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QUARTERLY REPORT
ADVANCED DIRECT COAL LIQUEFACTION CONCEPTS

Contract No: DE-AC22-92PC91050
Report No. QR 94/02

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SUMMARY

A detailed evaluation of the bench unit data on Black Thunder feedstocks was completed. The results show that in a once-through operation using counterflow reactor technology coal conversions in excess of 90% could be obtained, giving distillable oil yields in the range 60 - 65 wt% on MAF coal. The remaining non-distillable oil fraction which represents 20 - 25 wt% on MAF coal is a source of additional distillable oil in further processing, for example, bottoms recycle operation. C_1 - C_3 gas yields were generally in the order of 6 - 8 wt%.

In autoclave studies, Illinois #6 coal was found to be much less reactive than Black Thunder coal, and did not respond well to solubilization with carbon monoxide/steam. Process severity was, therefore, increased for bench unit operations on Illinois #6 coal, and work has concentrated on the use of hydrogen rather than carbon monoxide for solubilization.

Preliminary coking studies on the resid from bench unit runs on Black Thunder coal were also carried out. Distillable liquid yields of 55 - 60 wt% were obtained.

The technical and economic study to be carried out by Kilborn Engineering Company has been initiated.

INTRODUCTION

The status of the project at the conclusion of the last quarter can be summarized as follows:

1. All the feedstocks required for the execution of the project had been acquired and characterized, with the exception of an Illinois #6 derived oil for bench unit operation. A sample of Illinois #6 derived oil sufficient for autoclave tests had been received and partially characterized.
2. Agglomeration tests on both Black Thunder and Illinois #6 coals had been completed.
3. Autoclave tests and bench unit operations on Black Thunder coal had been completed.

During this quarter the following major activities were pursued:

1. Compilation of the analytical data in Runs DOE-BU-014 and DOE-BU-015 was completed. A detailed assessment of the data from these two runs was carried out, since these runs represent our best conditions for bench unit operation on Black Thunder coal.

2. Preliminary coking tests were completed on V340 residue from the bench unit runs on Black Thunder coal.

3. Autoclave tests on Illinois #6 coal to define conditions for bench unit operations were completed.

4. Initial bench unit tests on Illinois #6 coal were performed.

5. The technical and economic assessment of the process was initiated.

EXPERIMENTAL PROGRAM

Task 2 Feedstocks

2.1 Feed Procurement and Characterization

Coal derived oils (LO-6282 and LO-6305) were obtained from HRI during the quarter. Both were 0-43 recycle oils produced from the processing of Illinois #6 coal. These oils were ash free mixtures of atmospheric still bottoms and Rose SR deasphalted oil. LO-6282 (15 litres) was utilized for screening tests in the autoclave to identify suitable process conditions for the bench unit operations. LO-6305 (3 barrels) was used for the bench unit program.

Characterization of the oils is shown in Table 1. The oils were very similar both chemically and physically. They were lighter and less viscous than the ideal liquefaction solvents for the CFR system.

Table 1: Properties of Illinois Solvents

	LO-6282	LO-6305
API gravity,°	14.8	[2]
Viscosity, cST @ 20°C @ 40°C	201 49	[2] [2]
Carbon[1]	88.5	88.6
Hydrogen[1]	10.5	10.7
Nitrogen[1]	0.08	0.13
Sulphur[1]	0.07	0.08
H/C Ratio	1.42	1.45
CCR[1]	1.9	[2]
Asphaltenes[1] (C5)	2.4	1.4
Simulated Distillation[1]		
0 - 182°C	-	-
182 - 343°C	30.0	29.0
343 - 525°C	63.7	64.7
525+	6.3	6.3

[1] weight%
[2] in progress

Task 3 Experimental Work

3.1 Ash Removal

No activity in this quarter.

3.2 Autoclave Program

Five tests were completed on Illinois #6 coal with the following objectives:

1. Identify first stage process conditions for the solubilization of Illinois #6 coal using CO/steam or hydrogen.

2. Determine the processibility of Illinois #6 coal in a simulated 2 stage test.

Run summaries are given in Table 2, along with a similar test with Black Thunder coal. The most obvious conclusion that can be drawn is that the Illinois #6 coal is less reactive than Black Thunder coal, and it does not respond well to carbon monoxide/steam. At the standard autoclave conditions for Black Thunder coal (390°C/600 psi CO cold/30 minutes) coal conversion for Illinois #6 coal was only 67%, almost 20% lower than for Black Thunder. Raising the temperature to 425°C improved coal conversion to 81% (DOE-64) with a CO atmosphere. This was still below the value obtained in hydrogen even with the low activity iron catalysts (DOE-61 and 62). One simulated 2 stage run was also performed using hydrogen (DOE-63). The autoclave was initially set to 425°C to promote solubilization, then raised to 440°C for the hydrocracking step where Fe_2O_3/DMDS was the catalyst system. The gas was hydrogen throughout so it was not necessary to let down the pressure between stages and to recharge the autoclave. Hydrogen consumption during this run was not excessive as the final pressure was still over 2000 psi, of which about 85% was hydrogen. Process performance is depicted in Figure 1. All runs with hydrogen gave coal conversions of close to or over 90%.

Figure 1 Process performance -- Illinois coal

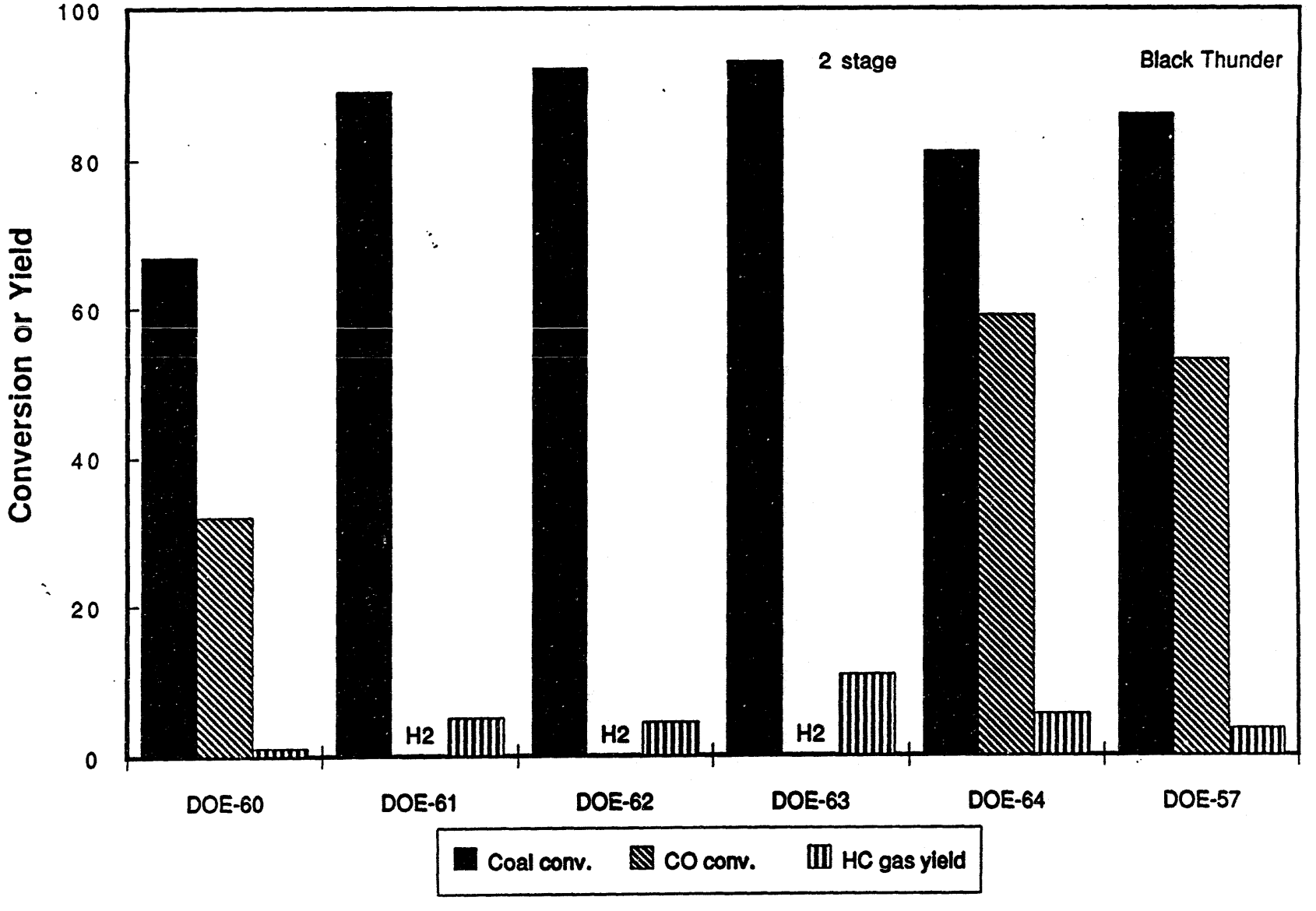


TABLE 2 AUTOCLAVE PROGRAM RESULTS

RUN #	CONDITIONS			CATALYST	COAL CONV	CO CONV	HC GAS	H2 CONS	Notes
	TEMP oC	CO or H2	Time, min		%	%	g/100g	g/100g	%
DOE-60	390	600	30	Na2AlO2	67	32	1.1	0.4	FeS added
DOE-61	425	1000	30	FeS	89	H2	5.0	0.6	Na2AlO2 added
DOE-62	425	1000	30	Fe2O3	92	H2	4.4	0.9	
DOE-63	425	1100	30						2 stage
	440		30	Fe2O3/DMDS	93	H2	10.7	2.2	
DOE-64	425	600	30	Na2AlO2	81	59	5.4	0.9	Fe2O3 added
DOE-57	410	600	30	Na2AlO2	86	53	3.5	1.3	Black Thunder

Runs 60 to 64 -- Illinois #6 coal and LO-6282 solvent

RUN #	CONDITIONS			CATALYST	COAL CONV	Asphalt	Preasphalt	Oils+	NOTES
	TEMP oC	CO psi	Time, min		%	g/100g	g/100g	g/100g	
DOE-60	390	600	30	Na2AlO2	67	24.3	32.4	9.2	FeS added
DOE-61	425	1000	30	FeS	89	19.4	30.8	32.6	Na2AlO2 added
DOE-62	425	1000	30	Fe2O3	92	23.6	39.0	24.7	
DOE-63	425	1100	30						2 stage
	440		30	Fe2O3/DMDS	93	28.2	15.9	36.2	
DOE-64	425	600	30	Na2AlO2	81	26.6	29.8	19.5	Fe2O3 added
DOE-57	410	600	30	Na2AlO2	86	78.1	9.3	-5.0	Black Thunder

Product yield distribution also indicated the lower reactivity of the Illinois #6 coal. During the first stage solubilization, preasphaltene levels exceeded that of the asphaltenes, which was the reverse of that observed with Black Thunder. Also, in the two stage test, there was 16% preasphaltenes unconverted, while during similar runs with Black Thunder the preasphaltenes were almost eliminated (5% or less). These results are shown visually in Figure 2.

