	0.59	0.62
PROPANE	0.00	0.00	0.00	0.00	0.01	0.00	0.01
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.01	0.00	0.05	0.00	0.00	0.04	0.00
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)							
HYDROGEN	76.82	76.18	76.62	76.52	77.15	76.16	76.08
METHANE	11.23	11.57	11.45	11.71	11.66	11.72	11.77
ETHANE	2.97	2.97	2.86	2.95	2.88	2.98	3.01
PROPANE	1.51	1.55	1.50	1.57	1.51	1.59	1.61
I-BUTANE	0.11	0.11	0.10	0.11	0.11	0.12	0.11
N-BUTANE	0.62	0.62	0.60	0.63	0.60	0.65	0.64
HYDROGEN SULFIDE	0.89	0.88	0.88	0.89	0.83	0.88	0.88
CARBON MONOXIDE	0.15	0.15	0.20	0.15	0.16	0.21	0.13
CARBON DIOXIDE	0.22	0.23	0.23	0.24	0.21	0.23	0.24
AMMONIA	0.48	0.48	0.51	0.52	0.49	0.45	0.49
WATER	4.99	5.26	5.05	4.73	4.40	5.03	5.04
BLEED OFF GAS							
HYDROGEN	88.53	88.18	88.71	88.38	87.80	88.01	88.13
METHANE	9.65	10.05	9.64	9.93	10.39	10.25	10.17
ETHANE	1.35	1.29	1.17	1.20	1.27	1.22	1.25
PROPANE	0.07	0.07	0.07	0.04	0.04	0.02	0.04
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.39	0.41	0.42	0.44	0.51	0.51	0.40
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
GAS COMPOSITIONS, VOL%							
AMINE REACTIVATOR GAS							
HYDROGEN	16.57	15.98	16.88	15.99	16.48	14.79	12.39
METHANE	1.68	1.84	1.75	1.87	1.85	1.96	1.95
ETHANE	0.36	0.38	0.35	0.33	0.39	0.40	0.37
PROPANE	0.04	0.01	0.00	0.00	0.00	0.00	0.01
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.01	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	58.15	57.91	57.34	53.30	57.30	58.61	60.18
CARBON MONOXIDE	0.02	0.03	0.06	0.05	0.04	0.02	0.09
CARBON DIOXIDE	23.16	23.86	23.63	23.46	23.93	24.22	25.02
NAPHTHA REACTIVATOR GAS							
HYDROGEN	29.37	28.37	30.33	29.49	28.10	27.32	26.04
METHANE	23.08	23.98	24.47	24.77	24.63	25.02	25.12
ETHANE	21.32	21.98	21.14	21.25	21.90	22.22	22.37
PROPANE	17.52	17.35	16.25	16.42	17.07	17.15	17.65
I-BUTANE	1.10	1.06	0.99	1.02	1.05	1.07	1.12
N-BUTANE	5.93	5.68	5.32	5.48	5.65	5.60	5.96
PENTANES	1.47	1.37	1.27	1.35	1.39	1.38	1.52
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.00	0.00	0.01	0.00	0.00	0.02	0.01
CARBON DIOXIDE	0.22	0.21	0.22	0.22	0.21	0.22	0.21
DEBUTANIZER GAS							
HYDROGEN	56.52	56.78	56.95	57.12	57.64	56.59	59.12
METHANE	13.58	13.56	13.59	13.62	13.81	13.65	13.42
ETHANE	7.75	7.57	7.60	7.63	7.45	7.41	7.19
PROPANE	8.29	8.52	8.63	8.74	8.39	8.40	7.66
I-BUTANE	0.83	0.85	0.84	0.84	0.84	0.91	0.79
N-BUTANE	5.54	5.51	5.46	5.41	5.34	5.70	5.06
PENTANES	2.53	2.34	2.29	2.24	2.13	2.39	2.24
HYDROGEN SULFIDE	4.92	4.79	4.54	4.28	4.33	4.81	4.46
CARBON MONOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.04	0.08	0.10	0.13	0.06	0.13	0.07

COAL INSPECTIONS

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
FEED COAL							
ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	68.30	68.30	68.30	68.30	68.30	68.30	68.30
HYDROGEN, SEMI-MICRO, WT%	4.94	4.94	4.94	4.94	4.94	4.94	4.94
NITROGEN, GB11, WT%	1.28	1.28	1.28	1.28	1.28	1.28	1.28
SULFUR, TOTAL, GRM1159, WT%	3.18	3.18	3.18	3.18	3.18	3.18	3.18
SULFUR, ORGANIC, WT%	0.62	0.62	0.62	0.62	0.62	0.62	0.62
SULFUR, PYRITIC, WT%	2.49	2.49	2.49	2.49	2.49	2.49	2.49
SULFUR, SULFATE, WT%	0.07	0.07	0.07	0.07	0.07	0.07	0.07
OXYGEN, GRM1117, WT%	13.69	13.69	13.69	13.69	13.69	13.69	13.69
OXYGEN, ORGANIC, WT%	5.72	5.72	5.72	5.72	5.72	5.72	5.72
OXYGEN, INORGANIC, WT%	7.97	7.97	7.97	7.97	7.97	7.97	7.97
METALS, BY SPEC ASH, WT%	8.61	8.61	8.61	8.61	8.61	8.61	8.61
MINERAL MATTER, WT%*	19.14	19.14	19.14	19.14	19.14	19.14	19.14
MOISTURE, D271, WT%	0.95	0.95	0.95	0.95	0.95	0.95	0.95
VOLATILE MATTER, WT%	34.40	34.40	34.40	34.40	34.40	34.40	34.40
ASH, D271, WT%	16.46	16.46	16.46	16.46	16.46	16.46	16.46
SULFUR, WT% OF ASH	2.25	2.25	2.25	2.25	2.25	2.25	2.25
OXYGEN, WT% OF ASH	45.40	45.40	45.40	45.40	45.40	45.40	45.40
ALUMINUM, WT% OF ASH	15.0	15.0	15.0	15.0	15.0	15.0	15.0
CALCIUM, WT% OF ASH	3.3	3.3	3.3	3.3	3.3	3.3	3.3
IRON, WT% OF ASH	10.0	10.0	10.0	10.0	10.0	10.0	10.0
MAGNESIUM, WT% OF ASH	2.0	2.0	2.0	2.0	2.0	2.0	2.0
POTASSIUM, WT% OF ASH	1.3	1.3	1.3	1.3	1.3	1.3	1.3
SILICON, WT% OF ASH	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SODIUM, WT% OF ASH	.4	.4	.4	.4	.4	.4	.4
TITANIUM, WT% OF ASH	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TRACE METALS, WT% OF ASH	.1	.1	.1	.1	.1	.1	.1
PARTICLE SIZE DISTRIBUTION, WT%							
ON 80 MESH							
THRU 80 ON 200 MESH	3.9	3.9	3.9	3.9	3.9	3.9	3.9
THRU 200 ON 325 MESH	20.6	20.6	20.6	20.6	20.6	20.6	20.6
THRU 325 ON 625 MESH	35.7	35.7	35.7	35.7	35.7	35.7	35.7
THRU 625 MESH	39.8	39.8	39.8	39.8	39.8	39.8	39.8

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
DEBUTANIZER BOTTOMS							
GRAVITY, D287, API	30.3	27.5	25.7	26.3	27.6	30.2	28.8
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	84.52	84.80	84.92*	85.09*	84.69	84.60	84.30
HYDROGEN, SEMI-MICRO, WT%	10.89	10.71	10.61	10.71*	10.65	10.94	10.84
NITROGEN, G811, WT%	0.75	0.79	0.82	0.83	0.79	0.73	0.76
SULFUR, GRM1156, WT%	0.15	0.12	0.16	0.16	0.20*	0.13	0.20*
OXYGEN, GRM1117, WT%	3.69	3.59	3.50	3.20	3.67	3.60	3.89
VISCOSITY, KIN, D445, CS							
-35C							10.39
0C							2.92
WATER, G525, PPM	6596	5893	5364	5401	5433	6336	6138
HEAT OF COMB., D240, BTU/LB							17999
POUR POINT, D97, C							-53
DISTILLATION, D86, C							
INITIAL BOILING POINT	61	61	57	60	62	57	63
5 VOL %	71	80	71	76	76	73	77
10 VOL %	93	103	111	110	107	96	102
30 VOL %	145	166	176	172	162	147	157
50 VOL %	175	191	189	201	190	177	185
70 VOL %	189	204	219	221	210	193	200
90 VOL %	206	220	244	247	236	214	219
95 VOL %	220	230	258	262	252	230	243
END POINT	243	252	271	274	264	251	252
WATER (INCLUDES FLUSH WATER)							
TOTAL CARBON, PPM	10500	8900	8600	7700	8850	10300	9550
ORGANIC CARBON, PPM	10000	8400	8200	7200	8650	10200	9100
NITROGEN, G811, WT%	2.13	2.17	2.16*	2.21	2.26	2.16*	2.15
SULFUR, GRM1156, WT%	1.90*	1.90*	1.90*	1.90*	1.97	1.90*	1.89

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
PROCESS SOLVENT							
GRAVITY, D287, API	9.7	9.0	8.3	7.7	7.5	8.1	8.2
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WTX	87.82	88.25	88.41	88.23	88.29	88.34	88.21
HYDROGEN, SEMI-MICRO, WTX	8.93	8.72	8.57	8.71	8.62	8.64	8.62
NITROGEN, G811, WTX	1.05	1.07	1.06	1.08	1.09	1.07	1.05
SULFUR, GRM1156, WTX	0.21	0.18	0.18	0.18	0.30	0.15	0.33
OXYGEN, GRM1117, WTX	1.99	1.78	1.79	1.80	1.70	1.80	1.80
VISCOSITY, KIN, D445, CS							
25 C							19.48
50 C							6.80
100 C							2.09
WATER, G525, PPM	453	460	710	512	384	379	455
HEAT OF COMB., D240, BTU/LB							17460
POUR POINT, D97, C							-17
DISTILLATION, CUSHMAN, C							
CORRECTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	221	227	236	231	227	237	237
10 VOL %	242	260	260	251	253	259	261
20 VOL %	249	266	267	274	283	278	274
30 VOL %	258	267	281	286	299	293	293
40 VOL %	271	286	295	301	313	304	302
50 VOL %	289	301	314	319	324	318	317
60 VOL %	316	323	329	338	340	338	333
70 VOL %	335	352	351	352	360	361	349
80 VOL %	360	373	377	382	376	384	376
90 VOL %	398	406	413	409	421	429	403
END POINT	461	500	489	454	467	467	454

PRODUCT INSPECTIONS

RUN NUMBER.	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
VACUUM TOWER BOTTOMS							
SPECIFIC GRAVITY, D70, G/CC	1.57	1.56	1.57	1.56	1.55	1.54	1.56
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	58.56*	58.54*	58.54*	59.49	59.20	59.14	59.06
HYDROGEN, SEMI-MICRO, WT%	3.40	3.42	3.45	3.65	3.77	3.53	3.82
NITROGEN, GB11, WT%	1.18	1.17	1.19	1.21	1.22	1.22	1.23
SULFUR, TOTAL, D1552, WT%	3.03	3.20	3.11	2.87	2.79	2.82	2.56
SULFUR, SULFIDE, WT%							
SULFUR, PYRITIC, WT%							0.44
OXYGEN, GRM1117, WT%	15.58	15.38*	15.38*	15.47*	15.64	15.46	15.36
METALS, WT%	18.24	18.28	18.33	17.30	17.38	17.82	17.98
ASH, G599, WT%							
SULFUR, WT% OF ASH	2.25*	2.25*	2.25*	2.25*	2.25*	2.25*	2.25*
OXYGEN, WT% OF ASH	45.40*	45.40*	45.40*	45.40*	45.40*	45.40*	45.40*
METALS, WT% OF ASH (BY DIFF)	52.35	52.35	52.35	52.35	52.35	52.35	52.35
PYRIDINE INSOLUABLES, WT%	46.3	48.3	47.3	47.1	46.4	47.8	47.9
MELTING POINT, G898, C	147	142	137	120	132	125	125
HEAT OF COMB., D240, BTU/LB							10690
CONCARBON RSD, D189, WT%							76.7
DISTILLATION, CUSHMAN, C							
CONVERTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	394	400	400	390	388	417	387
INTERMEDIATE BOILING POINT							
END POINT	453	467	454	464	456	474	468
OVER AT INTERMED BP, WT%							
RESIDUE, WT%	97.3	96.3	96.9	92.2	92.6	92.6	93.6

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-42-2	P99-42-3	P99-42-4	P99-42-5	P99-42-6	P99-42-7	P99-42-8
YIELDS, WT% MOISTURE FREE COAL							
HYDROGEN (BY H BALANCE)	-4.15	-4.16	-3.92	-3.86	-3.95	-3.88	-4.19
METHANE	5.16	5.36	5.20	5.27	5.29	5.21	5.21
ETHANE	3.80	3.90	3.75	3.86	3.89	3.91	3.94
PROPANE	3.81	3.92	3.79	3.92	3.93	3.96	4.00
I-BUTANE	0.24	0.26	0.23	0.22	0.23	0.28	0.28
N-BUTANE	2.07	2.07	2.02	2.09	2.10	2.15	2.14
TOTAL C1 TO C4	15.08	15.51	14.99	15.35	15.45	15.51	15.58
AMMONIA (BY N BALANCE)	0.54	0.54	0.49	0.46	0.46	0.48	0.50
HYDROGEN SULFIDE (BY S BAL)	1.97	1.78	1.70	1.72	1.83	1.88	2.02
CARBON DIOXIDE	0.58	0.60	0.59	0.61	0.57	0.57	0.60
CARBON MONOXIDE	0.23	0.24	0.24	0.24	0.27	0.26	0.21
TOTAL OTHER GASES	3.31	3.16	3.01	3.03	3.13	3.20	3.33
WATER (BY OXYGEN BALANCE)	6.27	5.67	5.00	4.56	4.95	5.34	5.50
C5 - 193 C (C5 - 380 F)	10.78	10.46	10.02	8.72	8.55	9.36	9.86
193 - 288 C (380 - 550 F)	16.05	18.18	18.27	16.78	14.38	11.01	13.80
288 - 482 C (550 - 900 F)	12.20	7.67	6.43	8.96	13.65	15.53	12.95
TOTAL C5+ DISTILLATE*	39.03	36.31	34.72	34.46	36.58	35.90	36.61
482 C+ (900 F+) PYRIDINE SOL.	20.17	21.26	23.29	22.24	20.89	20.86	20.56
INSOLUABLE ORGANIC MATTER	3.83	5.79	6.45	7.77	6.50	6.62	6.15
ASH	16.46	16.46	16.46	16.46	16.46	16.46	16.46
TOTAL 482 C+ (900 F+) PROD	40.46	43.51	46.20	46.46	43.84	43.94	43.17

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER P99-42-2 P99-42-3 P99-42-4 P99-42-5 P99-42-6 P99-42-7 P99-42-8