We can conclude from the results that process severity will have to be increased in the bench unit when processing Illinois #6 coal. Also, it is likely that the first stage operation will be more effective if hydrogen rather than carbon monoxide is the reducing gas.

3.2.1 Future Work

No autoclave tests have been performed at this time on Illinois #6 coal and LO-6305 solvent. To permit correlations with the bench unit the following tests are planned:

1. Solvent stability
2. 425°C/30 minutes/600 psi CO - 1 stage
3. 425°C/30 minutes/1000 psi H_2 - 1 stage

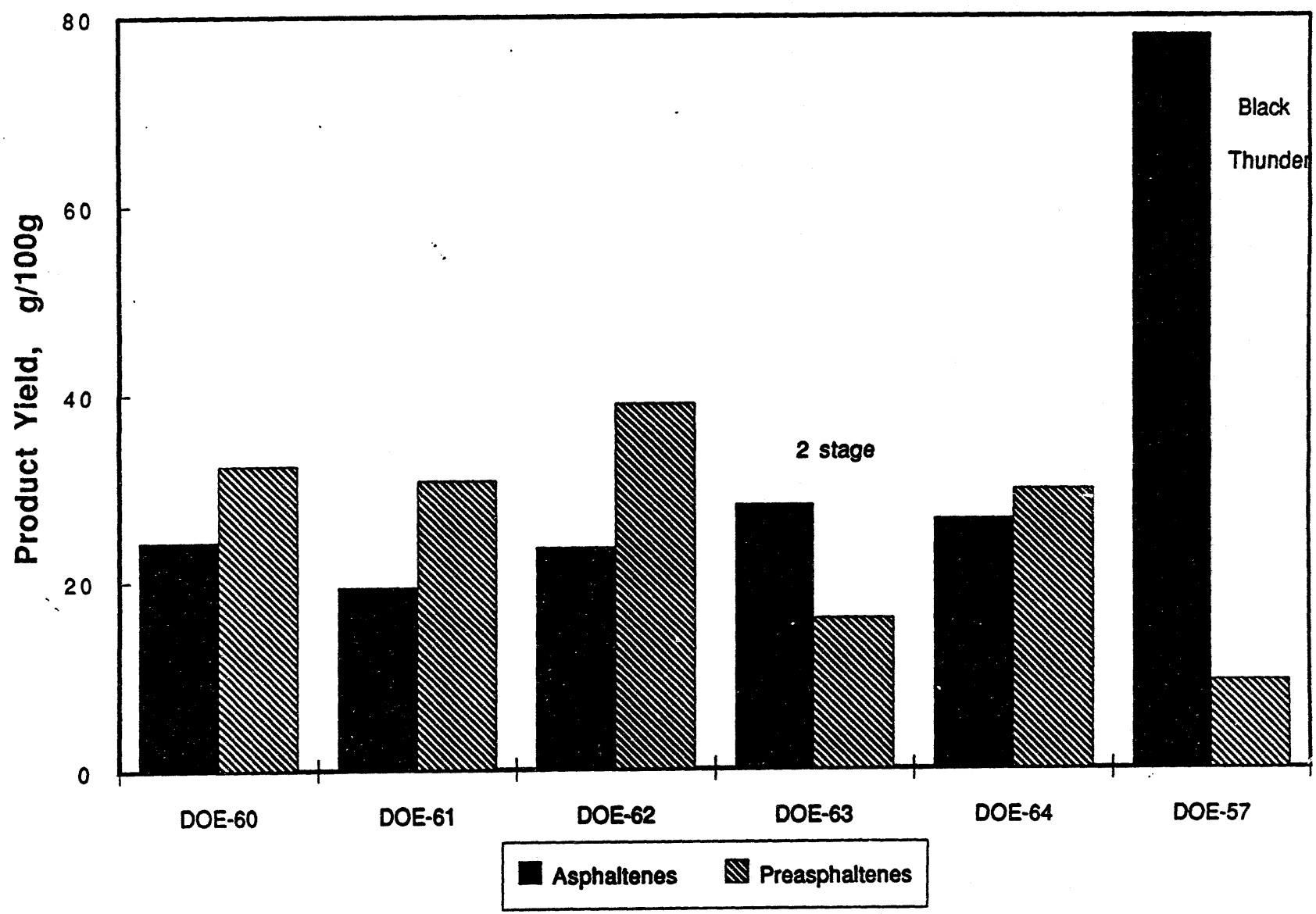
4a. 425°C/30 minutes/1000 psi H_2/Fe catalyst

b. 440°C/30 minutes/1000 psi H_2 - 2 stage

5. 2 stage as 4, but using Mo catalyst.

Also, to determine if the products from the counterflow reactor can be further processed, autoclave tests are in progress on the V-340 products from Illinois #6 coal bench unit runs.

Figure 2 Process performance -- Product yield



3.3 Bench Unit

3.3.1 Modifications

No major modifications were made to the bench unit during this quarter. During Runs DOE-BU-016 and DOE-BU-017, the decision was made to by-pass the first stage reactor and direct the feed line from the preheater straight to the second reactor. This allowed for the operation of the second stage only.

3.3.2 Operations

With the completion of Runs-BU-014 and DOE-BU-15 last quarter, bench unit operations on Black Thunder coal were concluded. The time allocation remaining for bench unit operations was scheduled for Illinois #6 coal. The start time for these runs was dictated by the receipt at Devon of Illinois #6 derived solvent from HRI. This solvent was received on March 17th, and the first runs on Illinois #6 coal, DOE-BU-016 and DOE-BU-017 were carried out in the weeks of March 21st and March 28th, respectively. The plan was to run two stage operations both weeks. DOE-BU-016 was to use CO/steam in the first stage and hydrogen in the second stage. First stage conditions were fixed at a temperature of 425°C, pressure 10.34 MPa with WHSV about 1.7 using aluminate catalyst. These conditions had been determined as a result of autoclave tests. For the second stage, two yield periods were scheduled with iron oxide catalyst and two yield periods with ammonium molybdate catalyst. In each case temperatures of 430°C and 440°C represented the difference in the two yield periods. For DOE-BU-017, hydrogen was to be used in the first stage instead of CO/steam, with all other conditions the same as DOE-BU-016. Dimethyldisulphide was added as sulfiding agent throughout.

However, in all attempts at two stage operation, plugging occurred at the check valves of the transfer pump between the first and second stage reactors approximately one to two hours after introduction of the coal into the feed. As a result the decision was made

to by-pass the first reactor and feed directly to the second stage reactor. In this case hydrogen was used for solubilization and hydrocracking in a one stage operation. Two yield periods were completed using iron oxide as catalyst at second stage temperatures of 430°C and 440°C, respectively. Subsequently, two yield periods were carried out with ammonium molybdate as catalyst at similar conditions. The results of these one stage operations on Illinois #6 coal are discussed in the next section.

3.3.3 Results

The bench unit tests on Black Thunder coal concluded with Runs DOE-BU-014 and DOE-BU-015. These runs represented the most optimized data obtained on Black Thunder coal using the counterflow reactor technology. Much effort has, therefore, been applied this quarter to analyzing the results from -014 and -015 and establishing the best data base from which preliminary economic studies could be made.

Preliminary results from DOE-BU-014 and DOE-BU-015 were presented in the last quarterly report. A revised set of data on these runs is now presented in the Appendix. Overall mass balances based on the raw data were quite good ranging from 96.4 to 103.2 percent. The water balances were, however, consistently high. Errors associated with water measurement in the first stage were identified as a problem, so the decision was made to force a water balance in the first stage, but leaving the oil produced in the first stage overhead on an as measured basis. This assumption of water balance in the first stage is reasonable, since autoclave results earlier suggested oxygen removal from coal appeared essentially as carbon dioxide during solubilization with CO/steam. Overall mass balances were changed only slightly by these adjustments, ranging now from 95.5 to 102.5%. Water was produced in the second stage reactor through oxygen removal from the MAF coal during hydrocracking. With iron oxide catalyst the water produced (6-8 wt%) was slightly higher than in the case where molybdate was catalyst (about 5 wt%). These values were supported by elemental balances which show good oxygen balance and which will be discussed later. Another adjustment in the data was made when it was

discovered that the hydrogen flow meter on the second stage reactor was reading 3% high. This gave overall hydrogen consumption now in the range of 6-8% wt, more consistent with values reported elsewhere.

The product yields on an MAF coal basis are shown in Figure 3. The results show that THF extractables ($C_4 \rightarrow$ preasphaltenes) yields in the 70 - 80 wt% range with molybdenum catalyst. As expected these were slightly higher than with the iron oxide catalyst. Conversely, the iron oxide catalyst gave slightly higher gas and water yields. The conditions in the first stage were kept constant for all these runs, the only variable apart from catalyst was the temperature of the second stage reactor. Between 430°C and 445°C (determined earlier to be the optimum range) temperature did not appear to have a major effect, but the IOM did tend to be lower at higher temperatures, as would be expected.

The gas and water yields are broken down into water, carbon oxides and hydrocarbon gas in Figure 4.

Some variability in the data is shown here, but the data suggests:

1. Hydrocarbon gas yields increase with temperature with iron oxide catalyst.
2. Water yields are slightly higher with iron oxide catalyst.

The breakdown of the THF extractables on the basis of solubility is shown in Figure 5. This data indicates that ammonium molybdate catalyst does give slightly higher oil yields (pentane soluble), than iron oxide. Oil yields also tend to increase with temperature while asphaltene yields (toluene soluble) decrease. Preasphaltene yields (THF soluble fraction) are low and fairly constant at 2-3 wt%.

In general, the distillable oil would be expected to be most of the pentane soluble oil, while most of the asphaltene fraction and the preasphaltene fraction would be expected

FIGURE 3 PRODUCT YIELDS

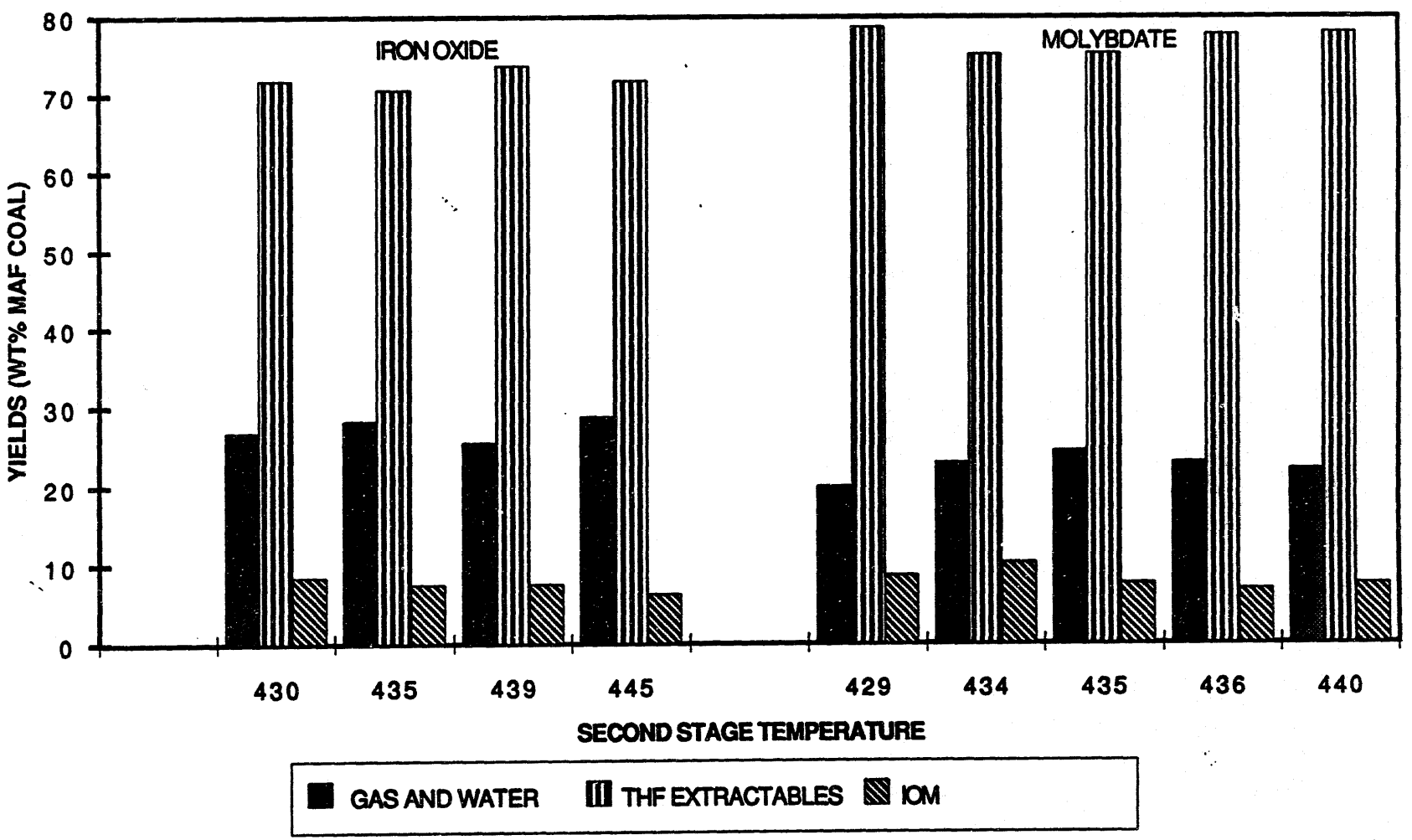


FIGURE 4 GAS AND WATER YIELDS

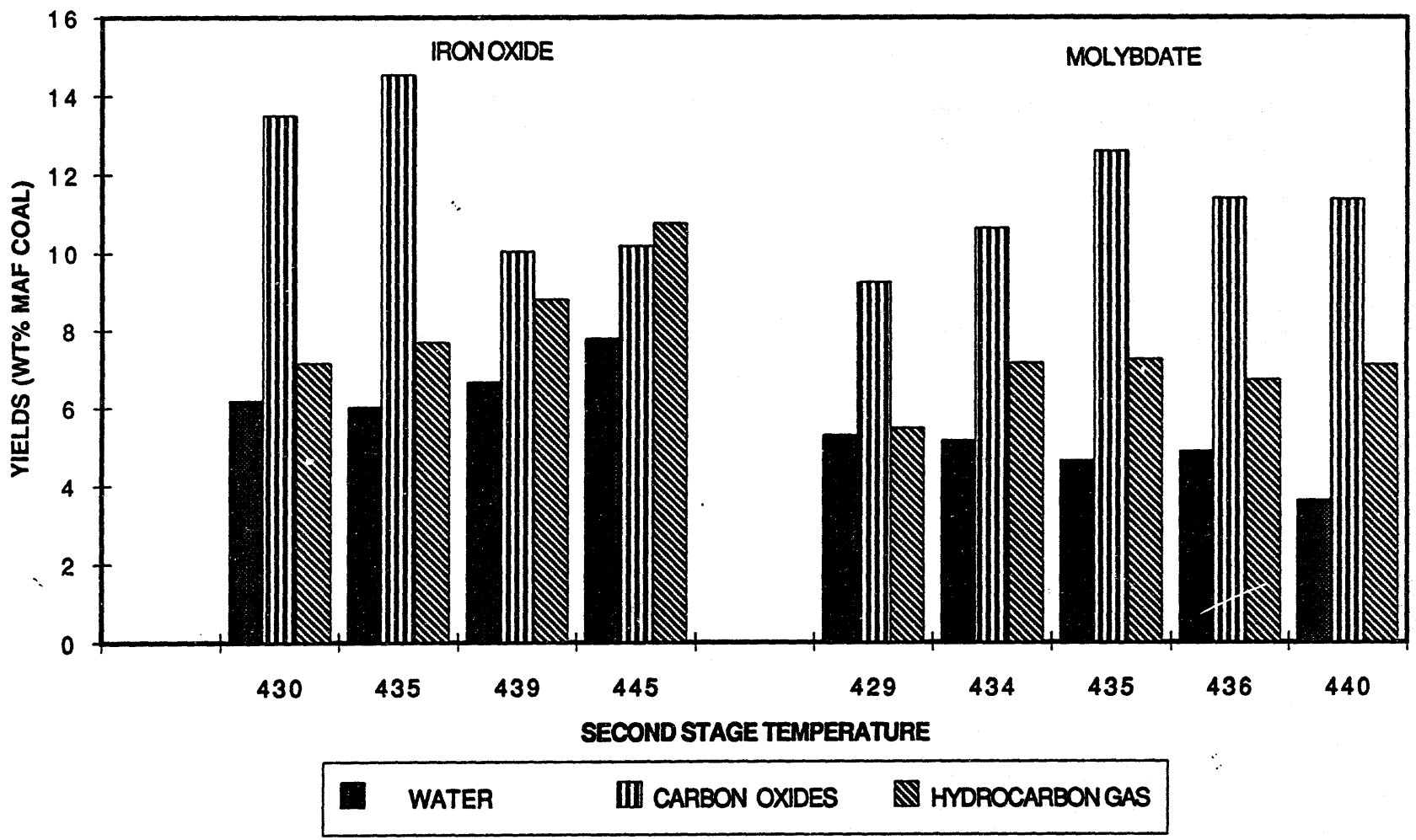
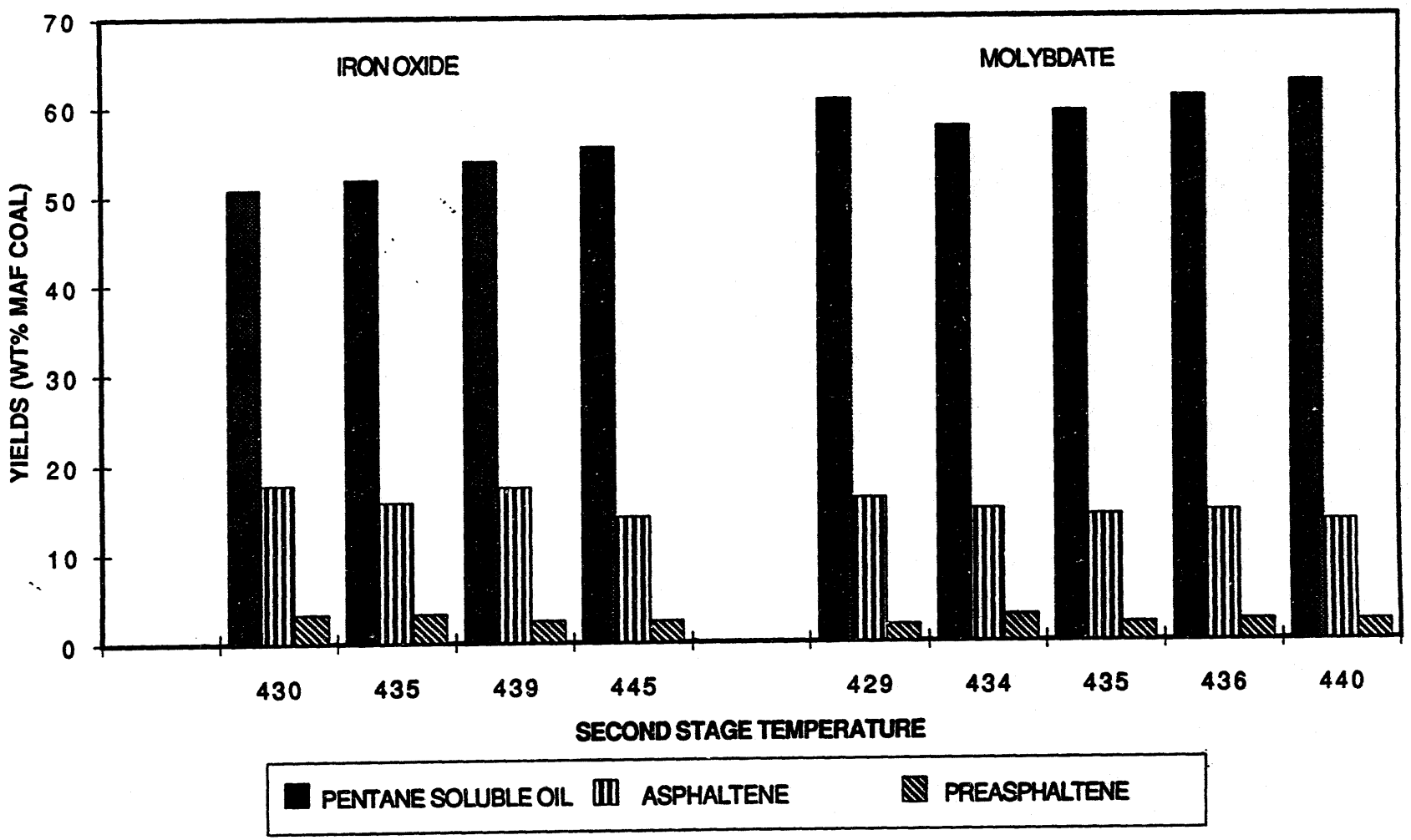


FIGURE 5 THF EXTRACTABLES YIELDS



to be non-distillable. The V1074 solvent provided from Wilsonville, for instance, was 87.9% pentane soluble oil and 12.1% asphaltene.

As occurred in the autoclave program, difficulties were experienced in determining reliable distillable oil values by laboratory distillation procedures. D1160 distillation methods were unsatisfactory due to the fact that a consistent and reliable end point for the distillation could not be achieved. Initially distillable oil yields were estimated from simulated distillation data (D2887) on the solvent, V220 and V330 overheads and a crude simulated distillation procedure on the V340 bottoms. However, it was discovered that the V330 overheads contained some asphaltenes and therefore might have non-distillable material present. The D2887 procedure might therefore lead to an over statement of distillable oil yields. Eventually a procedure based on crude simulated distillation data on the solvent and on composite product samples of V220, V330, and V340 bottoms blended in the correct ratios was established. It is felt that this procedure gives the most reliable results. Figure 6 shows a comparison of the distillable oil yields with the pentane soluble oil yields determined by extraction. The results show that the distillable oil yields are indeed in fairly good agreement with the pentane soluble oil yields obtained by extraction. Distillable oil yields of about 55 wt% based on MAF coal were obtained using iron oxide as catalyst, but with molybdate these yields were increased to 60 - 65%. A value of 62% was taken for the economic study.