YIELDS, WTX MOISTURE AND ASH FREE COAL

HYDROGEN (BY H BALANCE)	-4.97	-4.98	-4.69	-4.63	-4.72	-4.65	-5.01
METHANE	6.18	6.41	6.22	6.31	6.33	6.23	6.24
ETHANE	4.54	4.66	4.49	4.62	4.66	4.68	4.72
PROPANE	4.56	4.69	4.54	4.69	4.71	4.74	4.79
I-BUTANE	0.29	0.31	0.27	0.26	0.28	0.34	0.33
N-BUTANE	2.48	2.48	2.41	2.50	2.51	2.57	2.57
TOTAL C1 TO C4	18.05	18.56	17.94	18.37	18.49	18.56	18.64
AMMONIA (BY N BALANCE)	0.64	0.65	0.59	0.55	0.55	0.58	0.60
HYDROGEN SULFIDE (BY S BAL)	2.36	2.14	2.03	2.06	2.20	2.25	2.41
CARBON DIOXIDE	0.69	0.71	0.71	0.73	0.68	0.68	0.72
CARBON MONOXIDE	0.27	0.29	0.28	0.29	0.32	0.32	0.25
TOTAL OTHER GASES	3.96	3.78	3.61	3.63	3.75	3.83	3.98
WATER (BY OXYGEN BALANCE)	7.50	6.79	5.99	5.46	5.93	6.39	6.59
C5 - 193 C (C5 - 380 F)	12.90	12.52	12.00	10.43	10.23	11.20	11.80
193 - 288 C (380 - 550 F)	19.21	21.76	21.86	20.09	17.21	13.18	16.52
288 - 482 C (550 - 900 F)	14.61	9.18	7.69	10.72	16.34	18.59	15.50
TOTAL C5+ DISTILLATE*	46.72	43.46	41.56	41.25	43.78	42.97	43.82
482 C+ (900 F+) PYRIDINE SOL.	24.15	25.45	27.88	26.62	25.00	24.97	24.61
INSOLUABLE ORGANIC MATTER	4.59	6.94	7.72	9.30	7.78	7.93	7.36
TOTAL 482 C+ ORGANIC PROD	28.74	32.39	35.60	35.91	32.78	32.89	31.97

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

SRC-II RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
DATE (START OF PERIOD)	10-3-78	10-4-78	10-5-78	10-6-78	10-19-78	10-20-78	10-21-78
TIME & DATE CODE (START & END OF PERIOD)	0815 2768 0415 2778	0815 2778 0415 2788	0815 2788 0415 2798	0815 2798 0415 2808	1215 2928 0415 2938	0815 2938 0415 2948	0815 2948 0415 2958
RUN HOURS INCLUDED IN PERIOD	124-143	148-167	172-191	196-215	133-148	157-176	181-200
COAL CHARGE	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447	ROB RUN LR-25447
OPERATING CONDITIONS							
RECYCLE SLURRY/MF COAL RATIO	3.08	3.10	3.10	3.09	2.39	2.37	2.40
OIL TO SOLIDS RATIO	1.20	1.20	1.18	1.19	1.12	1.12	1.16
SLURRY COMPOSITION, WTX							
COAL (MOISTURE FREE)	24.5	24.4	24.4	24.5	29.5	29.7	29.4
DISTILLATE	32.5	32.7	32.3	32.8	31.4	32.4	34.4
482 C+ (900 F+) PYRIDINE SOL.	22.1	21.7	21.9	21.6	21.3	20.5	19.4
PYRIDINE INSOLUABLES	20.9	21.2	21.4	21.1	17.8	17.5	16.8
TOTAL RX PRESSURE, MPA	13.80	13.79	13.80	13.78	13.79	13.78	13.78
PRESS X XH2 IN INLET GAS, MPA	12.40	12.42	12.43	12.48	12.41	12.44	12.40
OUTLET H2 PARTIAL PRESS, MPA	8.94	8.94	8.94	8.94	8.95	8.95	8.95
DISSOLVER TEMPERATURES, C							
ZONE 4 (TOP)	457	457	457	457	457	457	457
ZONE 3	456	456	456	456	456	456	456
ZONE 2	455	455	455	455	455	455	455
ZONE 1 (BTM)	452	453	452	453	452	452	452
AVERAGE	455	455	455	455	455	455	455
PREHEATER OUTLET	395	392	392	390	388	388	389
NOMINAL SLURRY RES. TIME, HR	0.99	0.98	0.98	0.99	0.99	1.00	0.99
WHSV, KG/HR/DM3							
SLURRY	1.21	1.22	1.22	1.22	1.21	1.20	1.21
COAL (MOISTURE FREE)	0.30	0.30	0.30	0.30	0.36	0.36	0.36
DISSOLVER GAS							
DM3/KG SLURRY	369	368	371	363	426	422	420
DM3/KG MF FEED COAL	1504	1507	1522	1485	1445	1422	1428
HYDROGEN CONTENT, VOL%	89.9	90.0	90.0	90.5	90.0	90.2	90.0
FLUSH H2O, % OF PRODUCT H2O	226.8	237.1	225.5	231.8	188.5	188.8	235.2

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
WATER IN THE FEED COAL ASSUMED							
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WEIGHT BALANCE, O/I, WT%	96.9	98.2	99.5	96.2	96.3	98.0	98.7

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WT% FEED COAL

HYDROGEN	-3.83	-3.90	-3.71	-3.85	-3.59	-3.53	-3.46
METHANE	5.30	5.39	5.21	5.46	4.86	4.79	4.79
ETHANE	3.78	3.90	3.80	3.96	3.46	3.51	3.43
PROPANE	3.78	3.96	3.86	3.98	3.36	3.49	3.40
I-BUTANE	0.22	0.22	0.21	0.24	0.15	0.19	0.22
N-BUTANE	2.07	2.08	2.07	2.08	1.79	1.80	1.80
TOTAL C1 TO C4	15.14	15.56	15.15	15.71	13.62	13.79	13.64
AMMONIA	0.45	0.48	0.48	0.49	0.40	0.41	0.42
HYDROGEN SULFIDE	1.80	1.77	1.76	1.74	1.91	1.86	1.84
CARBON DIOXIDE	0.80	0.85	0.73	0.84	0.80	0.84	0.82
CARBON MONOXIDE	0.18	0.21	0.21	0.22	0.22	0.21	0.21
TOTAL OTHER GASES	3.27	3.31	3.18	3.29	3.34	3.32	3.29
WATER	5.01	4.79	4.71	5.44	5.14	4.49	4.99
DEBUTANIZER LIQUID	19.50	19.54	18.98	19.81	19.11	18.32	18.07
PROCESS SOLVENT	13.54	12.97	14.68	12.73	10.92	12.25	7.54
TOTAL C5+ DISTILLATE	33.04	32.50	33.66	32.54	30.03	30.57	25.61
VACUUM TOWER BOTTOMS	47.37	47.73	47.00	46.88	51.46	51.36	55.94

CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE
DM3/KG FEED COAL

	449	457	435	452	421	414	406
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CONVERSIONS, WT% FEED COAL

HYDROCRACKING	67.1	66.3	67.4	65.4	61.2	60.9	58.0
DESULFURIZATION	55.9	55.0	59.2	54.6	53.1	55.5	52.8
DENITROGENATION	31.1	29.1	30.5	32.0	27.4	26.6	25.7
OXYGEN REMOVAL	40.4	38.3	39.4	39.6	35.4	35.2	31.1

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
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GAS RATES, DM3/KG FEED COAL

DISSOLVER INLET GAS	973.4	927.6	913.2	931.8	952.1	906.7	927.4
TOTAL QUENCH GAS	578.9	607.2	616.6	612.1	548.3	544.9	519.7
TOTAL DISSOLVER GAS	1552.4	1534.8	1529.9	1543.9	1500.4	1451.6	1447.1
MAKEUP GAS TO DISSOLVER	329.6	363.6	348.9	375.8	375.4	374.1	356.8
MAKEUP GAS TO SEP. SPARGE	88.9	80.6	70.5	62.8	60.0	60.6	72.2
MAKEUP GAS TO INSTRUMENT TAPS	318.8	314.5	309.9	321.2	267.3	262.5	260.6
TOTAL MAKEUP GAS	737.3	758.7	729.2	759.8	702.6	697.2	689.6
DISSOLVER OUTLET GAS	1260.7	1238.8	1251.8	1254.0	1225.7	1182.5	1184.7
GAS LEAVING SCRUBBERS	1828.7	1728.5	1707.1	1660.9	1590.8	1536.9	1596.1
SEPARATOR SPARGE GAS	418.8	340.1	309.0	258.0	239.6	235.3	292.9
PRODUCT GASES							
BLEED OFF GAS	269.5	291.6	282.0	291.5	280.0	278.9	279.7
DEBUTANIZER GAS	60.7	61.5	61.7	65.1	50.8	53.3	52.7
AMINE REACTIVATOR GAS	12.1	11.7	11.6	11.8	12.8	12.3	12.4
NAPHTHA REACTIVATOR GAS	96.9	91.7	90.2	95.4	78.3	77.8	77.0
CHROMATOGRAPH BLEED GAS	6.5	6.2	5.7	6.1	6.1	5.8	5.4

ELEMENTAL BALANCES

WATER IN THE FEED COAL ASSUMED LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CARBON, O/I	1.01	1.01	1.01	1.00	0.99	1.00	0.98
HYDROGEN, O/I	1.01	1.00	1.02	1.03	1.00	1.00	0.99
NITROGEN, O/I	1.00	1.02	1.00	0.99	0.98	1.00	1.01
SULFUR, O/I	0.97	0.97	0.93	0.97	1.03	0.99	1.02
OXYGEN, O/I	0.97	0.98	0.96	1.01	1.03	0.99	1.07
METALS, O/I	0.99	0.98	0.97	0.97	0.99	0.97	1.04
ASH, O/I	0.99	0.98	0.97	0.97	0.99	0.97	1.04

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
YIELDS, WT% MOISTURE FREE COAL							
HYDROGEN (BY H BALANCE)	-3.94	-3.89	-3.92	-4.08	-3.58	-3.54	-3.33
METHANE	5.27	5.36	5.15	5.47	4.90	4.77	4.88
ETHANE	3.75	3.88	3.76	3.96	3.48	3.49	3.50
PROPANE	3.75	3.94	3.82	3.99	3.36	3.48	3.46
I-BUTANE	0.21	0.22	0.21	0.24	0.15	0.19	0.22
N-BUTANE	2.05	2.07	2.05	2.08	1.81	1.80	1.84
TOTAL C1 TO C4	15.04	15.46	14.99	15.73	13.72	13.73	13.89
AMMONIA (BY N BALANCE)	0.49	0.46	0.49	0.50	0.42	0.42	0.38
HYDROGEN SULFIDE (BY S BAL)	1.90	1.87	2.02	1.84	1.78	1.88	1.76
CARBON DIOXIDE	0.80	0.85	0.72	0.84	0.81	0.83	0.83
CARBON MONOXIDE	0.18	0.21	0.21	0.22	0.22	0.21	0.22
TOTAL OTHER GASES	3.37	3.39	3.43	3.39	3.23	3.35	3.18
WATER (BY OXYGEN BALANCE)	5.47	5.09	5.39	5.21	4.54	4.62	3.74
DEBUTANIZER LIQUID	19.38	19.42	18.77	19.84	19.25	18.24	18.40
PROCESS SOLVENT	13.46	12.89	14.52	12.75	11.00	12.19	7.68
TOTAL C5+ DISTILLATE	32.83	32.31	33.29	32.59	30.25	30.43	26.09
VTB PYRIDINE SOLUABLES	24.60	24.55	24.29	25.37	28.48	29.28	31.81
INSOLUABLE ORGANIC MATTER	6.18	6.64	6.06	5.33	6.91	5.68	8.17
ASH	16.46	16.46	16.46	16.46	16.46	16.46	16.46
VACUUM TOWER BOTTOMS	47.23	47.64	46.51	47.15	51.84	51.42	56.44
CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL							
BY HYDROGEN BALANCE	462	457	459	478	419	415	391
CONVERSIONS, WT% MF COAL							
HYDROCRACKING	57.3	66.5	67.8	65.4	60.9	61.1	57.2
DESULFURIZATION	56.2	55.3	59.7	54.5	52.8	55.7	52.0
DENITROGENATION	31.6	29.6	31.3	31.9	26.9	26.9	24.3
OXYGEN REMOVAL	40.5	38.4	39.7	39.2	34.6	35.3	29.6

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
GAS COMPOSITIONS, VOL%							
REACTOR INLET GAS							
HYDROGEN	89.89	90.04	90.05	90.53	89.99	90.21	89.99
METHANE	9.07	8.84	8.86	8.41	8.73	8.49	8.76
ETHANE	0.95	1.02	1.02	0.92	1.14	1.09	1.13
PROPANE	0.00	0.01	0.00	0.00	0.01	0.00	0.01
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.09	0.09	0.07	0.14	0.13	0.21	0.11
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)							
HYDROGEN	70.92	70.62	71.37	70.91	71.50	71.68	71.26
METHANE	16.47	16.50	16.14	15.83	15.66	15.58	15.75
ETHANE	3.38	3.59	3.49	3.45	3.46	3.52	3.49
PROPANE	1.55	1.67	1.61	1.64	1.44	1.54	1.49
I-BUTANE	0.11	0.12	0.11	0.12	0.10	0.11	0.11
N-BUTANE	0.64	0.65	0.65	0.64	0.57	0.60	0.59
HYDROGEN SULFIDE	0.94	0.94	0.93	0.91	1.02	1.03	1.02
CARBON MONOXIDE	0.22	0.24	0.21	0.30	0.29	0.38	0.27
CARBON DIOXIDE	0.32	0.35	0.30	0.34	0.33	0.36	0.35
AMMONIA	0.51	0.51	0.51	0.51	0.43	0.46	0.47
WATER	4.94	4.81	4.69	5.36	5.20	4.73	5.22
BLEED OFF GAS							
HYDROGEN	83.98	83.55	83.80	83.91	83.22	83.67	83.45
METHANE	13.95	14.10	13.87	13.90	14.18	13.80	14.03
ETHANE	1.50	1.67	1.62	1.55	1.90	1.82	1.85
PROPANE	0.02	0.08	0.08	0.02	0.06	0.07	0.02
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.56	0.60	0.62	0.62	0.65	0.64	0.64
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
GAS COMPOSITIONS, VOL%							
AMINE REACTIVATOR GAS							
HYDROGEN	11.98	11.33	11.65	14.91	10.98	10.32	10.11
METHANE	2.47	2.55	2.47	2.58	2.06	2.09	2.15
ETHANE	0.41	0.44	0.43	0.45	0.34	0.37	0.37
PROPANE	0.00	0.01	0.00	0.00	0.01	0.00	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	58.72	58.74	58.61	55.58	60.91	60.71	60.18
CARBON MONOXIDE	0.03	0.07	0.04	0.02	0.01	0.03	0.04
CARBON DIOXIDE	26.39	26.86	26.81	26.46	25.69	26.47	27.16
NAPHTHA REACTIVATOR GAS							
HYDROGEN	22.80	21.28	21.93	23.45	22.64	22.02	21.66
METHANE	30.37	29.38	29.33	29.27	27.68	27.92	27.96
ETHANE	22.05	22.82	22.57	22.39	22.28	22.64	22.63
PROPANE	16.53	17.77	17.48	16.82	18.03	18.22	18.33
I-BUTANE	1.04	1.12	1.11	1.04	1.17	1.19	1.20
N-BUTANE	5.57	5.90	5.85	5.46	6.20	6.16	6.31
PENTANES	1.43	1.52	1.53	1.39	1.67	1.64	1.70
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.14	0.01	0.03
CARBON MONOXIDE	0.01	0.01	0.02	0.00	0.00	0.01	0.00
CARBON DIOXIDE	0.20	0.19	0.19	0.18	0.18	0.20	0.19
DEBUTANIZER GAS							
HYDROGEN	53.70	51.41	51.51	51.43	47.88	48.37	51.50
METHANE	18.19	18.60	18.34	18.45	20.47	19.49	18.38
ETHANE	7.89	8.79	8.82	8.78	9.81	9.99	9.00
PROPANE	7.69	8.48	8.46	8.76	8.37	9.04	8.40
I-BUTANE	0.80	0.84	0.84	0.85	0.82	0.84	0.82
N-BUTANE	5.13	5.14	5.27	5.12	5.04	4.95	4.84
PENTANES	2.21	2.21	2.29	2.19	2.01	2.14	1.99
HYDROGEN SULFIDE	4.34	4.45	4.41	4.27	5.33	5.00	4.93
CARBON MONOXIDE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.04	0.07	0.06	0.14	0.28	0.18	0.15