It has to be remembered that the bench unit was operated in the once through mode with no recycle of bottoms material. It is expected, therefore, that significantly higher distillable oil yields would be achieved with bottoms recycle. If all the pentane soluble oil fraction was converted to distillable oil, and 25% of the asphaltene fraction to distillable oil, yields close to 70% wt based on MAF coal should be achieved. This would be at least comparable with other technologies that use recycle.

The elemental balances for Runs DOE-BU-014, YP3 and DOE-BU-015, YP5 are shown in Tables 3 and 4, respectively. The carbon balances are only slightly high, and as

FIGURE 6 OIL YIELDS

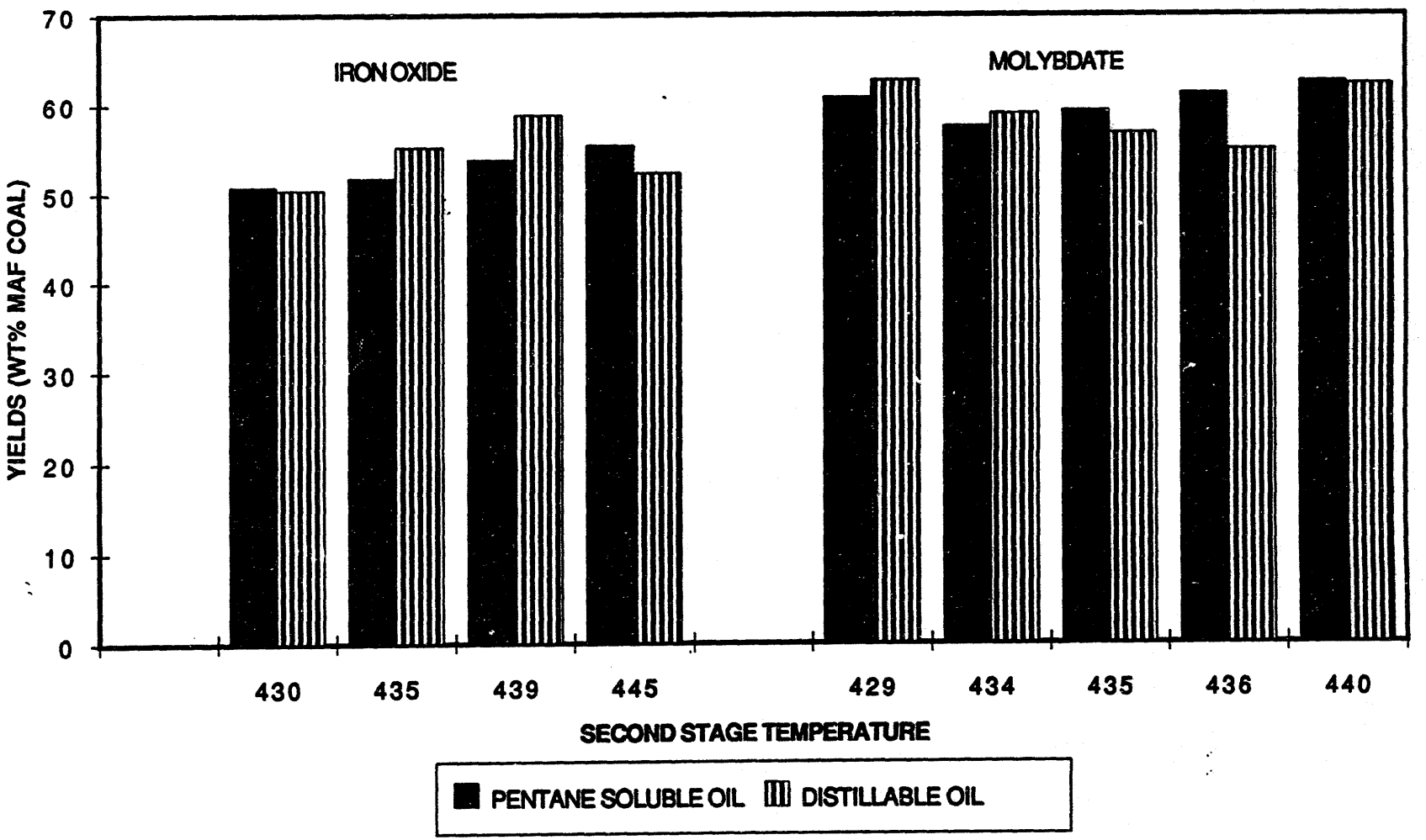


Table 3

ELEMENTAL BALANCE

RUN No.: DOE-BU-014 M.B.No.: YP-03/ C1

COMPONENT (1)	Mass Balance (2)	CARBON in (1)	CARBON in (2)	HYDROGEN in (1)	HYDROGEN in (2)	NITROGEN in (1)	NITROGEN in (2)	SULPHUR in (1)	SULPHUR in (2)	OXYGEN in (1)	OXYGEN in (2)	ELEMENT BALANCE
FEED												
Coal	41.81%	75.70%	31.65%	5.60%	2.34%	1.03%	0.43%	0.43%	0.18%	17.24%	7.21%	
Solvent	58.19%	87.80%	51.09%	8.50%	4.95%	0.85%	0.49%	0.05%	0.03%	2.80%	1.63%	
CO	12.45%	42.90%	5.34%							57.10%	7.11%	
Water	8.01%			11.00%	0.88%					87.20%	6.98%	
Hydrogen	2.35%			100.00%	2.35%							
TOTAL FEED	122.82%		88.08%		10.52%		0.93%		0.21%		22.93%	122.67%
PRODUCT												
CO2	22.65%	27.30%	6.18%							72.70%	16.47%	
CO	1.12%	42.90%	0.48%							57.10%	0.64%	
H2S				5.90%				94.10%				
Water	2.79%			11.00%	0.31%					87.20%	2.43%	
Hydrogen	0.33%			100.00%	0.33%							
CH4	1.92%	75.00%	1.44%	25.00%	0.48%							
C2H6	0.90%	80.00%	0.72%	20.00%	0.18%							
C3H8	0.87%	81.80%	0.71%	18.20%	0.16%							
C4+	1.45%	83.00%	1.20%	17.00%	0.25%							
IBP - 182		84.40%		13.20%		0.25%		0.11%		2.04%		
182 - 343	14.59%	85.20%	12.43%	10.00%	1.46%	0.66%	0.10%	0.05%	0.01%	4.09%	0.60%	
343 - 524	58.47%	88.30%	51.63%	8.90%	5.20%	0.76%	0.44%	0.05%	0.03%	1.99%	1.16%	
524+	17.73%	87.50%	15.51%	6.70%	1.19%	1.35%	0.24%	1.20%	0.21%	3.25%	0.58%	
TOTAL PRODUCT	122.82%		90.31%		9.56%		0.78%		0.25%		21.88%	122.77%
COMPONENT BALAN	100.00%		102.52%		90.80%		84.30%		119.34%		95.39%	100.08%

Table 4

ELEMENTAL BALANCE

RUN No.: DOE-BU-015 M.B.No.: YP-05/C1

COMPONENT (1)	Mass Balance (2)	CARBON in (1)	CARBON in (2)	HYDROGEN in (1)	HYDROGEN in (2)	NITROGEN in (1)	NITROGEN in (2)	SULPHUR in (1)	SULPHUR in (2)	OXYGEN in (1)	OXYGEN in (2)	ELEMENT BALANCE
FEED												
Coal	41.88%	75.70%	31.70%	5.60%	2.35%	1.03%	0.43%	0.43%	0.18%	17.24%	7.22%	
Solvent	58.12%	87.80%	51.03%	8.50%	4.94%	0.85%	0.49%	0.05%	0.03%	2.80%	1.63%	
CO	11.97%	42.90%	5.13%							57.10%	6.83%	
Water	7.70%			11.00%	0.85%					87.20%	6.71%	
Hydrogen	2.68%			100.00%	2.68%							
TOTAL FEED	122.35%		87.87%		10.81%		0.93%		0.21%		22.40%	122.21%
PRODUCT												
CO2	22.07%	27.30%	6.02%							72.70%	16.04%	
CO	1.50%	42.90%	0.64%							57.10%	0.86%	
H2S				5.90%				94.10%				
Water	1.52%			11.00%	0.17%					87.20%	1.32%	
Hydrogen	0.33%			100.00%	0.33%							
CH4	1.13%	75.00%	0.85%	25.00%	0.28%							
C2H6	0.92%	80.00%	0.74%	20.00%	0.18%							
C3H8	0.93%	81.80%	0.76%	18.20%	0.17%							
C4+	1.45%	83.00%	1.20%	17.00%	0.25%							
IBP - 182	1.27%	83.90%	1.07%	13.30%	0.17%	0.23%	0.00%	0.78%	0.01%	1.79%	0.02%	
182 - 343	22.73%	84.80%	19.27%	9.90%	2.25%	0.61%	0.14%	0.23%	0.05%	4.46%	1.01%	
343 - 524	50.45%	86.90%	43.84%	9.70%	4.89%	0.76%	0.38%	0.11%	0.06%	2.53%	1.28%	
524+	18.05%	84.40%	15.24%	7.30%	1.32%	1.05%	0.19%	0.13%	0.02%	7.12%	1.29%	
TOTAL PRODUCT	122.35%		89.64%		10.01%		0.71%		0.14%		21.82%	122.32%
COMPONENT BALANCE	100.00%		102.01%		92.58%		77.21%		67.46%		97.42%	100.09%

mentioned earlier the oxygen balances are quite good indicating the validity of the procedures used to measure shift reaction and water balance. The sulphur balances are variable in percentage terms, but in actual quantities are quite close considering the difficulties in accurately measuring all sulphur in small pilot plants. The nitrogen balances are low in both cases, but acceptable considering that we know some ammonium bicarbonate is formed and deposits in the second stage product gas line and is not accounted for. Also, the produced water was not analyzed for ammonia or hydrogen sulphide. One problem area appears to be the hydrogen balances which are low in both cases. It is not clear at the moment whether this is due to analytical or measurement error, but might suggest that the stated hydrogen consumptions are conservatively high.

As mentioned earlier, Runs DOE-BU-016 and DOE-BU-017 were run with Illinois #6 coal using the second stage reactor only during the last two weeks of the quarter. The operating conditions and coal conversions are shown in Table 5. All the coal conversions were in the 80 - 90% range with molybdate again giving slightly higher results. It is evident that a two stage process will be required to achieve the maximum conversion in the mid-nineties. It is planned to use an autoclave system for the first stage and the counterflow reactor as the second stage in a run to be carried out in the next quarter. All the results on this and previous Illinois #6 runs will be processed next quarter.