COAL INSPECTIONS

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
FEED COAL							
ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	68.30	68.30	68.30	68.30	68.30	68.30	68.30
HYDROGEN, SEMI-MICRO, WT%	4.94	4.94	4.94	4.94	4.94	4.94	4.94
NITROGEN, SEMI-MICRO, WT%	1.28	1.28	1.28	1.28	1.28	1.28	1.28
SULFUR, TOTAL, GRM1159, WT%	3.18	3.18	3.18	3.18	3.18	3.18	3.18
SULFUR, ORGANIC, WT%	0.62	0.62	0.62	0.62	0.62	0.62	0.62
SULFUR, PYRITIC, WT%	2.49	2.49	2.49	2.49	2.49	2.49	2.49
SULFUR, SULFATE, WT%	0.07	0.07	0.07	0.07	0.07	0.07	0.07
OXYGEN, GRM1117, WT%	13.69	13.69	13.69	13.69	13.69	13.69	13.69
OXYGEN, ORGANIC, WT%	5.72	5.72	5.72	5.72	5.72	5.72	5.72
OXYGEN, INORGANIC, WT%	7.97	7.97	7.97	7.97	7.97	7.97	7.97
METALS, BY SPEC ASH, WT%	8.61	8.61	8.61	8.61	8.61	8.61	8.61
MINERAL MATTER, WT%*	19.14	19.14	19.14	19.14	19.14	19.14	19.14
MOISTURE, D271, WT%	0.95	0.95	0.95	0.95	0.95	0.95	0.95
VOLATILE MATTER, WT%	34.40	34.40	34.40	34.40	34.40	34.40	34.40
ASH, D271, WT%	16.46	16.46	16.46	16.46	16.46	16.46	16.46
SULFUR, WT% OF ASH	2.25	2.25	2.25	2.25	2.25	2.25	2.25
OXYGEN, WT% OF ASH	45.40	45.40	45.40	45.40	45.40	45.40	45.40
ALUMINUM, WT% OF ASH	15.0	15.0	15.0	15.0	15.0	15.0	15.0
CALCIUM, WT% OF ASH	3.3	3.3	3.3	3.3	3.3	3.3	3.3
IRON, WT% OF ASH	10.0	10.0	10.0	10.0	10.0	10.0	10.0
MAGNESIUM, WT% OF ASH	2.0	2.0	2.0	2.0	2.0	2.0	2.0
POTASSIUM, WT% OF ASH	1.3	1.3	1.3	1.3	1.3	1.3	1.3
SILICON, WT% OF ASH	20.0	20.0	20.0	20.0	20.0	20.0	20.0
SODIUM, WT% OF ASH	.4	.4	.4	.4	.4	.4	.4
TITANIUM, WT% OF ASH	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TRACE METALS, WT% OF ASH	.1	.1	.1	.1	.1	.1	.1
PARTICLE SIZE DISTRIBUTION, WT%							
ON 80 MESH							
THRU 80 ON 200 MESH	3.9	3.9	3.9	3.9	3.9	3.9	3.9
THRU 200 ON 325 MESH	20.6	20.6	20.6	20.6	20.6	20.6	20.6
THRU 325 ON 625 MESH	35.7	35.7	35.7	35.7	35.7	35.7	35.7
THRU 625 MESH	39.8	39.8	39.8	39.8	39.8	39.8	39.8

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
DEBUTANIZER BOTTOMS							
GRAVITY, D287, API	28.5	28.9	28.8	29.0	27.6	27.8	28.2
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	84.92	84.59	84.55	84.56	84.80	84.93	85.14
HYDROGEN, SEMI-MICRO, WT%	10.85	10.76	10.72	10.88	10.93	10.79	10.80
NITROGEN, GB11, WT%	0.76	0.77	0.78	0.75	0.77	0.77	0.77
SULFUR, GRM1156, WT%	0.20*	0.20*	0.3d	0.20*	0.20*	0.20*	0.20*
OXYGEN, GRM1117, WT%	3.27	3.69	3.5d	3.61	3.30	3.30	3.09
VISCOSITY, KIN, D445, CS							
-35C						10.42	
0C				2.96		3.24	
WATER, G525, PPM	5309	6189	6087	6417	5730	5950	5187
HEAT OF COMB., D240, BTU/LB				1760d		17144	
POUR POINT, D97, C				-53		-53	
DISTILLATION, D86, C							
INITIAL BOILING POINT	58	59	62	51	55	58	57
5 VOL %	75	77	74	79	71	70	76
10 VOL %	102	100	106	106	98	103	106
30 VOL %	157	154	159	158	158	158	159
50 VOL %	188	186	188	188	191	191	192
70 VOL %	210	205	206	205	213	214	215
90 VOL %	235	228	228	229	241	242	242
95 VOL %	248	240	241	242	255	256	258
END POINT	264	258	255	258	270	267	268
WATER (INCLUDES FLUSH WATER)							
TOTAL CARBON, PPM	12500	13750	13300	13400	13600	13800	14000
ORGANIC CARBON, PPM	10000	10300	11600	10400	11000	10300	11200
NITROGEN, GB11, WT%	2.14	2.16	2.16	2.14	2.24	2.35	2.35
SULFUR, GRM1156, WT%	2.00*	2.00*	2.00*	2.00*	2.40	2.61	2.50*

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
PROCESS SOLVENT							
GRAVITY, D287, API	8.3	8.5	8.8	8.8	9.1	9.0	9.0
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	88.00	88.19	88.07	88.18	87.77	87.68	87.93
HYDROGEN, SEMI-MICRO, WT%	8.76	8.58	8.76	8.75	8.89	8.88	8.82
NITROGEN, GB11, WT%	1.04	1.08	1.07	1.06	1.04	1.05	1.05
SULFUR, GRM1156, WT%	0.31	0.36	0.30*	0.30*	0.30*	0.30*	0.30*
OXYGEN, GRM1117, WT%	1.89	1.80	1.79	1.71	2.00	2.10	1.90
VISCOSITY, KIN, D445, CS							
25 C				19.63		17.87	
50 C				6.85		6.42	
100 C				2.12		2.02	
WATER, 3525, PPM	386	792	625	477	645	622	603
HEAT OF COMB., D240, BTU/LB				17557		17502	
POUR POINT, D97, C				-15		-15	
DISTILLATION, CUSHMAN, C							
CORRECTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	224	224	230	224	193	192	204
10 VOL %	254	256	258	248	246	242	249
20 VOL %	280	281	276	271	258	258	263
30 VOL %	296	291	288	285	268	279	279
40 VOL %	305	304	302	299	284	297	296
50 VOL %	318	317	314	312	304	312	313
60 VOL %	335	331	324	324	319	325	325
70 VOL %	353	352	347	347	341	348	344
80 VOL %	369	377	369	375	363	364	380
90 VOL %	417	407	397	421	401	392	406
END POINT	461	481	467	461	493	478	464

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
VACUUM TOWER BOTTOMS							
SPECIFIC GRAVITY, D70, G/CC	1.48	1.55	1.46	1.55	1.50	1.48	1.47
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)							
CARBON, SEMI-MICRO, WT%	59.60	59.43	59.67	59.11	60.64	60.95	61.00
HYDROGEN, SEMI-MICRO, WT%	3.62	3.61	3.65	3.68	3.77	3.74	3.77
NITROGEN, GR11, WT%	1.21	1.25	1.20	1.21	1.25	1.27	1.28
SULFUR, TOTAL, D1552, WT%	2.75	2.77	2.47	2.87	2.72	2.57	2.55
SULFUR, SULFIDE, WT%				2.25			
SULFUR, PYRITIC, WT%				0.61		0.45	
OXYGEN, GRM1117, WT%	15.09	15.42	15.39*	15.42*	15.25*	15.35*	15.44*
METALS, WT%	17.73	17.52	17.62	17.71	16.38	16.12	15.96
ASH, G599, WT%	33.48	33.47	33.65	33.82	31.28	30.79	30.48
SULFUR, WT% OF ASH	2.25*	2.25*	2.25*	2.25*	2.25*	2.25*	2.25*
OXYGEN, WT% OF ASH	45.40*	45.40*	45.40*	45.40*	45.40*	45.40*	45.40*
METALS, WT% OF ASH (BY DIFF)	52.35	52.35	52.35	52.35	52.35	52.35	52.35
PYRIDINE INSOLUABLES, WT%	47.2	47.6	47.1	44.8	44.5	42.3	43.8
MELTING POINT, 3898, C	135	135	130	125	127	126	127
HEAT OF COMB., D240, BTU/LB				10707		11172	
CONCARBON RSD, D189, WT%				77.1		73.4	
DISTILLATION, CUSHMAN, C							
CONVERTED TO 760 MM HG USING K10 FACTOR							
INITIAL BOILING POINT	392	406	400	425	404	394	392
INTERMEDIATE BOILING POINT							
END POINT	479	486	478	454	464	447	457
OVER AT INTERMED BP, WT%							
RESIDUE, WT%	91.2	91.7	90.8	94.7	93.5	93.7	92.8

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
YIELDS, WTX MOISTURE FREE COAL							
HYDROGEN (BY H BALANCE)	-3.94	-3.89	-3.92	-4.08	-3.58	-3.54	-3.33
METHANE	5.27	5.36	5.15	5.47	4.90	4.77	4.88
ETHANE	3.75	3.88	3.76	3.96	3.48	3.49	3.50
PROPANE	3.75	3.94	3.82	3.99	3.38	3.48	3.46
I-BUTANE	0.21	0.22	0.21	0.24	0.15	0.19	0.22
N-BUTANE	2.05	2.07	2.05	2.08	1.81	1.80	1.84
TOTAL C1 TO C4	15.04	15.46	14.99	15.73	13.72	13.73	13.89
AMMONIA (BY N BALANCE)	0.49	0.46	0.49	0.50	0.42	0.42	0.38
HYDROGEN SULFIDE (BY S BAL)	1.90	1.87	2.02	1.84	1.78	1.88	1.76
CARBON DIOXIDE	0.80	0.85	0.72	0.84	0.81	0.83	0.83
CARBON MONOXIDE	0.18	0.21	0.21	0.22	0.22	0.21	0.22
TOTAL OTHER GASES	3.37	3.39	3.43	3.39	3.23	3.35	3.18
WATER (BY OXYGEN BALANCE)	5.47	5.09	5.39	5.21	4.54	4.62	3.74
C5 - 193 C (C5 - 380 F)	8.55	9.15	8.24	8.91	8.10	7.68	7.56
193 - 288 C (380 - 550 F)	14.22	13.55	14.42	14.97	15.06	14.20	13.14
288 - 482 C (550 - 900 F)	14.32	13.38	15.08	13.56	11.39	13.94	10.91
TOTAL C5+ DISTILLATE*	37.08	36.08	37.74	37.44	34.55	35.83	31.62
482 C+ (900 F+) PYRIDINE SOL.	20.35	20.78	19.85	20.81	24.18	23.88	26.28
INSOLUABLE ORGANIC MATTER	6.18	6.64	6.06	5.03	6.91	5.68	8.17
ASH	16.46	16.46	16.46	16.46	16.46	16.46	16.46
TOTAL 482 C+ (900 F+) PROD	42.98	43.88	42.36	42.29	47.54	46.02	50.90

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-43-1	P99-43-2	P99-43-3	P99-43-4	P99-44-1	P99-44-2	P99-44-3
YIELDS, WT% MOISTURE AND ASH FREE COAL							
HYDROGEN (BY H BALANCE)	-4.72	-4.66	-4.69	-4.88	-4.28	-4.24	-3.99
METHANE	6.30	6.42	6.17	6.54	5.86	5.71	5.84
ETHANE	4.49	4.64	4.50	4.74	4.17	4.18	4.18
PROPANE	4.49	4.71	4.57	4.77	4.05	4.16	4.15
I-BUTANE	0.26	0.26	0.25	0.28	0.18	0.23	0.26
N-BUTANE	2.46	2.48	2.45	2.49	2.16	2.15	2.20
TOTAL C1 TO C4	18.00	18.51	17.94	18.83	16.42	16.43	16.63
AMMONIA (BY N BALANCE)	0.59	0.55	0.58	0.60	0.50	0.50	0.45
HYDROGEN SULFIDE (BY S BAL)	2.27	2.24	2.41	2.21	2.13	2.26	2.10
CARBON DIOXIDE	0.96	1.02	0.86	1.00	0.97	1.00	1.00
CARBON MONOXIDE	0.21	0.25	0.25	0.26	0.26	0.26	0.26
TOTAL OTHER GASES	4.03	4.05	4.11	4.06	3.87	4.01	3.81
WATER (BY OXYGEN BALANCE)	6.54	6.09	6.45	6.24	5.43	5.53	4.47
C5 - 193 C (C5 - 380 F)	10.23	10.95	9.86	10.66	9.70	9.19	9.05
193 - 288 C (380 - 550 F)	17.02	16.22	17.26	17.92	18.03	17.00	15.72
288 - 482 C (550 - 900 F)	17.14	16.02	18.05	16.23	13.63	16.69	13.06
TOTAL C5+ DISTILLATE*	44.39	43.18	45.17	44.82	41.36	42.88	37.84
482 C+ (900 F+) PYRIDINE SOL.	24.35	24.88	23.75	24.91	28.94	28.58	31.45
INSOLUBLE ORGANIC MATTER	7.40	7.95	7.25	6.02	8.27	6.80	9.78
TOTAL 482 C+ ORGANIC PROD	31.75	32.82	31.01	30.93	37.21	35.39	41.23

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

APPENDIX C

COMPUTER PRINTOUTS OF INDIVIDUAL
PERIODS FOR THE SECOND SHIPMENT OF POWHATAN COAL

SRC-II RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
DATE (START OF PERIOD)	11-9-78	11-10-78	11-11-78	11-12-78	11-13-78
TIME & DATE CODE (START & END OF PERIOD)	815 3138 415 3148	815 3148 415 3158	815 3158 415 3168	815 3168 415 3178	815 3178 415 3188
RUN HOURS INCLUDED IN PERIOD	181-200	205-224	229-248	253-272	277-296
COAL CHARGE	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-27534	POWHATAN LR-25734
OPERATING CONDITIONS					
RECYCLE SLURRY/MF COAL RATIO	2.40	2.43	2.37	2.43	2.38
OIL TO SOLIDS RATIO	1.26	1.27	1.27	1.31	1.29
SLURRY COMPOSITION, WT%					
COAL (MOISTURE FREE)	29.4	29.1	29.7	29.1	29.6
DISTILLATE	32.5	31.7	32.1	32.8	33.0
482 C+ (900 F+) PYRIDINE SOL.	23.7	24.3	23.9	24.0	23.2
PYRIDINE INSOLUABLES	14.4	14.8	14.3	14.1	14.2
TOTAL RX PRESSURE, MPA					
PRESS X %H ₂ IN INLET GAS, MPA	13.80	13.79	13.82	13.80	13.79
OUTLET H ₂ PARTIAL PRESS, MPA	12.47	12.43	12.52	12.42	12.38
	9.03	9.03	9.03	9.03	9.03
DISSOLVER TEMPERATURES, C					
ZONE 4 (TOP)	457	457	456	457	457
ZONE 3	456	456	456	456	456
ZONE 2	455	455	455	455	455
ZONE 1 (BTM)	451	451	451	452	452
AVERAGE	455	455	455	455	455
PREHEATER OUTLET	394	396	398	396	396
NOMINAL SLURRY RES. TIME, HR					
*HSV, KG/HR/DM ³	0.99	0.98	1.00	0.98	0.99
SLURRY	1.22	1.23	1.21	1.23	1.21
COAL (MOISTURE FREE)	0.36	0.36	0.36	0.36	0.36
DISSOLVER GAS					
DM ³ /KG SLURRY	460	450	484	458	460
DM ³ /KG MF FEED COAL	1562	1543	1630	1573	1577
HYDROGEN CONTENT, VCL%	90.4	90.1	90.6	90.0	89.8
FLUSH H ₂ O, % OF PRODLCT H ₂ O	186.6	192.7	215.8	208.7	195.0

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
WATER IN THE FEED COAL ASSUMED					
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0
WEIGHT BALANCE, O/I, WT%	101.2	102.1	97.9	98.5	99.1

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WT% FEED COAL

HYDROGEN	-3.54	-3.33	-3.75	-3.87	-3.92
METHANE	5.05	5.24	5.54	5.53	5.43
ETHANE	3.58	3.71	3.77	3.76	3.78
PROPANE	3.40	3.49	3.38	3.38	3.52
I-BUTANE	0.15	0.17	0.17	0.16	0.22
N-BUTANE	1.69	1.64	1.58	1.65	1.64
TOTAL C1 TO C4	13.87	14.24	14.45	14.47	14.59
AMMONIA	0.35	0.37	0.37	0.39	0.40
HYDROGEN SULFIDE	1.88	1.90	2.05	2.05	2.06
CARBON DIOXIDE	1.02	1.05	1.19	1.10	1.14
CARBON MONOXIDE	0.17	0.21	0.18	0.22	0.21
TOTAL OTHER GASES	3.41	3.53	3.79	3.76	3.82
WATER	4.63	5.53	5.85	5.79	6.02
DEBUTANIZER LIQUID	19.20	18.40	18.80	19.12	19.27
PROCESS SOLVENT	11.17	10.55	10.31	8.29	8.72
TOTAL C5+ DISTILLATE	30.37	28.94	29.11	27.41	28.00
VACUUM TOWER BOTTOMS	51.26	51.08	50.56	52.43	51.50
CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE					
DM3/KG FEED COAL	415	391	440	454	460
CONVERSIONS, WT% FEED COAL					
HYDROCRACKING	63.3	63.8	63.5	63.2	63.2
DESULFURIZATION	58.5	61.1	59.5	56.8	56.3
DENITROGENATION	23.7	24.4	24.4	23.0	24.7
OXYGEN REMOVAL	49.8	50.3	48.6	49.3	51.7

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
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GAS RATES, DM3/KG FEED COAL

DISSOLVER INLET GAS	1073.0	1055.8	1093.4	1045.4	1009.2
TOTAL QUENCH GAS	469.8	455.2	571.9	550.8	581.2
TOTAL DISSOLVER GAS	1542.9	1511.0	1665.3	1596.3	1590.4
MAKEUP GAS TO DISSOLVER	383.1	371.5	435.5	430.0	439.4
MAKEUP GAS TO SEP. SPARGE	74.9	74.1	78.4	81.4	82.0
MAKEUP GAS TO INSTRUMENT TAPS	253.5	251.5	262.2	260.6	259.0
TOTAL MAKEUP GAS	711.5	697.1	776.1	771.9	780.4
DISSOLVER OUTLET GAS	1278.0	1275.0	1385.1	1303.3	1288.8
GAS LEAVING SCRUBBERS	1685.8	1681.5	1801.2	1720.4	1700.5
SEPARATOR SPARGE GAS	301.8	301.3	299.6	302.1	296.9
PRODUCT GASES					
BLEED OFF GAS	291.9	307.2	342.2	325.5	326.9
DEBUTANIZER GAS	60.4	58.9	58.8	58.8	57.5
AMINE REACTIVATOR GAS	13.2	13.1	13.6	13.6	13.9
NAPHTHA REACTIVATOR GAS	73.9	74.3	73.3	73.0	72.7
CHROMATOGRAPH BLEED GAS	7.3	7.6	8.0	8.0	7.8

ELEMENTAL BALANCES

WATER IN THE FEED COAL ASSUMED					
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0
CARBON, O/I	1.02	1.00	1.00	1.00	1.00
HYDROGEN, O/I	1.01	1.05	1.01	0.99	1.00
NITROGEN, O/I	0.98	0.99	0.99	1.02	1.01
SULFUR, O/I	0.97	0.95	1.01	1.04	1.04
OXYGEN, O/I	0.99	0.95	0.99	0.98	0.97
METALS, O/I	1.06	1.05	0.99	0.99	0.99
ASH, O/I	1.06	1.05	0.99	0.99	0.99

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER P99-45-2 P99-45-3 P99-45-4 P99-45-5 P99-45-6

YIELDS, WT% MOISTURE FREE COAL

HYDROGEN (BY H BALANCE)	-3.75	-3.82	-3.84	-3.82	-3.88
METHANE	4.98	5.24	5.54	5.51	5.40
ETHANE	3.53	3.70	3.77	3.74	3.76
PROPANE	3.35	3.48	3.38	3.37	3.50
I-BUTANE	0.15	0.17	0.17	0.16	0.22
N-BUTANE	1.67	1.63	1.58	1.65	1.63
TOTAL C1 TO C4	13.66	14.22	14.44	14.43	14.52
AMMONIA (BY N BALANCE)	0.39	0.38	0.38	0.37	0.39
HYDROGEN SULFIDE (BY S BAL)	2.01	2.08	2.02	1.94	1.92
CARBON DIOXIDE	1.00	1.05	1.18	1.09	1.14
CARBON MONOXIDE	0.17	0.21	0.18	0.22	0.21
TOTAL OTHER GASES	3.57	3.72	3.78	3.61	3.66
WATER (BY OXYGEN BALANCE)	6.38	6.29	5.95	6.11	6.46
DEBUTANIZER LIQUID	18.91	18.37	18.79	19.06	19.18
PROCESS SOLVENT	11.01	10.53	10.30	8.26	8.68
TOTAL C5+ DISTILLATE	29.92	28.90	29.09	27.32	27.87
VTB PYRIDINE SOLUABLES	31.34	32.87	30.74	33.75	33.97
INSOLUABLE ORGANIC MATTER	6.69	5.62	7.66	6.40	5.21
ASH	12.19	12.19	12.19	12.19	12.19
VACUUM TOWER BOTTOMS	50.22	50.68	50.59	52.34	51.37

CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL

BY HYDROGEN BALANCE	440	448	451	448	455
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CONVERSIONS, WT% MF COAL

HYDROCRACKING	63.8	63.8	63.5	63.3	63.4
DESULFURIZATION	59.2	61.1	59.6	56.9	56.6
DENITROGENATION	24.9	24.5	24.5	23.3	25.0
OXYGEN REMOVAL	50.0	49.8	48.2	48.9	51.5

RUN NUMBER P99-45-2 P99-45-3 P99-45-4 P99-45-5 P99-45-6

GAS COMPOSITIONS, VOL%

REACTOR INLET GAS

HYDROGEN	90.37	90.12	90.62	89.96	89.79
METHANE	8.41	8.66	8.27	8.77	8.90
ETHANE	1.09	1.14	1.09	1.20	1.27
PROPANE	0.00	0.00	0.00	0.00	0.01
I-BUTANE	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.13	0.07	0.02	0.07	0.04
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00

REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)

HYDROGEN	72.83	71.71	72.79	70.91	70.39
METHANE	15.26	15.44	14.99	16.05	16.15
ETHANE	3.39	3.47	3.30	3.56	3.65
PROPANE	1.39	1.42	1.27	1.34	1.40
I-BUTANE	0.10	0.10	0.09	0.10	0.09
N-BUTANE	0.52	0.50	0.44	0.49	0.49
HYDROGEN SULFIDE	0.97	0.98	0.97	1.03	1.04
CARBON MONOXIDE	0.26	0.21	0.12	0.21	0.17
CARBON DIOXIDE	0.41	0.42	0.43	0.43	0.45
AMMONIA	0.36	0.38	0.35	0.39	0.41
WATER	4.52	5.37	5.24	5.49	5.76

BLEED OFF GAS

HYDROGEN	83.13	82.64	82.93	82.13	82.45
METHANE	14.42	14.62	14.55	15.14	14.64
ETHANE	1.89	1.98	1.96	2.09	2.12
PROPANE	0.07	0.19	0.11	0.08	0.25
I-BUTANE	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.48	0.57	0.45	0.57	0.54
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
GAS COMPOSITIONS, VOL%					
AMINE REACTIVATOR GAS					
HYDROGEN	10.76	9.55	7.70	7.12	9.38
METHANE	2.09	1.95	1.82	1.88	1.73
ETHANE	0.42	0.37	0.36	0.37	0.35
PROPANE	0.00	0.00	0.00	0.01	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	56.96	56.28	58.56	59.14	58.73
CARBON MONOXIDE	0.04	0.02	0.02	0.03	0.02
CARBON DIOXIDE	29.73	31.82	31.54	31.46	29.80
NAPHTHA REACTIVATOR GAS					
HYDROGEN	21.86	21.23	20.66	19.80	21.58
METHANE	29.31	29.55	29.41	29.83	29.00
ETHANE	23.45	23.94	24.29	24.13	23.44
PROPANE	17.60	17.64	17.91	18.13	17.95
I-BUTANE	1.07	1.07	1.09	1.12	1.09
N-BUTANE	5.23	5.07	5.07	5.33	5.37
PENTANES	1.30	1.34	1.41	1.49	1.43
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.00	0.00	0.01	0.00	0.00
CARBON DIOXIDE	0.18	0.15	0.15	0.15	0.14
DEBUTANIZER GAS					
HYDROGEN	48.95	48.25	49.05	48.43	46.77
METHANE	17.72	17.54	17.46	17.73	18.53
ETHANE	9.64	9.79	9.49	9.57	10.31
PROPANE	9.14	9.33	8.68	8.74	9.18
I-BUTANE	0.87	0.90	0.83	0.86	0.81
N-BUTANE	5.17	5.06	4.78	4.99	4.90
PENTANES	2.27	2.29	2.26	2.36	2.20
HYDROGEN SULFIDE	5.66	6.13	6.68	6.57	6.63
CARBON MONOXIDE	0.00	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.57	0.70	0.76	0.76	0.67

COAL INSPECTIONS

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
FEED COAL					
ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WTX	70.96	70.96	70.96	70.96	70.96
HYDROGEN, SEMI-MICRO, WTX	4.92	4.92	4.92	4.92	4.92
NITROGEN, GB11, WTX	1.29	1.29	1.29	1.29	1.29
SULFUR, TOTAL, GRM1159, WTX	3.20	3.20	3.20	3.20	3.20
SULFUR, ORGANIC, WTX	1.65	1.65	1.65	1.65	1.65
SULFUR, PYRITIC, WTX	1.51	1.51	1.51	1.51	1.51
SULFUR, SULFATE, WTX	0.04	0.04	0.04	0.04	0.04
OXYGEN, GRM1117, WTX	12.97	12.97	12.97	12.97	12.97
OXYGEN, ORGANIC, WTX	7.20	7.20	7.20	7.20	7.20
OXYGEN, INORGANIC, WTX	5.78	5.78	5.78	5.78	5.78
METALS, BY SPEC ASH, WTX	6.67	6.67	6.67	6.67	6.67
MINERAL MATTER, WTX*	14.00	14.00	14.00	14.00	14.00
MOISTURE, D271, WTX	0.81	0.81	0.81	0.81	0.81
VOLATILE MATTER, WTX	38.00	38.00	38.00	38.00	38.00
ASH, D271, WTX	12.19	12.19	12.19	12.19	12.19
SULFUR, WTX OF ASH	0.78	0.78	0.78	0.78	0.78
OXYGEN, WTX OF ASH	44.50	44.50	44.50	44.50	44.50
ALUMINUM, WTX OF ASH	15.0	15.0	15.0	15.0	15.0
CALCIUM, WTX OF ASH	.9	.9	.9	.9	.9
IRON, WTX OF ASH	15.0	15.0	15.0	15.0	15.0
MAGNESIUM, WTX OF ASH	.8	.8	.8	.8	.8
POTASSIUM, WTX OF ASH	1.2	1.2	1.2	1.2	1.2
SILICON, WTX OF ASH	20.0	20.0	20.0	20.0	20.0
SODIUM, WTX OF ASH	.3	.3	.3	.3	.3
TITANIUM, WTX OF ASH	.7	.7	.7	.7	.7
TRACE METALS, WTX OF ASH	.4	.4	.4	.4	.4
PARTICLE SIZE DISTRIBUTION, WTX					
ON 80 MESH	.3	.3	.3	.3	.3
THRU 80 ON 200 MESH	35.6	35.6	35.6	35.6	35.6
THRU 200 ON 325 MESH	18.6	18.6	18.6	18.6	18.6
THRU 325 ON 625 MESH	21.1	21.1	21.1	21.1	21.1
THRU 625 MESH	24.4	24.4	24.4	24.4	24.4

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
DEBUTANIZER BOTTOMS					
GRAVITY, D287, API	28.5	28.6	28.4	28.7	28.1
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WT%	84.34	84.31	84.41	84.05	84.46
HYDROGEN, SEMI-MICRO, WT%	10.77	10.77	10.69	10.82	10.69
NITROGEN, GB11, WT%	0.69	0.66	0.64	0.65	0.63
SULFUR, GRM1156, WT%	0.20*	0.18	0.18	0.39	0.20
OXYGEN, GRM1117, WT%	4.00*	4.08	4.08	4.09	4.02
VISCOSITY, KIN, D445, CS					
-35C					9.66
0C					3.06
WATER, G525, PPM	7436	7623	7751	7612	8360
HEAT OF COMB., D240, BTU/LB					17846
POUR POINT, D97, C					-53
DISTILLATION, D86, C					
INITIAL BOILING POINT	70	58	56	58	57
5 VOL %	89	76	71	74	71
10 VOL %	98	86	87	92	94
30 VOL %	111	146	157	154	159
50 VOL %	161	181	187	184	188
70 VOL %	193	203	203	201	203
90 VOL %	221	224	226	221	221
95 VOL %	239	239	234	229	230
END POINT	263	265	258	259	257
WATER (INCLUDES FLUSH WATER)					
TOTAL CARBON, PPM	20000*	18000*	17000*	18000*	16000*
ORGANIC CARBON, PPM	16950	15450	13100	15300	12100
NITROGEN, GB11, WT%	1.59	1.62	1.52	1.60	1.65
SULFUR, GRM1156, WT%	1.60*	1.60*	1.60*	1.60*	1.60*