3.3.4 Conclusions

Runs DOE-BU-014 and DOE-BU-015 represent the best conditions found so far for the liquefaction of Black Thunder coal using counterflow reactor technology. Based on a two stage process, solubilization with CO/steam followed by hydrocracking of the solubilized coal using iron oxide or ammonium molybdate as catalyst in a once through operation The following results were recorded:

1. Overall coal conversions in excess of 90% were obtained.

Table 5

SUMMARY OF BENCH UNIT TEST RUNS					
08-Apr-94					
RUN No.:	DOE-BU-016		DOE-BU-017		
M.B.No.:	YP-01/ C1	YP-02/ C1	YP-01/ C1	YP-02/ C1	YP-03/ C1
Coal	Illinois#6	Illinois#6	Illinois#6	Illinois#6	Illinois#6
wt % maf	32.56%	32.56%	39.80%	38.15%	39.87%
Second Stage:					
Feed Rate (kg / hr) / IWHSV	0.92	0.80	1.06	0.94	0.88
Pressure Mpa	17.24	17.24	17.24	17.24	17.24
Temperatu deg C	428	440	428	442	431
Catalyst	FeO+DMDS	FeO+DMDS	Moly+DMDS	Moly+DMDS	Moly+DMDS
Hydrogen kg / kg maf coal	0.69	0.79	0.57	0.67	0.69
moles / 100g maf coal	34.22	39.55	28.37	33.30	34.34
consumed wt % maf coal	3.50%	4.55%	2.47%	2.46%	1.82%
Coal Conversion (wt % maf coal)	**83.03%**	**84.20%**	**86.01%**	**86.59%**	**89.14%**
NOTE: All data are preliminary					

2. On a MAF coal basis, distillable oil yields in the range 60 - 65% were achieved.

3. The distillable oil yields were comparable with the pentane soluble oil yields obtained by extraction. Asphaltene yields were in the range of 10 - 15 wt% based on MAF coal and may represent some further distillable oil yield in a recycle operation.

4. C_1 - C_3 gas yields were generally 6 - 8 wt% based on MAF coal, except higher at higher second stage operating temperatures with iron oxide as catalyst. Carbon oxide and water yields from coal were somewhat variable but in the range 10 - 14 wt% and 4 - 6 wt%, respectively.

5. Further optimization of the process for Black Thunder coal must include recycle of a bottoms fraction to maximize distillable oil yield.

3.4 Coking

3.4.1 Test Procedure

A tubular reactor was adapted for the batch coking tests. The system included nitrogen up-flow through the feed charge. Off gases and liquid products were passed through a condenser and a gas meter. The gases were collected in a gas bag and analyzed by GC. In a typical test approximately 100 g of V-340 residue from the bench unit was loaded into a reactor. Heating was initiated and nitrogen was introduced at a flow rate of 1 litre/minute. The reactor was raised either directly to 500°C or in 2 stages to 350°C and then 500°C. In the latter case it was anticipated that lighter boiling components would have an opportunity to be swept out by the nitrogen flow before the onset of coking. The temperature was held at 500°C for 30 minutes or until nitrogen flow was blocked by coke.

3.4.2 Results

Two samples of V-340 resid (14-03 and 15-05) were selected from coking. Properties of the feed and results of the coking trials are shown in Table 6. Both feedstocks had potential for the production of additional liquids based on the compositional and CCR analysis.

It appeared that coke formation was promoted by holding the temperature at an intermediate level. Coke levels were greater in the Runs (DOE-C-1, DOE-C-4) with a 350°C holding step. In these runs coke yield equalled or exceeded the CCR values of the feed. Raising the temperature directly to 500°C resulted in lower coke yield and in 14-03 enhanced liquid product yield. Using DOE-C-2 as an example an additional 9.0 g/100g of liquid product was formed from the V-340 residue. This represents 45% of the +524 oils (i.e.9.0 out of 20.2g).

3.4.3 Future Work

Runs DOE-C-2 and 3 will be repeated. Samples of V-340 material from Illinois #6 coal will be subjected to coking trials.

4.0 Assessment

4.1 Technical Assessment

For the liquefaction of Black Thunder coal, the technical assessment of the bench unit test runs has almost been completed (see Sections 3.3.3). For a once-through operation, i.e. without recycle of generated solvent oil, the bench unit runs have demonstrated that the counterflow reactor concept offers a viable alternative to other reactor concepts. For subbituminous coal, the first stage CO/steam to solubilize the coal to around 70 - 80% is essential for a successful operation of the overall process. When coal solubilization of

Table 6: Coking Trials

Feedstock Properties (V-340), g/100g

	14.03	15.05
-524 liquids	56.4	58.0
+524 residue (includes ash)	43.6	42.0
asphaltenes	17.0	20.7
ash + IOM	23.4	17.7
CCR	36.7	34.2

Coking Conditions

Run #	DOE-C-1	DOE-C-2	DOE-C-3	DOE-C-4
Temperature, °C	350/500	500	500	350/500
Time, minutes	30/30	35	30	20/30
Nitrogen flow, L/min.	1	1	1	1

Product Yields, g/100g

Gas	2.0	no sample	1.2	2.6
Liquids	53.5	65.4	60.4	60.4
Coke	41.5	28.5	29.9	33.9

around 80% is achieved in the first stage, an overall coal conversion of around 92% (MAF coal) and oil yield in excess of 60% (MAF coal) are obtained.

4.2 Economic Assessment

A first meeting was held with Kilborn Inc. (subcontractor for the economic assessment study) to define the scope of the assessment. The basis for the study was reviewed and clarified. A preliminary block flow diagram has been established based on the bench unit runs and the product analyses. As far as justifiable, an attempt is being made to retain as much of the block flow diagram as possible of the "Improved Baseline Design" established by Bechtel for DOE. It is anticipated that the economic assessment will be completed by the end of May 1994.

FUTURE WORK

In the next quarter, the following items will be addressed:

1. All remaining experimental work on the project will be completed. This includes the autoclave and bench unit program on Illinois #6 coal feedstocks, and coking tests on Black Thunder and Illinois #6 coal resids.

2. A detailed analysis of all the data from the experimental program will be completed.

3. The technical and economic assessment by Kilborn will be completed.

4. The final report and Phase II proposal documents will be prepared.

APPENDIX

26-Apr-94

SUMMARY OF BENCH UNIT TEST RUNS

(forced water balance in V-200 and kept oil as measured)

RUN No.:	DOE-BU-014				DOE-BU-015					
M.B.No.:	YP-01/ C1	YP-02/ C1	YP-03/ C1	YP-04/ C1	YP-01/ C1	YP-02/ C1	YP-03/ C1	YP-04/ C1	YP-05/C1	YP-06/C1
Coal	BTH	BTH	BTH	BTH	BTH	BTH	BTH	BTH	BTH	BTH
wt % maf	39.80%	41.98%	41.81%	41.81%	38.42%	40.61%	42.94%	44.70%	41.88%	41.62%
First Stage:										
Feed Rate (kg / hr) / IWHSV	1.77	1.79	1.76	1.73	1.82	2.29	1.74	1.86	1.83	1.85
Pressure Mpa	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34	10.34
Temperatur deg C	411	411	411	410	411	412	412	409	411	411
Catalyst	Aluminate	Aluminate	Aluminate	Aluminate	Aluminate	Aluminate	Aluminate	Aluminate	Aluminate	Aluminate
CO Rate kg / kg maf coal	0.96	0.90	0.92	0.94	1.22	0.84	0.92	0.82	0.89	0.87
moles / 100g maf coal	3.42	3.22	3.27	3.34	4.34	3.01	3.29	2.93	3.17	3.12
consumed moles / 100g maf coal	1.09	0.99	1.06	1.09	1.38	0.99	1.06	0.96	1.02	1.01
Water Rate kg / kg maf coal	0.96	0.90	0.92	0.94	1.22	0.84	0.92	0.82	0.89	0.87
moles / 100g maf coal	5.32	5.00	5.06	5.20	6.75	4.66	5.11	4.56	4.93	4.85
Hydrogen wt % maf coal	1.35%	1.18%	1.35%	1.37%	1.71%	1.28%	1.37%	1.23%	1.28%	1.27%
Second Stage:										
Feed Rate (kg / hr) / IWHSV	1.06	1.07	1.06	1.04	0.85	1.20	1.04	1.11	1.10	1.11
Pressure Mpa	17.24	17.24	17.24	17.24	17.24	17.24	17.24	17.24	17.24	17.24
Temperatur deg C	430	435	439	445	430	434	435	429	440	436
Catalyst	FeO+DMDS	FeO+DMDS	FeO+DMDS	FeO+DMDS	Molybdate	Molybdate	Molybdate	Molybdate	Molybdate	Molybdate
Hydrogen kg / kg maf coal	0.58	0.55	0.56	0.57	0.74	0.51	0.56	0.50	0.54	0.53
moles / 100g maf coal	29.02	27.30	27.79	28.35	36.68	25.56	27.89	24.94	26.94	26.52
consumed wt % maf coal	5.78%	5.29%	5.63%	5.50%	2.61%	7.13%	6.12%	6.18%	6.39%	6.33%
Coal Conversion (wt % maf coal)	91.54%	92.51%	92.44%	93.74%	82.63%	89.78%	92.34%	91.36%	92.46%	93.16%
Product Yield (wt % maf coal)										
H2O	6.19%	6.02%	6.67%	7.80%	2.40%	5.15%	4.64%	5.30%	3.62%	4.88%
COx	13.51%	14.54%	10.06%	10.19%	16.88%	10.64%	12.60%	9.25%	11.37%	11.40%
H2S										
C1 to C3	7.15%	7.70%	8.82%	10.77%	7.04%	7.17%	7.26%	5.47%	7.13%	6.72%
C4 - 182	5.99%	4.43%	3.46%	7.22%	7.05%	6.47%	6.53%	5.82%	6.51%	6.94%
182 - 343	35.09%	34.73%	32.39%	36.76%	41.63%	41.35%	43.92%	42.29%	51.77%	46.85%
343 - 524	9.37%	16.12%	23.07%	8.42%	1.27%	11.19%	6.43%	14.69%	4.02%	1.88%
IBP - 524	50.44%	55.28%	58.92%	52.41%	49.95%	59.01%	56.88%	62.79%	62.29%	55.68%
524+	29.84%	22.95%	22.50%	25.71%	28.08%	26.43%	26.11%	24.58%	23.26%	28.94%
TOTAL	107.13%	106.48%	106.98%	106.88%	104.32%	108.40%	107.49%	107.42%	107.67%	107.60%
Yields based on Solubility										
Pentane soluble (incl. C4)	50.79%	51.78%	53.92%	55.46%	45.57%	57.64%	59.33%	60.74%	62.62%	61.06%
Asphaltenes	17.71%	15.63%	17.40%	13.94%	12.09%	14.72%	14.05%	16.06%	13.29%	14.45%
Preasphalt.	3.31%	3.33%	2.54%	2.47%	2.97%	2.87%	1.96%	1.92%	2.11%	2.25%
IOM	8.46%	7.49%	7.56%	6.26%	17.37%	10.22%	7.66%	8.64%	7.54%	6.84%
TOTAL	80.28%	78.22%	81.43%	78.12%	78.00%	86.46%	82.99%	87.35%	85.55%	84.60%
Sim.Dist. (THF-Extract)										
C4 - 182	8.27%	6.61%	5.58%	7.03%	6.33%	7.01%	7.07%	6.39%	6.52%	6.15%
182 - 343	45.43%	45.25%	49.67%	53.05%	53.50%	56.57%	60.03%	54.31%	68.15%	63.85%
343 - 524	-9.01%	-9.66%	3.43%	-0.12%	-24.84%	-2.95%	-11.02%	0.77%	-11.31%	-4.83%
IBP - 524	44.68%	42.20%	58.67%	55.96%	36.00%	60.63%	56.08%	61.48%	63.36%	65.18%
524+	35.59%	38.02%	22.75%	18.14%	43.01%	24.82%	26.91%	25.92%	22.19%	19.44%