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
PROCESS SOLVENT					
GRAVITY, D287, API	8.8	7.6	7.7	7.6	7.5
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WT%	88.25	88.14	87.87*	88.06	88.01
HYDROGEN, SEMI-MICRO, WT%	8.39	8.59	8.56	8.51	8.49
NITROGEN, GRM11, WT%	1.05	1.03	1.01	1.04	1.05
SULFUR, GRM1156, WT%	0.22	0.24	0.27	0.31	0.26
OXYGEN, GRM1117, WT%	2.09	2.00	2.29	2.08	2.19
VISCOSITY, KIN, C445, CS					
25 C					19.82
50 C					6.83
100 C					2.09
WATER, G525, PPM	1848	980	943	1166	454
HEAT OF COMB., D240, BTU/LB					17425
POUR POINT, D97, C					-15
DISTILLATION, CUSHMAN, C					
CORRECTED TO 760 MM HG USING K10 FACTOR					
INITIAL BOILING POINT	216	237	226	232	234
10 VOL %	261	262	259	254	259
20 VOL %	273	271	271	268	268
30 VOL %	286	285	282	280	279
40 VOL %	299	294	293	291	294
50 VOL %	314	308	302	308	308
60 VOL %	326	331	322	328	326
70 VOL %	347	344	342	342	345
80 VOL %	366	379	366	362	380
90 VOL %	402	402	419	393	399
END POINT	480	450	447	458	450

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
VACUUM TOWER BOTTOMS					
SPECIFIC GRAVITY, D70, G/CC	1.48	1.44	1.44	1.43	1.45
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WT%	68.07*	68.20*	68.21	69.10	69.03
HYDROGEN, SEMI-MICRO, WT%	3.99	3.98*	4.00	4.08	4.02
NITROGEN, G811, WT%	1.38	1.41	1.44	1.44	1.45*
SULFUR, TOTAL, D1552, WT%	2.42	2.29	2.40*	2.41*	2.57
SULFUR, SULFIDE, WT%	0.61	0.51	0.51	0.54	
SULFUR, PYRITIC, WT%					0.16
OXYGEN, GRM1117, WT%	10.53*	10.55*	11.01*	10.52*	10.21*
METALS, WT%	13.59	13.56	12.93	12.45	12.71
ASH, G599, WT%	24.84*	24.79	23.63	22.75	23.22
SULFUR, WT% OF ASH	0.78*	0.78*	0.78*	0.78*	0.78*
OXYGEN, WT% OF ASH	44.50*	44.50*	44.50*	44.50*	44.50*
METALS, WT% OF ASH (BY DIFF)	54.72	54.72	54.72	54.72	54.72
PYRIDINE INSOLUABLES, WT%	37.5	35.1	38.7	35.0	33.5
MELTING POINT, G898, C	130	137	145	145	145
HEAT OF COMB., D240, BTU/LB					11857
CONCARBON RSD, D189, WT%					73.7
DISTILLATION, CUSHMAN, C					
CONVERTED TO 760 MM HG USING K10 FACTOR					
INITIAL BOILING POINT	398	392	394	386	391
INTERMEDIATE BOILING POINT	460	466	468	462	451
END POINT	515	517	511	528	511
OVER AT INTERMED BP, WT%	5.6	5.1	7.1	5.6	4.8
RESIDUE, WT%	86.9	86.3	86.3	83.7	85.6

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-45-2	P99-45-3	P99-45-4	P99-45-5	P99-45-6
YIELDS, WT% MOISTURE FREE COAL					
HYDROGEN (BY H BALANCE)	-3.75	-3.82	-3.84	-3.82	-3.88
METHANE	4.93	5.24	5.54	5.51	5.40
ETHANE	3.53	3.70	3.77	3.74	3.76
PROPANE	3.35	3.48	3.38	3.37	3.50
I-BUTANE	0.15	0.17	0.17	0.16	0.22
N-BUTANE	1.67	1.63	1.58	1.65	1.63
TOTAL C1 TO C4	13.66	14.22	14.44	14.43	14.52
AMMONIA (BY N BALANCE)	0.39	0.38	0.38	0.37	0.39
HYDROGEN SULFIDE (BY S BAL)	2.01	2.08	2.02	1.94	1.92
CARBON DIOXIDE	1.00	1.05	1.18	1.09	1.14
CARBON MONOXIDE	0.17	0.21	0.18	0.22	0.21
TOTAL OTHER GASES	3.57	3.72	3.78	3.61	3.66
WATER (BY OXYGEN BALANCE)	6.38	6.29	5.95	6.11	6.46
C5 - 193 C (C5 - 380 F)	12.09	9.55	8.83	9.51	8.81
193 - 288 C (380 - 550 F)	9.79	12.20	13.45	12.33	13.30
288 - 482 C (550 - 900 F)	12.32	11.00	11.41	9.78	10.69
TOTAL C5+ DISTILLATE*	34.19	32.76	33.69	31.62	32.80
482 C+ (900 F+) PYRIDINE SOL.	27.07	29.02	26.14	29.46	29.04
INSOLUABLE ORGANIC MATTER	6.69	5.62	7.66	6.40	5.21
ASH	12.19	12.19	12.19	12.19	12.19
TOTAL 482 C+ (900 F+) PROD	45.95	46.83	45.99	48.05	46.44

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER P99-45-2 P99-45-3 P99-45-4 P99-45-5 P99-45-6

YIELDS, WT% MOISTURE AND ASH FREE COAL

HYDROGEN (BY H BALANCE)	-4.27	-4.35	-4.38	-4.35	-4.42
METHANE	5.67	5.96	6.31	6.28	6.15
ETHANE	4.02	4.22	4.29	4.26	4.28
PROPANE	3.81	3.97	3.85	3.83	3.99
I-BUTANE	0.17	0.19	0.19	0.18	0.25
N-BUTANE	1.90	1.86	1.80	1.88	1.86
TOTAL C1 TO C4	15.56	16.20	16.44	16.43	16.53
AMMONIA (BY N BALANCE)	0.44	0.44	0.44	0.42	0.45
HYDROGEN SULFIDE (BY S BAL)	2.29	2.37	2.31	2.20	2.19
CARBON DIOXIDE	1.14	1.19	1.35	1.24	1.30
CARBON MONOXIDE	0.19	0.24	0.21	0.25	0.24
TOTAL OTHER GASES	4.06	4.23	4.30	4.11	4.17
WATER (BY OXYGEN BALANCE)	7.27	7.16	6.77	6.96	7.36
C5 - 193 C (C5 - 380 F)	13.76	10.88	10.06	10.83	10.03
193 - 288 C (380 - 550 F)	11.15	13.89	15.32	14.04	15.15
288 - 482 C (550 - 900 F)	14.02	12.53	13.00	11.14	12.17
TOTAL C5+ DISTILLATE*	38.94	37.30	38.37	36.01	37.35
482 C+ (900 F+) PYRIDINE SOL.	30.83	33.05	29.77	33.54	33.07
INSOLUBLE ORGANIC MATTER	7.62	6.40	8.72	7.29	5.93
TOTAL 482 C+ ORGANIC PROD	38.44	39.45	38.49	40.84	39.01

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

SRC-II RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
DATE (START OF PERIOD)	11-17-78	11-18-78	11-19-78	11-20-78	11-21-78
TIME & DATE CODE (START & END OF PERIOD)	815 3218 415 3228	815 3228 415 3238	815 3238 415 3248	815 3248 415 3258	815 3258 415 3268
RUN HOURS INCLUDED IN PERIOD	66-85	90-109	114-133	138-157	162-181
COAL CHARGE	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-25734
OPERATING CONDITIONS					
RECYCLE SLURRY/MF COAL RATIO	2.37	2.37	2.37	2.36	2.38
OIL TO SOLIDS RATIO	1.28	1.32	1.31	1.35	1.37
SLURRY COMPOSITION, WTX					
COAL (MOISTURE FREE)	29.7	29.7	29.7	29.8	29.6
DISTILLATE	32.1	33.6	32.9	34.0	34.0
482 C+ (900 F+) PYRIDINE SOL.	24.1	23.4	23.8	23.6	23.8
PYRIDINE INSOLUABLES	14.1	13.3	13.6	12.7	12.6
TOTAL RX PRESSURE, MPA	13.80	13.80	13.79	13.79	13.78
PRESS X XH2 IN INLET GAS, MPA	12.48	12.44	12.41	12.42	12.40
OUTLET H2 PARTIAL PRESS, MPA	9.07	9.07	9.07	9.07	9.07
DISSOLVER TEMPERATURES, C					
ZONE 4 (TOP)	457	458	458	457	457
ZONE 3	456	457	457	456	456
ZONE 2	455	456	456	455	455
ZONE 1 (BTM)	451	451	451	452	452
AVERAGE	455	455	455	455	455
PREHEATER OUTLET	389	389	389	389	390
NOMINAL SLURRY RES. TIME, HR	1.00	1.00	1.00	1.00	0.99
WHSV, KG/HR/DM3					
SLURRY	1.21	1.21	1.21	1.20	1.21
COAL (MOISTURE FREE)	0.36	0.36	0.36	0.36	0.36
DISSOLVER GAS					
DM3/KG SLURRY	462	459	463	466	467
DM3/KG MF FEED COAL	1557	1548	1562	1566	1578
HYDROGEN CONTENT, VOL%	90.5	90.2	90.0	90.1	90.0
FLUSH H2O, % OF PRODUCT H2O	233.7	236.7	212.5	231.2	245.9

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
WATER IN THE FEED COAL ASSUMED					
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0
WEIGHT BALANCE, O/I, WTX	98.3	99.1	99.8	98.2	97.5

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WTX FEED COAL

HYDROGEN	-3.99	-4.02	-3.94	-3.94	-3.94
METHANE	5.42	5.23	5.27	5.28	5.41
ETHANE	3.72	3.72	3.77	3.72	3.77
PROPANE	3.44	3.50	3.57	3.51	3.53
I-BUTANE	0.22	0.20	0.23	0.24	0.24
N-BUTANE	1.64	1.69	1.72	1.73	1.72
TOTAL C1 TO C4	14.44	14.34	14.55	14.48	14.67
AMMONIA	0.40	0.43	0.42	0.42	0.40
HYDROGEN SULFIDE	2.07	2.02	2.08	1.99	2.01
CARBON DIOXIDE	1.01	1.01	0.97	0.96	0.95
CARBON MONOXIDE	0.21	0.22	0.23	0.23	0.24
TOTAL OTHER GASES	3.68	3.68	3.69	3.60	3.61
WATER	6.10	5.99	5.96	5.84	6.19
DEBUTANIZER LIQUID	19.48	18.07	18.21	18.06	17.38
PROCESS SOLVENT	8.58	8.87	13.88	11.59	9.86
TOTAL C5+ DISTILLATE	28.05	26.94	32.09	29.64	27.24
VACUUM TOWER BOTTOMS	51.71	53.07	47.64	50.37	52.23
CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE					
DM3/KG FEED COAL	468	472	462	462	462
CONVERSIONS, WTX FEED COAL					
HYDROCRACKING	57.1	60.9	66.2	64.0	57.6
DESULFURIZATION	58.3	56.5	62.1	58.9	57.6
DENITROGENATION	24.6	25.0	26.0	24.9	24.4
OXYGEN REMOVAL	46.0	44.9	49.0	47.1	46.3

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
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GAS RATES, DM3/KG FEED COAL

DISSOLVER INLET GAS	1130.3	1145.6	1154.7	1176.8	1194.5
TOTAL QUENCH GAS	453.6	415.6	411.0	417.1	424.2
TOTAL DISSOLVER GAS	1583.9	1561.1	1565.7	1593.9	1618.6
MAKEUP GAS TO DISSOLVER	427.0	438.1	434.7	448.4	449.8
MAKEUP GAS TO SEP. SPARGE	83.2	92.5	92.0	91.3	91.2
MAKEUP GAS TO INSTRUMENT TAPS	261.1	259.0	257.3	251.3	263.3
TOTAL MAKEUP GAS	771.3	789.6	784.0	801.0	804.3
DISSOLVER OUTLET GAS	1273.8	1243.6	1258.3	1285.8	1313.8
GAS LEAVING SCRUBBERS	1699.6	1685.1	1699.6	1729.2	1763.0
SEPARATOR SPARGE GAS	308.5	329.6	331.2	324.6	328.3
PRODUCT GASES					
BLEED OFF GAS	309.2	317.1	321.4	342.5	348.9
DEBUTANIZER GAS	55.6	58.8	59.8	56.4	59.2
AMINE REACTIVATOR GAS	13.5	13.2	12.8	12.8	12.9
NAPHTHA REACTIVATOR GAS	73.4	75.1	74.6	73.2	70.4
CHROMATOGRAPH BLEED GAS	8.3	7.9	8.0	8.0	8.2

ELEMENTAL BALANCES

WATER IN THE FEED COAL ASSUMED					
LOST FROM FEED TANK, %	100.0	100.0	100.0	100.0	100.0
CARBON, O/I	1.00	1.00	1.01	1.00	1.00
HYDROGEN, O/I	0.98	0.96	1.00	1.00	0.99
NITROGEN, O/I	1.01	1.02	1.01	1.02	1.01
SULFUR, O/I	1.02	1.03	0.99	1.00	1.02
OXYGEN, O/I	1.03	1.03	0.99	1.00	1.03
METALS, O/I	0.99	1.03	0.94	0.96	0.98
ASH, O/I	0.99	1.03	0.94	0.96	0.98

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER P99-46-2 P99-46-3 P99-46-4 P99-46-5 P99-46-6

YIELDS, WT% MOISTURE FREE COAL

HYDROGEN (BY H BALANCE)	-3.75	-3.60	-3.94	-3.88	-3.83
METHANE	5.44	5.26	5.22	5.26	5.43
ETHANE	3.73	3.74	3.74	3.70	3.78
PROPANE	3.45	3.51	3.54	3.50	3.54
I-BUTANE	0.22	0.20	0.22	0.24	0.24
N-BUTANE	1.65	1.70	1.71	1.73	1.72
TOTAL C1 TO C4	14.48	14.41	14.44	14.42	14.71
AMMONIA (BY N BALANCE)	0.38	0.39	0.42	0.40	0.38
HYDROGEN SULFIDE (BY S BAL)	1.98	1.91	2.12	2.01	1.95
CARBON DIOXIDE	1.01	1.02	0.96	0.96	0.95
CARBON MONOXIDE	0.21	0.22	0.22	0.23	0.24
TOTAL OTHER GASES	3.58	3.54	3.73	3.59	3.52
WATER (BY OXYGEN BALANCE)	5.68	5.49	6.22	5.91	5.75
DEBUTANIZER LIQUID	19.52	18.15	18.06	17.98	17.44
PROCESS SOLVENT	8.60	8.91	13.77	11.54	9.89
TOTAL C5+ DISTILLATE	28.12	27.06	31.84	29.52	27.33
VTB PYRIDINE SOLUABLES	33.54	34.93	30.60	33.31	34.79
INSOLUBLE ORGANIC MATTER	6.17	5.99	4.92	4.94	5.54
ASH	12.19	12.19	12.19	12.19	12.19
VACUUM TOWER BOTTOMS	51.89	53.10	47.71	50.44	52.52

CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL

BY HYDROGEN BALANCE	440	422	462	455	449
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CONVERSIONS, WT% MF COAL

HYDROCRACKING	57.0	60.7	66.5	64.2	57.5
DESULFURIZATION	58.2	56.3	62.4	59.1	57.5
DENITROGENATION	24.4	24.7	26.6	25.2	24.2
OXYGEN REMOVAL	45.5	44.3	49.0	46.9	45.8

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
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GAS COMPOSITIONS, VOL%

REACTOR INLET GAS

HYDROGEN	90.46	90.16	89.95	90.05	90.02
METHANE	8.41	8.56	8.70	8.55	8.63
ETHANE	1.10	1.17	1.23	1.25	1.26
PROPANE	0.00	0.01	0.00	0.03	0.01
I-BUTANE	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.01
PENTANES	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.03	0.11	0.12	0.11	0.07
CARBON DIOXIDE	0.00	0.00	0.00	0.01	0.00

REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)

HYDROGEN	70.95	70.34	70.33	71.00	70.96
METHANE	15.70	15.89	15.94	15.66	15.68
ETHANE	3.46	3.61	3.66	3.61	3.59
PROPANE	1.38	1.44	1.44	1.42	1.38
I-BUTANE	0.09	0.10	0.09	0.09	0.09
N-BUTANE	0.50	0.52	0.52	0.52	0.51
HYDROGEN SULFIDE	1.06	1.06	1.07	1.01	1.00
CARBON MONOXIDE	0.16	0.26	0.28	0.28	0.22
CARBON DIOXIDE	0.40	0.41	0.39	0.38	0.37
AMMONIA	0.40	0.45	0.44	0.42	0.40
WATER	5.90	5.92	5.83	5.51	5.81

BLEED OFF GAS

HYDROGEN	82.02	83.21	83.20	83.52	83.31
METHANE	15.22	14.11	14.04	13.62	13.86
ETHANE	2.02	1.95	1.99	2.00	2.03
PROPANE	0.16	0.14	0.19	0.29	0.23
I-BUTANE	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.01	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.57	0.58	0.59	0.57	0.57
CARBON DIOXIDE	0.00	0.00	0.00	0.00	0.00

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
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GAS COMPOSITIONS, VOL%

AMINE REACTIVATOR GAS

HYDROGEN	8.75	11.22	11.86	10.76	9.45
METHANE	1.92	1.65	1.59	1.71	1.94
ETHANE	0.38	0.36	0.34	0.37	0.38
PROPANE	0.00	0.00	0.00	0.00	0.00
I-BUTANE	0.00	0.00	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00	0.00	0.00
HYDROGEN SULFIDE	58.45	58.34	57.65	58.00	58.93
CARBON MONOXIDE	0.02	0.01	0.00	0.00	0.01
CARBON DIOXIDE	30.47	28.42	28.55	29.16	29.28

NAPHTHA REACTIVATOR GAS

HYDROGEN	20.27	22.91	23.20	22.75	21.77
METHANE	30.03	28.72	28.46	28.40	28.82
ETHANE	24.12	23.36	23.22	23.31	23.51
PROPANE	17.81	17.54	17.57	17.68	17.86
I-BUTANE	1.06	1.00	0.99	1.04	1.07
N-BUTANE	5.15	5.10	5.19	5.39	5.43
PENTANES	1.39	1.20	1.19	1.28	1.36
HYDROGEN SULFIDE	0.00	0.00	0.00	0.00	0.00
CARBON MONOXIDE	0.02	0.01	0.02	0.00	0.01
CARBON DIOXIDE	0.16	0.16	0.16	0.15	0.18

DEBUTANIZER GAS

HYDROGEN	46.79	47.51	46.92	48.45	46.70
METHANE	18.41	17.97	18.23	17.61	17.96
ETHANE	9.77	9.97	10.34	9.72	10.45
PROPANE	9.14	9.38	9.55	9.11	9.79
I-BUTANE	0.87	0.87	0.88	0.88	0.87
N-BUTANE	5.23	5.29	5.33	5.59	5.45
PENTANES	2.34	2.21	2.18	2.38	2.32
HYDROGEN SULFIDE	6.56	6.17	6.10	5.76	6.04
CARBON MONOXIDE	0.00	0.00	0.00	0.00	0.00
CARBON DIOXIDE	0.88	0.62	0.46	0.49	0.42

COAL INSPECTIONS

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
FEED COAL					
ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WT%	70.96	70.96	70.96	70.96	70.96
HYDROGEN, SEMI-MICRO, WT%	4.92	4.92	4.92	4.92	4.92
NITROGEN, GB11, WT%	1.29	1.29	1.29	1.29	1.29
SULFUR, TOTAL, GRM1159, WT%	3.20	3.20	3.20	3.20	3.20
SULFUR, ORGANIC, WT%	1.65	1.65	1.65	1.65	1.65
SULFUR, PYRITIC, WT%	1.51	1.51	1.51	1.51	1.51
SULFUR, SULFATE, WT%	0.04	0.04	0.04	0.04	0.04
OXYGEN, GRM1117, WT%	12.97	12.97	12.97	12.97	12.97
OXYGEN, ORGANIC, WT%	7.20	7.20	7.20	7.20	7.20
OXYGEN, INORGANIC, WT%	5.78	5.78	5.78	5.78	5.78
METALS, BY SPEC ASH, WT%	6.67	6.67	6.67	6.67	6.67
MINERAL MATTER, WT%*	14.00	14.00	14.00	14.00	14.00
MOISTURE, D271, WT%	0.81	0.81	0.81	0.81	0.81
VOLATILE MATTER, WT%	38.00	38.00	38.00	38.00	38.00
ASH, D271, WT%	12.19	12.19	12.19	12.19	12.19
SULFUR, WT% OF ASH	0.78	0.78	0.78	0.78	0.78
OXYGEN, WT% OF ASH	44.50	44.50	44.50	44.50	44.50
ALUMINUM, WT% OF ASH	15.0	15.0	15.0	15.0	15.0
CALCIUM, WT% OF ASH	.9	.9	.9	.9	.9
IRON, WT% OF ASH	15.0	15.0	15.0	15.0	15.0
MAGNESIUM, WT% OF ASH	.8	.8	.8	.8	.8
POTASSIUM, WT% OF ASH	1.2	1.2	1.2	1.2	1.2
SILICON, WT% OF ASH	20.0	20.0	20.0	20.0	20.0
SODIUM, WT% OF ASH	.3	.3	.3	.3	.3
TITANIUM, WT% OF ASH	.7	.7	.7	.7	.7
TRACE METALS, WT% OF ASH	.4	.4	.4	.4	.4
PARTICLE SIZE DISTRIBUTION, WT%					
ON 80 MESH	.3	.3	.3	.3	.3
THRU 80 ON 200 MESH	35.6	35.6	35.6	35.6	35.6
THRU 200 ON 325 MESH	18.6	18.6	18.6	18.6	18.6
THRU 325 ON 625 MESH	21.1	21.1	21.1	21.1	21.1
THRU 625 MESH	24.4	24.4	24.4	24.4	24.4

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
DEBUTANIZER BOTTOMS					
GRAVITY, D287, API	26.6	26.8	26.9	26.9	26.3
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WT%	84.57	84.34	84.29	84.35	84.22
HYDROGEN, SEMI-MICRO, WT%	10.40	10.60	10.60	10.65	10.58
NITROGEN, G811, WT%	0.68	0.58	0.71	0.71	0.70*
SULFUR, GRM1156, WT%	0.29	0.31	0.32	0.31	0.31
OXYGEN, GRM1117, WT%	4.06	4.18	4.08	3.98	4.20
VISCOSITY, KIN, D445, CS					
-35C					11.16
0C					3.35
WATER, G525, PPM	7664	7559	7856	8184	8039
HEAT OF COMB., D240, BTU/LB					17761
POUR POINT, D97, C					-53
DISTILLATION, D86, C					
INITIAL BOILING POINT	56	56	64	64	62
5 VOL %	73	72	77	75	73
10 VOL %	94	90	100	98	103
30 VOL %	162	157	161	159	168
50 VOL %	193	191	191	191	195
70 VOL %	212	209	211	211	213
90 VOL %	238	234	236	236	237
95 VOL %	254	247	248	250	253
END POINT	267	264	267	266	267
WATER (INCLUDES FLUSH WATER)					
TOTAL CARBON, PPM	13200	13200	13800	13800	13200
ORGANIC CARBON, PPM	11500	10100	10900	11200	10900
NITROGEN, G811, WT%	1.58	1.73	1.67	1.63	1.54
SULFUR, GRM1156, WT%	1.80*	1.83	2.23	2.05	1.79

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-46-2	P99-46-3	P99-45-4	P99-46-5	P99-46-6
PROCESS SOLVENT					
GRAVITY, D287, API	7.3	7.7	7.9	8.2	7.8
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WT%	87.79	87.73	87.80	87.54	87.48*
HYDROGEN, SEMI-MICRO, WT%	8.30	8.41	8.42	8.56	8.62
NITROGEN, G811, WT%	1.02	0.94	0.95	1.03	1.01
SULFUR, GRM1156, WT%	0.40*	0.42*	0.42	0.39	0.41
OXYGEN, GRM1117, WT%	2.49	2.50	2.40	2.48	2.49
VISCOSITY, KIN, D445, CS					
25 C					15.96
50 C					5.86
100 C					1.90
WATER, G525, PPM	614	657	366	452	713
HEAT OF COMB., D240, BTU/LB					
POUR POINT, D97, C					-23
DISTILLATION, CUSHMAN, C					
CORRECTED TO 760 MM. HG USING K10 FACTOR					
INITIAL BOILING POINT	215	143	146	157	157
10 VOL %	246	243	237	238	240
20 VOL %	265	256	254	259	259
30 VOL %	276	275	273	271	277
40 VOL %	293	291	287	288	291
50 VOL %	311	308	303	305	308
60 VOL %	324	328	317	314	322
70 VOL %	344	346	338	321	345
80 VOL %	354	374	361	364	361
90 VOL %	405	408	389	408	411
END POINT	454	450	447	434	448

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
VACUUM TOWER BOTTOMS					
SPECIFIC GRAVITY, D70, G/CC	1.42	1.44	1.45	1.39	1.50
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)					
CARBON, SEMI-MICRO, WTX	68.03*	67.98	67.73	67.90	68.27
HYDROGEN, SEMI-MICRO, WTX	4.00*	3.86	3.95	4.03	4.07
NITROGEN, G811, WTX	1.43	1.44	1.43	1.42	1.43
SULFUR, TOTAL, D1552, WTX	2.38	2.42	2.28	2.40*	2.40
SULFUR, SULFIDE, WTX					1.74
SULFUR, PYRITIC, WTX					0.17
OXYGEN, GRM1117, WTX	11.51	11.50*	11.54*	11.58	11.41*
METALS, WTX	12.65	12.80	13.06	12.67	12.43
ASH, G599, WTX	23.11	23.40	23.88	23.16	22.71
SULFUR, WTX OF ASH	0.78*	0.78*	0.78*	0.78*	0.78*
OXYGEN, WTX OF ASH	44.50*	44.50*	44.50*	44.50*	44.50*
METALS, WTX OF ASH (BY DIFF)	54.72	54.72	54.72	54.72	54.72
PYRIDINE INSOLUABLES, WTX	35.0	34.2	35.0*	33.4	33.4*
MELTING POINT, G898, C	145	148	143	140	140
HEAT OF COMB., D240, BTU/LB					12348
CONCARBON RSD, D189, WTX					72.2
DISTILLATION, CUSHMAN, C					
CONVERTED TO 760 MM HG USING K10 FACTOR					
INITIAL BUILDING POINT	393	397	396	394	411
INTERMEDIATE BUILDING POINT		439	460	454	
END POINT	447	514	519	515	457
OVER AT INTERMED BP, WTX		5.0	7.5	5.0	
RESIDUE, WTX	95.5	87.5	85.7	85.5	93.6

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
YIELDS, WT% MOISTURE FREE COAL					
HYDROGEN (BY H BALANCE)	-3.75	-3.60	-3.94	-3.88	-3.83
METHANE	5.44	5.26	5.22	5.26	5.43
ETHANE	3.73	3.74	3.74	3.70	3.78
PROPANE	3.45	3.51	3.54	3.50	3.54
I-BUTANE	0.22	0.20	0.22	0.24	0.24
N-BUTANE	1.65	1.70	1.71	1.73	1.72
TOTAL C1 TO C4	14.48	14.41	14.44	14.42	14.71
AMMONIA (BY N BALANCE)	0.38	0.39	0.42	0.40	0.38
HYDROGEN SULFIDE (BY S BAL)	1.98	1.91	2.12	2.01	1.95
CARBON DIOXIDE	1.01	1.02	0.96	0.96	0.95
CARBON MONOXIDE	0.21	0.22	0.22	0.23	0.24
TOTAL OTHER GASES	3.58	3.54	3.73	3.59	3.52
WATER (BY OXYGEN BALANCE)	5.68	5.49	6.22	5.91	5.75
C5 - 193 C (C5 - 380 F)	8.00	8.44	8.44	8.09	7.11
193 - 288 C (380 - 550 F)	14.35	12.58	14.28	13.96	13.34
288 - 482 C (550 - 900 F)	10.75	10.34	13.46	12.10	12.02
TOTAL C5+ DISTILLATE*	33.10	31.36	36.18	34.16	32.47
482 C+ (900 F+) PYRIDINE SOL.	28.55	30.62	26.26	28.67	29.64
INSOLUBLE ORGANIC MATTER	6.17	5.99	4.92	4.94	5.54
ASH	12.19	12.19	12.19	12.19	12.19
TOTAL 482 C+ (900 F+) PROD	46.91	48.80	43.37	45.80	47.37

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-46-2	P99-46-3	P99-46-4	P99-46-5	P99-46-6
YIELDS, WT% MOISTURE AND ASH FREE COAL					
HYDROGEN (BY H BALANCE)	-4.27	-4.10	-4.48	-4.42	-4.36
METHANE	6.19	5.99	5.95	5.99	6.18
ETHANE	4.24	4.26	4.26	4.22	4.31
PROPANE	3.93	4.00	4.03	3.98	4.03
I-BUTANE	0.25	0.23	0.25	0.27	0.27
N-BUTANE	1.88	1.93	1.94	1.97	1.96
TOTAL C1 TO C4	16.49	16.41	16.44	16.42	16.75
AMMONIA (BY N BALANCE)	0.44	0.44	0.47	0.45	0.43
HYDROGEN SULFIDE (BY S BAL)	2.25	2.18	2.42	2.29	2.23
CARBON DIOXIDE	1.15	1.16	1.10	1.09	1.09
CARBON MONOXIDE	0.24	0.25	0.25	0.26	0.27
TOTAL OTHER GASES	4.08	4.03	4.24	4.09	4.01
WATER (BY OXYGEN BALANCE)	6.47	6.25	7.09	6.73	6.55
C5 - 193 C (C5 - 380 F)	9.11	9.61	9.61	9.21	8.10
193 - 288 C (380 - 550 F)	16.34	14.33	16.27	15.90	15.19
288 - 482 C (550 - 900 F)	12.24	11.78	15.33	13.79	13.69
TOTAL C5+ DISTILLATE*	37.70	35.72	41.20	38.90	36.98
482 C+ (900 F+) PYRIDINE SOL.	32.52	34.88	29.91	32.65	33.76
INSOLUABLE ORGANIC MATTER	7.02	6.82	5.60	5.63	6.30
TOTAL 482 C+ ORGANIC PROD	39.54	41.69	35.51	38.28	40.06