NOTE: All data are preliminary

Table 10

SUMMARY OF BENCH UNIT MASS BALANCES

RUN No.:	DOE-BU-014				DOE-BU-015					
M.B.No.:	YP-01/C1	YP-02/C1	YP-03/ C1	YP-04/C1	YP-01/C	YP-02/C1	YP-03/C1	YP-04/C1	YP-05/C1	YP-06/C1
Material In:										
(1) Feed Slurry:	6950	7000	6890	6070	5520	7820	6800	7280	7160	7230
(2) CO-Gas:	2432	2422	2416	2179	2417	2424	2415	2420	2420	2419
(3) Water:	809	902	585	551	607	752	724	670	779	841
(4) Hydrogen:	1480	1475	1475	1326	1473	1477	1517	1476	1476	1475
(5) Catalyst (as solution):										
(6) S-Agent	83	84	84	84	72	84	81	81	84	83
TOTAL IN:	11754	11883	11449	10208	10090	12556	11536	11926	11918	12048
Material Out:										
(7) First Stage Liquid:	1049	1234	522	819	910	1392	1535	1490	1553	1524
(8) First Stage Product Gas:	3130	3166	3072	2773	3093	3060	3061	3063	3074	3088
(9) Second Stage Liquid:	3080	3120	4120	3680	1880	3940	2992	3410	4110	4420
(10) Second Stage Reactor Bottoms:	2530	2600	1940	1430	2420	2100	2170	2280	1750	1420
(11) Second Stage Product Gas:	1640	1690	1717	1618	1736	1639	1701	1597	1709	1672
(12) Dissolved Gas:	33	4	2	2	27	48	49	45	41	34
TOTAL OUT:	11461	11813	11372	10322	10066	12180	11508	11885	12238	12158
OVERALL BALANCE:	97.5%	99.4%	99.3%	101.1%	99.8%	97.0%	99.8%	99.7%	102.7%	100.9%
WATER BALANCE										
TOTAL IN:	1038	1188	816	754	761	1221	1120	1024	1134	1106
TOTAL OUT:	1187	1346	988	939	809	1363	1244	1182	1239	1246
WATER BALANCE:	114.4%	113.3%	121.1%	124.5%	106.3%	111.6%	111.1%	115.4%	109.2%	112.6%
ASH BALANCE	134.2%	147.8%	139.7%	132.3%	96.6%	106.1%	97.4%	96.8%	92.4%	87.7%

NOTE: All data are preliminary

RUN No.: DOE-BU-014			M.B.No.: YP-01/ C1	
	Date	Time	Date	Time
START:			Dec. 07, 93	02:00
END:			Dec. 07, 93	10:00
DURATION (hours):				8.00

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Feed:	Type	Wt% (maf)
Coal	BTH	39.80%
Solvent	V-1074	60.20%
Catalyst 1	Aluminate	2.00%
Catalyst 2	FeO+DMDS	2.00%
Other		

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		11100.00
End of Mass Ballance		4150.00
Rate	(G/HR)	669
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	
Reactor Temp.:	(C)	
TE-201I	(BTTM)	410
TE-202I		411
TE-203I		411
TE-204I	(Top)	390
Liquid Level	(mm)	540
Separator Temperature:	(C)	47
CO-Feed Rate:	L/MIN)	4.05
Water Feed Rate:	(ML/MIN)	1.69
Temperature:	(C)	180
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1048.50
Nitrogen Rate:	L/MIN)	3.95
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	138
Reactor Temp.:	(C)	
TE-301I	(BTTM)	431
TE-302I		431
TE-303I		430
TE-304I		429
TE-305I		428
TE-306I		427
TE-307I		423
TE-308I	(Top)	419
TE-309I	(VAP)	419
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.21
Temperature:	(C)	399
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1640
End of Mass Ballance		4720
Bottoms Product (WT-340):	(G)	
Start of Mass Ballance		-130
End of Mass Ballance		2400
Sulfiding Agent	(mL/HR)	10.40

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydrogen	2.02	4.28	97.42	34.81
CO2	44.01	13.03	0.09	22.30
CO	28.01	23.81	0.31	8.21
H2S	34.08			
Methane	16.04	0.50	0.71	0.56
Ethylen	28.05		0.02	0.48
Ethane	30.07		0.17	0.48
Propane	44.01		0.11	1.53
Propylene	42.08			
I-Butane	58.12		0.03	0.14
n-Butane	58.12		0.06	1.25
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.06	3.34
Nitrogen	28.02			
TOTAL		41.61	99.01	73.1045
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		3045.0	3262.0	9091.0
End of M.B. : (L)		8002.0	20683.0	9128.0
Total : (L)		4957.0	17621.0	37.0
Temperature: (C)		22.2	21.6	23.3
Meter Pressure : (mmH		699	699	699
Standard Volume: (L)		4216	15019	31
Nitrogen to R-200: (L)		1894		
Net Gas Out: (L)		2322	15019	31

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	411	430
Catalyst		Aluminate	FeO+DMDS
Feed	wt % maf coal	39.80%	
WHSV	(kg / hr) / l	1.77	1.06
CO Rate	kg / kg maf coal	0.96	
	moles / 100g maf coal	3.42	
consumed	moles / 100g maf coal	1.09	
Water Rate	kg / kg maf coal	0.96	
	moles / 100g maf coal	5.32	
Hydrogen	kg / kg maf coal		0.58
	moles / 100g maf coal		29.02
consumed	wt % maf coal	1.35%	5.78%

RUN No.: DOE-BU-014 M.B.No.: YP-01/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	6950	First Stage Liquid:	1049
CO-Gas:	2432	First Stage Product Gas:	3130
Water:	809	Second Stage Liquid:	3080
Hydrogen:	1480	Second Stage Reactor Bottoms:	2530
Catalyst:		Second Stage Product Gas:	1640
S-Agent	83	Dissolved Gas:	33
TOTAL IN:	11754	TOTAL OUT:	11461
Catalyst m/	278	OVERALL BALANCE:	97.5%

WATER BALANCE

TOTAL IN:	1038	TOTAL OUT:	1187
		WATER BALANCE:	114.4%

Coal Conversion	wt.% maf	91.5%
Ash Balance	wt.%	134.2%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	149.20	157.06	2.46%	157.06	6.19%
COx	325.59	342.73	5.36%	342.73	13.51%
H2S					
C1 to C3	172.43	181.51	2.85%	181.51	7.15%
C4 +	77.02	81.07	1.27%	81.07	3.20%
Oil	4352.22	4581.38	71.86%	1207.77	47.60%
Asphaltene	868.07	913.77	14.33%	449.37	17.71%
Preasphalt.	79.83	84.03	1.32%	84.03	3.31%
IOM	204.00	214.74	3.37%	214.74	8.46%
Total	6228.35	6556.29	102.84%	2718.29	107.13%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		199.41	209.91	209.91	8.27%		144.30	151.90	151.90	5.99%
182 - 343	153.52	1240.82	1306.16	1152.64	45.43%	69.08	911.42	959.41	890.32	35.09%
343 - 524	3684.48	3282.91	3455.77	-228.72	-9.01%	3220.08	3284.78	3457.73	237.65	9.37%
524+		857.99	903.16	903.16	35.59%	548.83	1240.63	1305.95	757.12	29.84%
TOTAL	3838.00	5581.14	5875.00	2036.99	80.28%	3838.00	5581.14	5875.00	2036.99	80.28%
IBP - 524	3838.00	4723.15	4971.83	1133.83	44.68%	3289.17	4340.50	4569.04	1279.87	50.44%

RUN No.: DOE-BU-014 M.B.No.: YP-01/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-350)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydogen	4.275						4.275	94.878	100.475	100.227	94.367	94.779	98.093	97.420	31.289	38.321					34.805
CO2	13.029						13.029	0.113	0.092	0.088	0.108	0.091	0.085	0.093	22.487	22.085					22.286
CO	23.812						23.812	0.273	0.304	0.291	0.361	0.309	0.310	0.311	8.066	8.361					8.214
H2S																					
Methane	0.495						0.495	0.754	0.684	0.712	0.729	0.711	0.695	0.714	0.580	0.536					0.558
Ethylen								0.021	0.023	0.022	0.021	0.023	0.021	0.022	0.911	0.056					0.483
Ethane								0.168	0.173	0.169	0.174	0.180	0.179	0.174	0.060	0.898					0.479
Propane								0.130	0.131	0.130	0.134	0.138	0.014	0.113	1.541	1.523					1.532
Propylene																					
i-Butane								0.025	0.025	0.026	0.026	0.026	0.027	0.026	0.145	0.143					0.144
n-Butane								0.057	0.057	0.061	0.059	0.061	0.060	0.059	1.257	1.244					1.251
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.079	0.075	0.075	0.075	0.079	0.075	0.076	3.280	3.404					3.342
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	96.286	102.039	101.783	96.074	96.397	101.459	99.008	69.628	76.583					73.105

RUN No.: DOE-BU-014 **M.B.No.: YP-01/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight:		16.64 (g/mole)		Average Mol Weight:		2.45 (g/mole)		Average Mol Weight:		23.37 (g/mole)	
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.27	21.50	0.69	97.42	98.40	1332.07	81.21	34.81	47.61	1.35	4.12
CO2	44.01	13.03	31.31	1427.84	45.62	0.09	0.09	27.66	1.69	22.30	30.50	18.78	57.44
CO	28.01	23.81	57.23	1660.83	53.06	0.31	0.31	59.03	3.60	8.21	11.24	4.40	13.47
H2S	34.08												
Methane	16.04	0.50	1.19	19.77	0.63	0.71	0.72	77.54	4.73	0.56	0.76	0.17	0.52
Ethylen	28.05					0.02	0.02	4.15	0.25	0.48	0.66	0.26	0.80
Ethane	30.07					0.17	0.18	35.38	2.16	0.48	0.66	0.28	0.84
Propane	44.01					0.11	0.11	33.59	2.05	1.53	2.10	1.29	3.95
Propylene	42.08												
i-Butane	58.12					0.03	0.03	10.29	0.63	0.14	0.20	0.16	0.49
n-Butane	58.12					0.06	0.06	23.28	1.42	1.25	1.71	1.39	4.25
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.08	0.08	37.28	2.27	3.34	4.57	4.62	14.12
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.61	100.00	3129.95	100.00	99.01	100.00	1640.27	100.00	73.10	100.00	32.69	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	27.54	27.54	27.54	27.54
Produced	[moles]			4.90	-16.90
Total	[moles]	27.54	27.54	32.44	10.65
Stochiom.	[grams]	771.45	496.31	1212.12	55.63
Produced	[grams]			215.72	-34.13
Total	[grams]	771.45	496.31	1427.84	21.50