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

SRC-1: RUN DATA, MATERIAL BALANCES, AND PRODUCT PROPERTIES

RUN NUMBER	P99-47-1	P99-47-2	P99-47-3
DATE (START OF PERIOD)	11-25-78	11-26-78	11-27-78
TIME & DATE CODE (START & END OF PERIOD)	815 329E 415 330E	915 330E 415 331E	815 331E 415 332E
RUN HOURS INCLUDED IN PERIOD	58-77	83-101	105-125
COAL CHARGE	POWHATAN LR-25734	POWHATAN LR-25734	POWHATAN LR-25734
OPERATING CONDITIONS			
RECYCLE SLURRY/MF COAL RATIO	2.38	2.39	2.40
OIL TO SOLIDS RATIO	1.37	1.34	1.34
SLURRY COMPOSITION, WTX			
COAL (MOISTURE FREE)	29.6	29.5	29.5
DISTILLATE	36.0	32.7	31.8
482 C+ (900 F+) PYRIDINE SOL.	21.6	24.6	25.4
PYRIDINE INSOLUABLES	12.6	13.2	13.3
TOTAL RX PRESSURE, MPA	13.80	13.79	13.79
PRESS X XH2 IN INLET GAS, MPA	12.37	12.34	12.44
OUTLET H2 PARTIAL PRESS, MPA	9.25	9.25	9.25
DISSOLVER TEMPERATURES, °C			
ZONE 4 (TOP)	453	453	452
ZONE 3	452	452	451
ZONE 2	450	450	450
ZONE 1 (BTM)	446	446	446
AVERAGE	450	450	450
PREHEATER OUTLET	387	387	389
NOMINAL SLURRY RES. TIME, HR	0.99	0.99	0.99
WHSV, KG/HR/DM3			
SLURRY	1.21	1.21	1.21
COAL (MOISTURE FREE)	0.36	0.36	0.36
DISSOLVER GAS			
DM3/KG SLURRY	460	464	463
DM3/KG MF FEED COAL	1557	1570	1573
HYDROGEN CONTENT, VOL%	89.6	89.5	90.2
FLUSH H2O, % CF PRODUCT H2O	237.5	248.9	233.0

THE FOLLOWING WEIGHT BALANCE AND HYDROGEN CONSUMPTION DATA WERE CALCULATED FROM MEASURED UNIT DATA

RUN NUMBER P99-47-1 P99-47-2 P99-47-3

WATER IN THE FEED COAL ASSUMED

LOST FROM FEED TANK, % 100.0 100.0 100.0

WEIGHT BALANCE, O/I, WT% 100.6 100.6 99.5

THE FOLLOWING DATA THROUGH AND INCLUDING ELEMENTAL BALANCES HAVE BEEN CORRECTED TO A 100% WT BALANCE

YIELDS, WT% FEED COAL

HYDROGEN -3.48 -3.48 -3.51

METHANE 4.81 4.88 4.81

ETHANE 3.40 3.42 3.30

PROPANE 3.09 3.03 3.03

I-BUTANE 0.21 0.20 0.20

N-BUTANE 1.50 1.48 1.49

TOTAL C1 TO C4 13.00 13.00 12.82

AMMONIA 0.35 0.38 0.34

HYDROGEN SULFIDE 1.98 1.93 1.98

CARBON DIOXIDE 0.95 0.92 1.15

CARBON MONOXIDE 0.18 0.18 0.17

TOTAL OTHER GASES 3.46 3.42 3.64

WATER 5.95 5.91 6.17

DEBUTANIZER LIQUID 18.84 18.26 17.93

PROCESS SOLVENT 10.46 8.83 7.95

TOTAL C5+ DISTILLATE 29.30 27.09 25.86

VACUUM TOWER BOTTOMS 51.77 54.05 55.00

CHEMICAL H2 CONSUMPTION BY UNIT GAS BALANCE

DM3/KG FEED COAL 409 408 412

CONVERSIONS, WT% FEED COAL

HYDROCRACKING 57.8 56.7 56.7

DESULFURIZATION 56.3 58.0 58.7

DENITROGENATION 24.2 22.4 21.2

OXYGEN REMOVAL 46.5 45.5 49.3

RUN NUMBER P99-47-1 P99-47-2 P99-47-3

GAS RATES, DM3/KG FEED COAL

DISSOLVER INLET GAS	1252.7	1254.5	1239.5
TOTAL QUENCH GAS	295.8	306.8	341.5
TOTAL DISSOLVER GAS	1548.4	1561.3	1581.0
MAKEUP GAS TO DISSOLVER	358.0	360.7	368.9
MAKEUP GAS TO SEP. SPARGE	83.9	85.6	84.2
MAKEUP GAS TO INSTRUMENT TAPS	255.2	255.2	258.0
TOTAL MAKEUP GAS	697.1	701.5	711.2
DISSOLVER OUTLET GAS	1281.3	1295.5	1310.4
GAS LEAVING SCRUBBERS	1757.0	1780.4	1786.3
SEPARATOR SPARGE GAS	362.8	370.7	361.0
PRODUCT GASES			
BLEED OFF GAS	277.9	284.8	287.1
DEBUTANIZER GAS	55.4	54.0	55.6
AMINE REACTIVATOR GAS	13.1	13.1	13.2
NAPTHA REACTIVATOR GAS	73.8	73.9	74.3
CHROMATOGRAPH BLEED GAS	9.7	10.0	10.3

ELEMENTAL BALANCES

WATER IN THE FEED COAL ASSUMED			
LOST FROM FEED TANK, %	100.0	100.0	100.0
CARBON, O/I	1.00	1.00	1.00
HYDROGEN, O/I	1.02	1.00	0.99
NITROGEN, O/I	0.98	1.02	1.01
SULFUR, O/I	1.02	0.99	0.99
OXYGEN, O/I	1.01	1.01	1.01
METALS, O/I	0.93	0.97	0.95
ASH, O/I	0.93	0.97	0.95

THE FOLLOWING DATA WERE BALANCED FOR CARBON, HYDROGEN, SULFUR, NITROGEN, OXYGEN, AND METALS

RUN NUMBER P99-47-1 P99-47-2 P99-47-3

YIELDS, WTX MOISTURE FREE COAL

HYDROGEN (BY H BALANCE)	-3.61	-3.45	-3.40
METHANE	4.80	4.88	4.79
ETHANE	3.39	3.41	3.28
PROPANE	3.08	3.03	3.01
I-BUTANE	0.21	0.20	0.20
N-BUTANE	1.50	1.47	1.48
TOTAL C1 TO C4	12.97	12.99	12.76
AMMONIA (BY N BALANCE)	0.38	0.35	0.34
HYDROGEN SULFIDE (BY S BAL)	1.92	1.97	2.00
CARBON DIOXIDE	0.95	0.92	1.14
CARBON MONOXIDE	0.18	0.18	0.17
TOTAL OTHER GASES	3.43	3.43	3.65
WATER (BY OXYGEN BALANCE)	5.87	5.72	6.13
DEBUTANIZER LIQUID	18.79	18.25	17.85
PROCESS SOLVENT	10.44	8.82	7.91
TOTAL C5+ DISTILLATE	29.23	27.07	25.76
VTB PYRIDINE SOLUABLES	35.50	36.81	37.31
INSOLUABLE ORGANIC MATTER	4.42	5.24	5.59
ASH	12.19	12.19	12.19
VACUUM TOWER BOTTOMS	52.11	54.24	55.09

CHEMICAL H2 CONSUMPTION, DM3/KG MOISTURE FREE COAL
BY HYDROGEN BALANCE 423 405 399

CONVERSIONS, WTX MF COAL

HYDROCRACKING	57.9	56.7	56.9
DESULFURIZATION	56.4	58.0	58.9
DENITROGENATION	24.4	22.5	21.5
OXYGEN REMOVAL	46.3	45.2	49.1

RUN NUMBER P99-47-1 P99-47-2 P99-47-3

GAS COMPOSITIONS. %DLX

REACTOR INLET GAS

HYDROGEN	89.65	89.53	90.18
METHANE	9.06	9.22	8.68
ETHANE	1.16	1.18	1.09
PROPANE	0.00	0.00	0.00
I-BUTANE	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00
CARBON MONOXIDE	0.13	0.07	0.05
CARBON DIOXIDE	0.00	0.00	0.00

REACTOR OUTLET GAS (BUTANES AND LIGHTER ONLY)

HYDROGEN	71.72	71.75	72.52
METHANE	15.49	15.68	14.93
ETHANE	3.30	3.30	3.11
PROPANE	1.23	1.20	1.18
I-BUTANE	0.08	0.08	0.08
N-BUTANE	0.45	0.44	0.44
HYDROGEN SULFIDE	1.01	0.97	0.98
CARBON MONOXIDE	0.26	0.19	0.17
CARBON DIOXIDE	0.37	0.36	0.44
AMMONIA	0.36	0.39	0.34
WATER	5.72	5.63	5.80

BLEED OFF GAS

HYDROGEN	83.96	83.97	84.53
METHANE	13.59	13.65	13.24
ETHANE	1.77	1.78	1.70
PROPANE	0.13	0.06	0.03
I-BUTANE	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00
HYDROGEN SULFIDE	0.00	0.00	0.00
CARBON MONOXIDE	0.56	0.54	0.50
CARBON DIOXIDE	0.00	0.00	0.00

RUN NUMBER

P99-47-1 P99-47-2 P99-47-3

GAS COMPOSITIONS, VOL%

AMINE REACTIVATOR GAS

HYDROGEN	9.60	9.57	9.00
METHANE	1.84	1.89	1.89
ETHANE	0.27	0.33	0.35
PROPANE	0.00	0.00	0.00
I-BUTANE	0.00	0.00	0.00
N-BUTANE	0.00	0.00	0.00
PENTANES	0.00	0.00	0.00
HYDROGEN SULFIDE	59.74	58.73	58.99
CARBON MONOXIDE	0.01	0.02	0.02
CARBON DIOXIDE	28.55	29.45	29.74

NAPHTHA REACTIVATOR GAS

HYDROGEN	23.55	23.35	23.14
METHANE	30.15	30.22	30.07
ETHANE	22.74	22.87	21.84
PROPANE	16.28	16.25	16.28
I-BUTANE	0.98	0.98	1.01
N-BUTANE	4.90	4.89	4.90
PENTANES	1.24	1.26	1.32
HYDROGEN SULFIDE	0.00	0.00	0.00
CARBON MONOXIDE	0.00	0.00	0.01
CARBON DIOXIDE	0.17	0.17	1.44

DEBUTANIZER GAS

HYDROGEN	50.24	50.13	51.61
METHANE	18.42	18.62	17.87
ETHANE	9.31	9.34	9.05
PROPANE	7.97	8.03	7.80
I-BUTANE	0.75	0.74	0.74
N-BUTANE	4.58	4.52	4.44
PENTANES	2.06	2.07	2.07
HYDROGEN SULFIDE	6.17	6.01	5.97
CARBON MONOXIDE	0.00	0.00	0.00
CARBON DIOXIDE	0.50	0.53	0.44

COAL INSPECTIONS

RUN NUMBER P99-47-1 P99-47-2 P99-47-3

FEED COAL

ELEMENTAL ANALYSIS (MOISTURE FREE, NORMALIZED TO 100%)

CARBON, SEMI-MICRO, WT%	70.96	70.96	70.96
HYDROGEN, SEMI-MICRO, WT%	4.92	4.92	4.92
NITROGEN, GRM11, WT%	1.29	1.29	1.29
SULFUR, TOTAL, GRM1159, WT%	3.20	3.20	3.20
SULFUR, ORGANIC, WT%	1.65	1.65	1.65
SULFUR, PYRITIC, WT%	1.51	1.51	1.51
SULFUR, SULFATE, WT%	0.04	0.04	0.04
OXYGEN, GRM1117, WT%	12.97	12.97	12.97
OXYGEN, ORGANIC, WT%	7.20	7.20	7.20
OXYGEN, INORGANIC, WT%	5.78	5.78	5.78
METALS, BY SPEC ASH, WT%	6.67	6.67	6.67

MINERAL MATTER, WT%*	14.00	14.00	14.00
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MOISTURE, D271, WT%	0.81	0.81	0.81
VOLATILE MATTER, WT%	38.00	38.00	38.00
ASH, D271, WT%	12.19	12.19	12.19
SULFUR, WT% OF ASH	0.78	0.78	0.78
OXYGEN, WT% OF ASH	44.50	44.50	44.50
ALUMINUM, WT% OF ASH	15.0	15.0	15.0
CALCIUM, WT% OF ASH	.9	.9	.9
IRON, WT% OF ASH	15.0	15.0	15.0
MAGNESIUM, WT% OF ASH	.8	.8	.8
POTASSIUM, WT% OF ASH	1.2	1.2	1.2
SILICON, WT% OF ASH	20.0	20.0	20.0
SODIUM, WT% OF ASH	.3	.3	.3
TITANIUM, WT% OF ASH	.7	.7	.7
TRACE METALS, WT% OF ASH	.4	.4	.4

PARTICLE SIZE DISTRIBUTION, WT%

ON 80 MESH	.3	.3	.3
THRU 80 ON 200 MESH	35.6	35.6	35.6
THRU 200 ON 325 MESH	18.6	18.6	18.6
THRU 325 ON 625 MESH	21.1	21.1	21.1
THRU 625 MESH	24.4	24.4	24.4

* BY PARR'S EQUATION: MINERAL MATTER = 1.08 X ASH + 0.55 X PYRITIC SULFUR

PRODUCT INSPECTIONS

RUN NUMBER	P99-47-1	P99-47-2	P99-47-3
DEBUTANIZER BOTTOMS			
GRAVITY, D287, API	26.2	26.0	26.0
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)			
CARBON, SEMI-MICRO, WT%	84.36	84.78	84.65
HYDROGEN, SEMI-MICRO, WT%	10.66	10.53	10.44
NITROGEN, G811, WT%	0.66	0.68	0.70*
SULFUR, GRM1156, WT%	0.35	0.22	0.22
OXYGEN, GRM1117, WT%	3.98	3.79	4.00
VISCOSITY, KIN. D445, CS			
-35C			
0C			3.57
WATER, G525, PPM	8353	8653	8378
HEAT OF COMB., D240, BTU/LB			17776
POUR POINT, D97, C			-53
DISTILLATION, D86, C			
INITIAL BOILING POINT	57	64	63
5 VOL %	78	75	81
10 VOL %	98	102	104
30 VOL %	158	163	165
50 VOL %	190	197	196
70 VOL %	210	216	218
90 VOL %	237	240	231
95 VOL %	251	264	247
END POINT	266	286	277
WATER (INCLUDES FLUSH WATER)			
TOTAL CARBON, PPM	13000	12200	12200
ORGANIC CARBON, PPM	10700	10500	10000
NITROGEN, G811, WT%	1.36	1.48	1.30
SULFUR, GRM1156, WT%	1.61	1.58	1.64