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	19.77	150.66	2.00	172.43
C4 +	[grams]		70.85	6.17	77.02
Total	[grams]	19.77	221.51	8.16	249.45

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	34.13	1480.17	1333.42	146.76	180.89

RUN No.: DOE-BU-014 **M.B.No.: YP-01/C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				6950	1049	2530	3080	
Total Sample	[grams]			54.61	14.5	50.58	61.93	
Water	[grams]			1.8	7.5		3	
Oils+Asphaltenes	[grams]			30.16	7.01	40.86	55.28	
Oils	[wt%] calc		87.90%	87.90%	94.57%	77.33%	86.28%	
Asphaltene	[wt%]		12.10%	12.10%	5.43%	22.67%	13.72%	
Pre-Asphaltenes	[grams]					0.9	0.7	
Insolubles	[grams]			22.9		9.77	3.66	
IOM	[wt%] calc			86.94%		33.78%	20.21%	
Ash	[wt%]			11.99%		65.73%	79.40%	
Moisture	[wt%]			1.08%		0.50%	0.39%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				6.88%	3.30%	0.73%	1.10%
182 - 343			1.80%	4.00%	37.24%	4.70%	34.77%	14.90%
343 - 524			83.90%	96.00%	55.88%	60.00%	64.50%	53.70%
524+			14.30%			32.00%		30.30%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-014 M.B.No.: YP-01/ C1

	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	54.61	14.50	50.58	61.93
Water	1.80	7.49		3.00
Oils+Asphaltenes	30.16	7.01	39.96	54.58
Oils	26.51	6.63	30.70	47.00
Asphaltenes	3.65	0.38	9.26	7.59
Pre-Asphaltenes			0.90	0.70
Insolubles	22.65		9.72	3.65
IOM	19.94		3.33	0.75
Ash	2.71		6.39	2.89
TOTAL	54.61	14.5	50.58	61.93
	in wt% of analysis sample			
Water	3.30%	51.65%		4.84%
Oils+Asphaltenes	55.22%	48.35%	79.00%	88.14%
Oils (on fraction)	87.90%	94.57%	76.82%	86.10%
(on total)	48.54%	45.72%	60.69%	75.89%
Asphalt. (on fract.)	12.10%	5.43%	23.18%	13.90%
(on total)	6.68%	2.63%	18.31%	12.25%
Pre-Asphaltenes			1.78%	1.13%
Insolubles	41.48%		19.22%	5.89%
IOM (on fraction)	88.02%		34.27%	20.60%
(on total)	36.51%		6.59%	1.21%
Ash (on fraction)	11.99%		65.73%	79.40%
(on total)	4.97%		12.63%	4.67%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	6950	1049	2530	3080
Water	229.1	541.6		149.2
Oils+Asphaltenes	3838.0	506.9	1998.7	2714.7
Oils (on fraction)	3373.6	479.4	1535.4	2337.4
(on total)	3373.6	479.4	1535.4	2337.4
Asphalt. (on fract.)	464.4	27.5	463.3	377.2
(on total)	464.4	27.5	463.3	377.2
Pre-Asphaltenes			45.0	34.8
Insolubles	2882.9		486.3	181.3
IOM (on fraction)	2537.4		168.6	37.4
(on total)	2537.4		168.6	37.4
Ash (on fraction)	345.5		319.6	144.0
(on total)	345.5		319.6	144.0
TOTAL (as is)	6950.0	1048.5	2530.0	3080.0
TOTAL (MAF)	6375.4	506.9	2210.4	2786.8

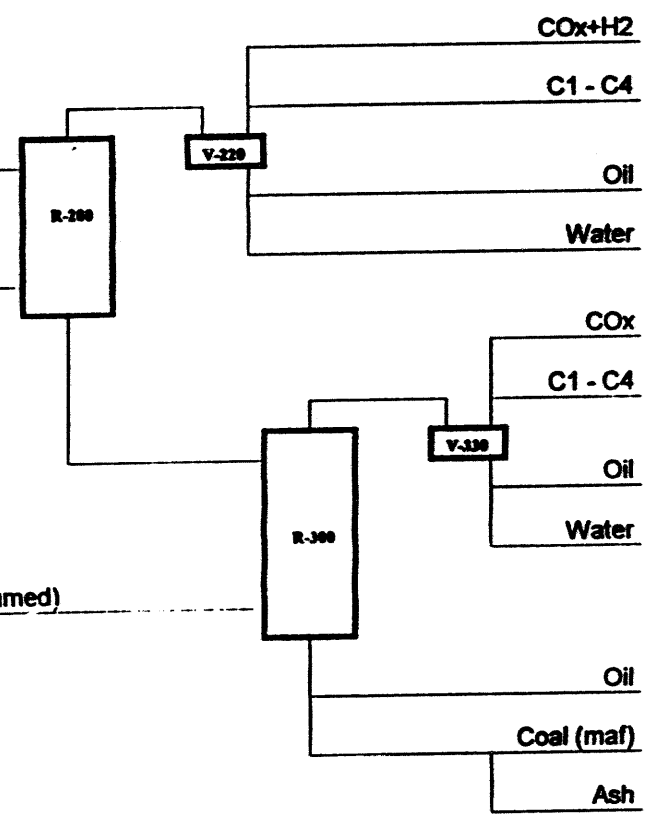
Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		34.88	67.44	20.07	122.39		67.29	67.29
182 - 343	153.52	188.77	96.08	956.00	1240.82	69.08	911.42	911.42
343 - 524	3684.48	283.26	1228.24	1773.42	3282.91	3220.08	3284.78	3284.78
524+			820.64	37.35	857.99	548.83	1853.42	1240.63
TOTAL	3838.00	506.91	2210.37	2786.84	5504.12	3838.00	6116.91	5504.12

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
3.46%	3.46%		2.26%	5.72%				2.46%	2.46%
55.13%	7.66%	30.22%	41.05%	78.93%	60.20%	8.37%	33.00%	44.82%	86.19%
48.46%	7.25%	23.21%	35.34%	65.80%	52.92%	7.92%	25.35%	38.59%	71.86%
6.67%	0.42%	7.01%	5.70%	13.13%	7.28%	0.45%	7.65%	6.23%	14.33%
		0.68%	0.53%	1.21%			0.74%	0.57%	1.32%
41.41%		5.94%	2.11%	8.05%					
36.45%		2.52%	0.56%	3.08%	39.80%		2.75%	0.62%	3.37%
4.96%		3.42%	1.54%	4.96%					
100.00%	11.13%	38.84%	45.83%	93.80%					
					100.00%	8.37%	38.50%	48.46%	93.34%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-014 M.B. No.: YP-01/C1

FEED wt% (coal+solvent) as is	maf	
55.1%	60.2%	Solvent
44.9%	39.8%	Coal
100.0%	100.0%	
11.1%	12.1%	CO (shift)
7.1%	7.8%	Water (shift)
2.1%	2.3%	Hydrogen (consumed)
120.3%	122.2%	



PRODUCT wt% (coal+solvent)	as is	maf
COx+H2	21.0%	22.9%
C1 - C4	0.3%	0.3%
Oil	7.7%	8.4%
Water	3.5%	
COx	1.7%	1.8%
C1 - C4	3.5%	3.8%
Oil	41.6%	45.4%
Water	2.3%	2.5%
Oil	30.9%	33.7%
Coal (maf)	3.1%	3.4%
Ash	5.0%	
	120.3%	122.2%

Remarks:

RUN No.: DOE-BU-014			M.B.No.: YP-02/ C1	
	Date	Time	Date	Time
START:			Dec. 08, 93	03:00
END:			Dec. 08, 93	11:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	41.98%
Solvent	V-1074	58.02%
Catalyst 1	Aluminate	2.00%
Catalyst 2	FeO+DMDS	2.00%
Other		

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		9670.00
End of Mass Ballance		2670.00
Rate	(G/HR)	875
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	
Reactor Temp.:	(C)	
TE-201I	(BTTM)	410
TE-202I		411
TE-203I		411
TE-204I	(Top)	390
Liquid Level	(mm)	540
Separator Temperature:	(C)	47
CO-Feed Rate:	L/MIN)	4.04
Water Feed Rate:	(ML/MIN)	1.88
Temperature:	(C)	180
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1233.60
Nitrogen Rate:	L/MIN)	3.93
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	138
Reactor Temp.:	(C)	
TE-301I	(BTTM)	434
TE-302I		436
TE-303I		435
TE-304I		434
TE-305I		434
TE-306I		435
TE-307I		431
TE-308I	(Top)	430
TE-309I	(VAP)	430
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.10
Temperature:	(C)	379
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1670
End of Mass Ballance		4790
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-310
End of Mass Ballance		2290
Sulfiding Agent	(mL/HR)	10.47

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydrogen	2.02	4.28	98.17	34.81
CO2	44.01	13.03	0.11	22.30
CO	28.01	23.81	0.37	8.21
H2S	34.08			
Methane	16.04	0.50	0.80	0.56
Ethylen	28.05		0.03	0.48
Ethane	30.07		0.22	0.48
Propane	44.01		0.16	1.53
Propylene	42.08			
I-Butane	58.12		0.02	0.14
n-Butane	58.12		0.07	1.25
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.07	3.34
Nitrogen	28.02			
TOTAL		41.61	100.02	73.1045

Gas Meter Readings	DTM-260	DTM-360	DTM-350
Start of M.B. : (L)	8627.0	8566.0	9167.0
End of M.B. : (L)	13650.0	26270.0	9171.0
Total : (L)	5023.0	17704.0	4.0
Temperature: (C)	22.7	22.1	23.7
Meter Pressure : (mmH	694	699	699
Standard Volume: (L)	4235	15064	3
Nitrogen to R-200: (L)	1886		
Net Gas Out: (L)	2348	15064	3

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	411	435
Catalyst		Aluminate	FeO+DMDS
Feed	wt % maf coal	41.98%	
WHSV	(kg / hr) / l	1.79	1.07
CO Rate	kg / kg maf coal	0.90	
	moles / 100g maf coal	3.22	
consumed	moles / 100g maf coal	0.99	
Water Rate	kg / kg maf coal	0.90	
	moles / 100g maf coal	5.00	
Hydrogen	kg / kg maf coal		0.55
	moles / 100g maf coal		27.30
consumed	wt % maf coal	1.18%	5.29%

RUN No.: DOE-BU-014 M.B.No.: YP-02/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	7000	First Stage Liquid:	1234
CO-Gas:	2422	First Stage Product Gas:	3166
Water:	902	Second Stage Liquid:	3120
Hydrogen:	1475	Second Stage Reactor Bottoms:	2600
Catalyst:		Second Stage Product Gas:	1690
S-Agent	64	Dissolved Gas:	4
TOTAL IN:	11863	TOTAL OUT:	11813
Catalyst m/	280	OVERALL BALANCE:	99.4%