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-47-1	P99-47-2	P99-47-3
PROCESS SOLVENT			
GRAVITY, D237, API	8.4	8.4	8.2
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)			
CARBON, SEMI-MICRO, WT%	87.66	87.59	87.69
HYDROGEN, SEMI-MICRO, WT%	8.60	8.63	8.58
NITROGEN, G811, WT%	0.96	0.98	0.96
SULFUR, GRM1156, WT%	0.38	0.41	0.38*
OXYGEN, GRM1117, WT%	2.40	2.39	2.39
VISCOSITY, KIN, D445, CS			
25 C			17.46
50 C			6.23
100 C			1.96
WATER, G525, PPM	337	385	442
HEAT OF COMB., D240, BTU/LB			17385
POUR POINT, D97, C			-15
DISTILLATION, CUSHMAN, C			
CORRECTED TO 760 MM HG USING K10 FACTOR			
INITIAL BOILING POINT	209	196	196
10 VOL %	246	246	246
20 VOL %	261	265	261
30 VOL %	274	279	280
40 VOL %	284	296	291
50 VOL %	296	306	308
60 VOL %	315	319	321
70 VOL %	333	343	339
80 VOL %	349	365	373
90 VOL %	391	417	421
END POINT	443	434	434

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

PRODUCT INSPECTIONS

RUN NUMBER	P99-47-1	P99-47-2	P99-47-3
VACUUM TOWER BOTTOMS			
SPECIFIC GRAVITY, D70, G/CC	1.45	1.44	1.42
ELEMENTAL ANALYSIS (NORMALIZED TO 100%)			
CARBON, SEMI-MICRO, WT%	68.70	69.07	70.47
HYDROGEN, SEMI-MICRO, WT%	4.00*	3.97	4.10
NITROGEN, G811, WT%	1.44	1.44	1.46
SULFUR, TOTAL, D1552, WT%	2.48	2.33	2.26
SULFUR, SULFIDE, WT%			1.21
SULFUR, PYRITIC, WT%			0.40
OXYGEN, GRM1117, WT%	11.40*	11.33	10.24
METALS, WT%	11.98	11.85	11.48
ASH, G599, WT%			
SULFUR, WT% OF ASH	0.78*	0.78*	0.78*
OXYGEN, WT% OF ASH	44.50*	44.50*	44.50*
METALS, WT% OF ASH (BY DIFF)	54.72	54.72	54.72
PYRIDINE INSOLUABLES, WT%	31.1	31.7	31.6
MELTING POINT, G898, °C	135	135	140
HEAT OF CUMB., D240, BTU/LB			12667
CONCARBON RSD, D189, WT%			69.9
DISTILLATION, CUSHMAN, °C			
CONVERTED TO 760 MM HG USING K10 FACTOR			
INITIAL BOILING POINT	401	394	394
INTERMEDIATE BOILING POINT			
END POINT	456	467	477
OVER AT INTERMED BP, WT%			
RESIDUE, WT%	93.0	91.6	89.8

* FOLLOWING AN ENTRY INDICATES THAT IT IS AN ESTIMATED VALUE

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER	P99-47-1	P99-47-2	P99-47-3
YIELDS, WTX MOISTURE FREE COAL			
HYDROGEN (BY H BALANCE)	-3.61	-3.45	-3.40
METHANE	4.80	4.88	4.79
ETHANE	3.39	3.41	3.28
PROPANE	3.08	3.03	3.01
I-BUTANE	0.21	0.20	0.20
N-BUTANE	1.50	1.47	1.48
TOTAL C1 TO C4	12.97	12.99	12.76
AMMONIA (BY N BALANCE)	0.38	0.35	0.34
HYDROGEN SULFIDE (BY S BAL)	1.92	1.97	2.00
CARBON DIOXIDE	0.95	0.92	1.14
CARBON MONOXIDE	0.18	0.18	0.17
TOTAL OTHER GASES	3.43	3.43	3.65
WATER (BY OXYGEN BALANCE)	5.87	5.72	6.13
C5 - 193 C (C5 - 380 F)	8.05	7.30	6.98
193 - 288 C (380 - 550 F)	14.43	12.95	13.12
288 - 482 C (550 - 900 F)	11.55	12.24	11.62
TOTAL C5+ DISTILLATE*	34.50	32.49	31.71
482 C+ (900 F+) PYRIDINE SOL.	30.23	31.39	31.36
INSOLUABLE ORGANIC MATTER	4.42	5.24	5.59
ASH	12.19	12.19	12.19
TOTAL 482 C+ (900 F+) PROD	46.85	48.82	49.14

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY. IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

IN THE FOLLOWING DATA, DISTILLATE YIELDS HAVE BEEN ADJUSTED TO THE BOILING RANGES INDICATED

RUN NUMBER P99-47-1 P99-47-2 P99-47-3

YIELDS, WT% MOISTURE AND ASH FREE COAL

HYDROGEN (BY H BALANCE)	-4.11	-3.93	-3.87
METHANE	5.47	5.55	5.45
ETHANE	3.36	3.89	3.74
PROPANE	3.51	3.45	3.43
I-BUTANE	0.24	0.22	0.22
N-BUTANE	1.70	1.68	1.69
TOTAL C1 TO C4	14.77	14.79	14.53
AMMONIA (BY N BALANCE)	0.43	0.40	0.38
HYDROGEN SULFIDE (BY S BAL)	2.18	2.25	2.28
CARBON DIOXIDE	1.08	1.05	1.30
CARBON MONOXIDE	0.21	0.21	0.20
TOTAL OTHER GASES	3.91	3.91	4.16
WATER (BY OXYGEN BALANCE)	6.68	6.52	6.98
C5 - 193 C (C5 - 380 F)	9.18	8.31	7.95
193 - 288 C (380 - 550 F)	16.94	14.75	14.94
288 - 482 C (550 - 900 F)	13.16	13.94	13.23
TOTAL C5+ DISTILLATE*	39.29	37.01	36.12
482 C+ (900 F+) PYRIDINE SOL.	34.43	35.74	35.72
INSOLUABLE ORGANIC MATTER	5.03	5.97	6.37
TOTAL 482 C+ ORGANIC PROD	39.47	41.71	42.08

* THE QUANTITY OF DISTILLATE SHOWN MAY NOT BE RECOVERABLE COMMERCIALY, IF THE TOTAL 482 C+ (900 F+) PRODUCT IS NOT FLUID ENOUGH TO BE EASILY REMOVED FROM THE VACUUM COLUMN

APPENDIX D

CHRONICLE OF SRC-II OPERATIONS ON P99
FOR RUNS 41 TO 47

APPENDIX D

Chronicle of Operations for Runs P99-41 Through P99-47

INTRODUCTION

This appendix presents a brief chronicle of operations for Runs P99-41 through P99-47. It is divided into two parts. The first section discusses the chronology of operations, giving an indication of the problems encountered with each run. The second section discusses the solids removed from parts of the unit following some of the operating periods.

Run P99-41 - August 29 to September 11, 1978

Run 41 was not as smooth as previous runs made with Pittsburgh Seam coal. Startup was delayed for two days because of problems with the flash tower level control and plugs in the lines to Tanks 6, 7, 8, and 9. During the first two days on coal, temperature control in the dissolver was erratic. This was found to be due to a faulty thermocouple. During most of this run the fractionation system was upset. This was due to a number of factors: (1) difficulty controlling the temperature in the hot and intermediate separators (they operated at a lower temperature than desired); (2) difficulty controlling the cut point in the fractionator (it ran lower than desired); and (3) poor operation of the vacuum column. Weight balance for the total run period averaged about 96.5%. The first high pressure sample from the bottom of the dissolver was taken at the end of this run.

Run P99-42 - September 12 to September 28, 1978

While the operating variables were being changed to Run 42 conditions, the primary condenser on the vacuum column plugged and had to be removed, cleaned, and reinstalled. The vacuum column plugged shortly after this and was replaced by a spare column which was on hand. On opening the

plugged column, it was found that the demister pad was completely filled with solids and sludge, but the rest of the column was relatively clean.

The unit was operated in an idle mode while the vacuum column was being replaced. The plugged demister pad is believed to have been the result of accidentally flooding the column during shutdown at the end of Run 39. Coal feed was restarted on September 17, and the run was completed on September 28. No water was injected after the hot separator during this run. The main operating problem during this run was in obtaining the proper distillation separation in the debutanizer and fractionator columns. The Freon compressor was found to be defective and was replaced. A dissolver sample was taken at the end of this run.

Run P99-43 - September 29 to October 6, 1978

After changing conditions, a number of minor upsets occurred due to checking coal rate measurements and changing a part on the dissolver feed pump. The unit ran well until conditions were changed on October 7.

Run P99-44 - October 7 to October 23, 1978

While changing conditions, the flash tower level control valve malfunctioned. While the valve was being replaced, the vacuum tower preheater plugged. The "cornucopia" style preheater was replaced with a hair-pin style preheater which was on hand. The run was restarted on October 12, but a number of plugs in the flash tower bottoms level control system upset operations for about a week. Three good run periods were completed by October 22, when the No. 2 let-down valves failed and could not be isolated for replacement due to a leaking block valve. At this time, it was decided to shutdown the unit to replace valves and check lines.

Turn around - October 24 to October 31, 1978

The emergency shutoff valve at the bottom outlet of the hot separator was found to be badly worn and was replaced. Several valves in the let-down system were also replaced. After changing to Powhatan coal, the run was started, but the two bottom temperatures in the dissolver were too low. The run was terminated and the dissolver was removed. When the dissolver was opened, it was found to contain about 15 inches of solids in the bottom.

Run P99-45 - November 1 to November 14, 1978

Run 45 was restarted on November 1. The first two days of operation were plagued with plugging in the Tank 1 coal chute and feed pump check valves. Also, large coke particles were found in the bottom of the flash column, where they upset level control. These problems are normally experienced during startup, but it was at first thought that the larger 80 mesh size coal ground by Conoco could have been aggravating these problems. However, later smooth operation showed that the 80 mesh coal was no more difficult to process than the 200 mesh coal.

On November 6, the atmospheric flash and fractionator overhead temperatures were increased to decrease the amount of middle distillate in the feed slurry. Column conditions were adjusted twice in order to achieve smooth operation. A feed tank composition similar to that run at Fort Lewis was obtained for most of the run. An attempt was made to take a dissolver sample, but a plugged line prevented this.

Run P99-46 - November 15 to November 22, 1978

Run 46 was started on November 15 and completed on November 22. The unit ran quite smoothly for most of this run. The flash tower bottoms plugged at the end of this run, and coal feed was stopped for several hours. Since the unit was upset, it was decided to change to Run 47 conditions. Two small cracks in the 30 ton coal feed hopper were noticed at this time. Since neither crack was extensive, it was decided to continue operation and to repair the cracks during the next extended shutdown.

Run P99-47 - November 23 to November 28, 1978

The first two days of this run were spent unplugging the flash column level control system and repairing the slurry charge pump. Run 47 was started on November 25, but had to be terminated prematurely on November 28 due to severe leakage at the emergency manual shutoff valve between the hot high pressure separator and the pressure let-down valves. The dissolver was cooled, and the contents were drained through the emergency dump valve. Several valves were replaced and the unit was prepared for restart without removing the dissolver. It was also decided to change coals at this time to a new batch of Powhatan coal which had been obtained from Fort Lewis and dried and ground by Empire Coke.

Analyses of Solids Removed From Various Locations
While Running with Robinson Run Coal

Run P99-41

Solids found in the vacuum tower primary overhead condenser following Run 41 had a composition similar to vacuum tower bottoms (see Table D-I). The vacuum column had overflowed during the emergency shutdown of Run 39. The secondary condenser had been replaced, but the primary condenser had only been flushed with hot solvent. The demister screen was plugged with solids (see Table D-1), and these solids were primarily pyridine insolubles and ash. The screen had apparently filled with solids when the vacuum column overflowed.

Run P99-43

Some grease-like, off-white solids were found in the kerosene scrubber McAfee gauge after Run 43. X-ray analysis indicated that the solids were non-crystalline and contained a considerable amount of sulfur and zinc (see Table D-II). The infrared spectrum suggested this to be an organo-zinc-dithiophosphate type material. A possible source of zinc is the lubricants used for the compressors and pumps, some of which contain zinc compounds. Solids removed from the plugged vacuum tower preheater were found to be mostly coke and ash (see Table D-III).

Run P99-44

Run 44 had to be terminated when the let-down valve system failed. Oil flow was stopped and the pressure was lowered in order to replace the valves. During startup of Run 45, the bottom temperature in the dissolver was observed to be too low, and it was concluded that solids had deposited in the bottom of the dissolver during the shutdown. The dissolver was removed, and approximately 15 inches of solids were found in the bottom. Analysis showed these solids to be mostly pyridine insolubles (see Table D-IV) which had settled to the bottom of the dissolver when oil circulation was stopped.

TABLE D-I

Analyses of Solids Found in the Vacuum Tower Following Run P99-41

Location Analyses	<u>Preheater Outlet</u>	<u>Primary Condenser</u>	<u>Demister Screen</u>
Pyridine Insolubles, Wt%	86.83	38.37	91.57
Carbon, Wt%		71.92	77.21
Hydrogen, Wt%		5.13	7.16
Ash, Wt% of P. I.	52.5	46.4	39.9
Spec. Ash, Wt% of Ash			
Al	-	-	10
Ba	-	-	trace
B	-	-	0.1
Ca	-	-	2
Cr	-	-	0.05
Cu	-	-	0.006
Fe	-	-	10
Mg	-	-	1
Mn	-	-	1
K	-	-	0.2
Si	-	-	25
Ag	-	-	0.3
Na	-	-	0.3
Sr	-	-	0.1
Ti	-	-	0.9

SCT:als,6/26/79,251-8370

TABLE D-II

Analyses of Solids Found in the Kerosene Scrubber Off-Gas McAfee Gauge After Run P99-43

X-Ray

The sample is an off-white solvent-wet solid. The sample contains ammonia or amine, elemental sulfur and sulfide sulfur. An x-ray diffraction scan indicates the sample is non-crystalline. The following elements were identified:

Major	S,Zn
Intermediate	Ca
Minor	P
Trace	Ti,Fe

Elemental analysis:

Carbon, Wt%	38.07
Hydrogen, Wt%	7.15
Nitrogen, Wt%	1.42
Sulfur, Wt%	14.13

Infrared

The infrared spectrum shows the presence of hydroxyls, some acid, phosphorus-oxygen bonds, phosphorus-sulfur bonds, and hydrocarbons. The spectrum is very suggestive of an organo zinc dithiophosphate-type material.

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TABLE D-III

Analyses of Solids Found in Vacuum Tower Preheater
After Run P99-43

Pyridine Insolubles, Wt%	95.91
Carbon, Wt%	51.54
Hydrogen, Wt%	1.63
Ash, Wt%	31.3
Ash, Wt% of P.I.	29.9
Spec. Ash, Wt% of Ash	

Al	10
Ba	trace
B	0.1
Cr	0.06
Cu	0.003
Fe	15
Mg	1
Mn	0.2
Ni	0.02
K	1
Si	25
Na	0.3
Ti	1
Zn	0.3

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TABLE D-IV

Analyses of Solids Found in Dissolver After Run P99-44

Pyridine Insolubles, Wt%	91.27
Carbon, Wt%	77.65
Hydrogen, Wt%	7.11
Ash, Wt%	9.60

Spec. Ash, Wt% of Ash

Al.	10
Ba	trace
B	0.2
Ca	3
Cr	0.05
Cu	0.007
Fe	9
Mg	1
Mn	0.4
Ni	0.08
K	1.2
Si	20
Na	0.3
Si	0.2
Ti	0.8
V	0.1

SCT:als,6/26/79,251-8370