WATER BALANCE

TOTAL IN:	1188	TOTAL OUT:	1346
		WATER BALANCE:	113.3%

Coal Conversion	wt.% maf	92.5%
Ash Balance	wt.%	147.8%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	156.43	161.73	2.53%	161.73	6.02%
COx	362.80	390.79	6.10%	390.79	14.54%
H2S					
C1 to C3	202.83	207.06	3.23%	207.06	7.70%
C4 +	72.87	74.39	1.16%	74.39	2.77%
Oil	4489.36	4582.99	71.57%	1317.57	49.01%
Asphaltene	851.86	869.62	13.58%	420.12	15.63%
Presasphalt.	87.71	89.54	1.40%	89.54	3.33%
IOM	197.19	201.30	3.14%	201.30	7.49%
Total	6443.05	6577.42	102.72%	2862.49	106.48%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		174.01	177.64	177.64	6.61%		116.57	119.00	119.00	4.43%
182 - 343	148.60	1337.24	1365.12	1216.53	45.25%	66.87	980.21	1000.65	933.78	34.73%
343 - 524	3566.33	3239.14	3306.69	-259.64	-9.66%	3116.83	3477.56	3550.08	433.25	16.12%
524+		948.61	968.39	968.39	36.02%	531.23	1124.65	1148.11	616.87	22.95%
TOTAL	3714.93	5698.99	5817.84	2102.91	78.22%	3714.93	5698.99	5817.84	2102.91	78.22%
IBP - 524	3714.93	4750.39	4849.45	1134.52	42.20%	3183.69	4574.34	4669.73	1486.04	55.28%

RUN no.: DOE-BU-014 M.B.No.: YP-02/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydrogen	4.275						4.275	98.768	94.508	98.768	98.001	98.823	99.144	98.169	31.289	36.321					34.805
CO2	13.029						13.029	0.075	0.151	0.128	0.151	0.084	0.079	0.111	22.497	22.095					22.296
CO	23.812						23.812	0.379	0.432	0.313	0.386	0.348	0.374	0.372	8.066	8.361					8.214
H2S																					
Methane	0.495						0.495	0.696	0.805	0.840	0.812	0.844	0.778	0.796	0.560	0.538					0.555
Ethylen								0.025	0.027	0.025	0.026	0.026	0.027	0.027	0.911	0.058					0.485
Ethane								0.174	0.226	0.241	0.223	0.234	0.200	0.216	0.060	0.898					0.479
Propane								0.141	0.163	0.174	0.165	0.177	0.156	0.163	1.541	1.523					1.532
Propylene																					
i-Butane								0.023	0.023	0.022	0.022	0.032	0.014	0.023	0.145	0.143					0.144
n-Butane								0.061	0.066	0.074	0.070	0.084	0.068	0.071	1.257	1.244					1.251
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.078	0.084	0.010	0.090	0.095	0.065	0.074	3.280	3.404					3.342
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	100.420	96.485	100.593	100.946	100.750	100.925	100.020	69.626	76.583					73.105

RUN No.: DOE-BU-014 **M.B.No.: YP-02/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.75 (g/mole)				Average Mol Weight: 2.51 (g/mole)				Average Mol Weight: 23.37 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.27	21.75	0.69	98.17	98.15	1332.73	78.84	34.81	47.61	0.15	4.12
CO2	44.01	13.03	31.31	1444.11	45.62	0.11	0.11	32.83	1.94	22.30	30.50	2.03	57.44
CO	28.01	23.81	57.23	1679.76	53.06	0.37	0.37	70.03	4.14	8.21	11.24	0.48	13.47
H2S	34.08												
Methane	16.04	0.50	1.19	20.00	0.63	0.80	0.80	85.79	5.08	0.56	0.76	0.02	0.52
Ethylen	28.05					0.03	0.03	5.00	0.30	0.48	0.66	0.03	0.80
Ethane	30.07					0.22	0.22	43.72	2.59	0.48	0.66	0.03	0.84
Propane	44.01					0.16	0.16	48.11	2.85	1.53	2.10	0.14	3.95
Propylene	42.08												
i-Butane	58.12					0.02	0.02	8.85	0.52	0.14	0.20	0.02	0.49
n-Butane	58.12					0.07	0.07	27.67	1.64	1.25	1.71	0.15	4.25
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.07	0.07	35.68	2.11	3.34	4.57	0.50	14.12
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.61	100.00	3165.62	100.00	100.02	100.00	1690.41	100.00	73.10	100.00	3.53	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	26.51	26.51	26.51	26.51
Produced	[moles]			6.30	-15.74
Total	[moles]	26.51	26.51	32.81	10.77
Stochiom.	[grams]	742.52	477.70	1166.67	53.55
Produced	[grams]			277.44	-31.80
Total	[grams]	742.52	477.70	1444.11	21.75

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	20.00	182.62	0.22	202.83
C4 +	[grams]		72.20	0.67	72.87
Total	[grams]	20.00	254.82	0.88	275.70

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	31.80	1475.19	1332.87	142.32	174.12

RUN No.: DOE-BU-014 **M.B.No.: YP-02/ C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				7000	1234	2600	3120	
Total Sample	[grams]			51.34	14.7	52.41	61.05	
Water	[grams]			2.1	8.5		3.1	
Oils+Asphaltenes	[grams]			27.25	6.24	42.57	54.66	
Oils	[wt%] calc	100.00%	87.90%	87.90%	94.57%	79.00%	86.40%	
Asphaltene	[wt%]		12.10%	12.10%	5.43%	21.00%	13.60%	
Pre-Asphaltenes	[grams]					1.15	0.6	
Insolubles	[grams]			23.03		10.02	3.3	
IOM	[wt%] calc			85.15%		32.81%	16.37%	
Ash	[wt%]			10.35%		65.38%	83.20%	
Moisture	[wt%]			4.50%		1.81%	0.43%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				6.88%	2.33%	0.57%	0.70%
182 - 343			1.80%	4.00%	37.24%	4.67%	37.36%	15.70%
343 - 524			83.90%	96.00%	55.88%	57.42%	62.07%	55.70%
524+			14.30%			35.58%		27.90%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-014 M.B.No.: YP-02/ C1

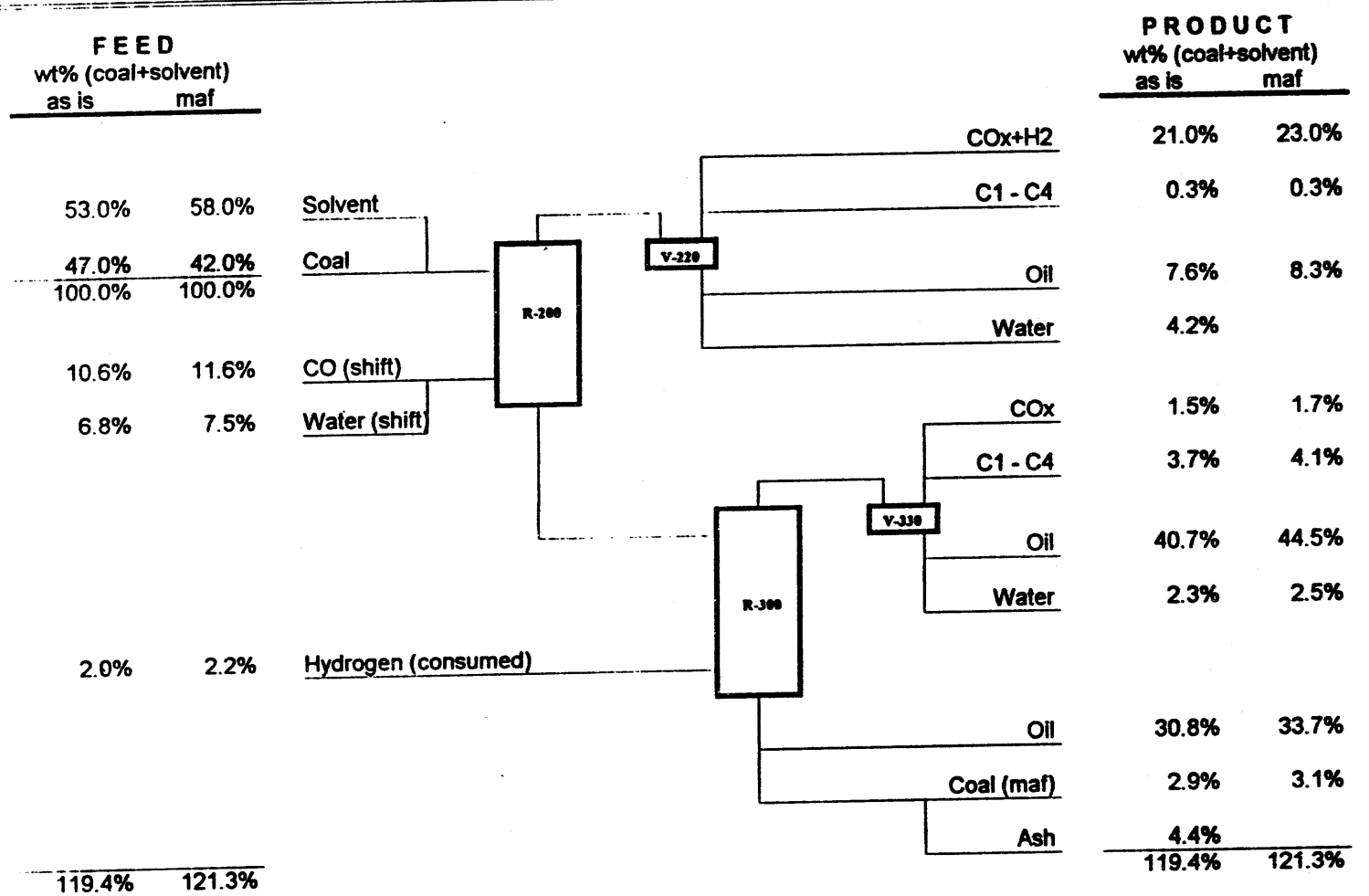
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	51.34	14.70	52.41	61.05
Water	2.10	8.46		3.10
Oils+Asphaltenes	27.25	6.24	41.42	54.06
Oils	23.95	5.90	32.48	46.63
Asphaltenes	3.30	0.34	8.94	7.43
Pre-Asphaltenes			1.15	0.60
Insolubles	21.99		9.84	3.29
IOM	19.72		3.41	0.55
Ash	2.28		6.43	2.73
TOTAL	51.34	14.7	52.41	61.05
	in wt% of analysis sample			
Water	4.09%	57.57%		5.08%
Oils+Asphaltenes	53.07%	42.43%	79.03%	88.56%
Oils (on fraction)	87.90%	94.57%	78.42%	86.25%
(on total)	46.65%	40.12%	61.98%	76.38%
Asphalt. (on fract.)	12.10%	5.43%	21.58%	13.75%
(on total)	6.42%	2.30%	17.06%	12.18%
Pre-Asphaltenes			2.19%	0.98%
Insolubles	42.84%		18.77%	5.38%
IOM (on fraction)	89.65%		34.62%	16.80%
(on total)	38.41%		6.50%	0.90%
Ash (on fraction)	10.35%		65.38%	83.20%
(on total)	4.43%		12.27%	4.48%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	7000	1234	2600	3120
Water	286.3	710.2		158.4
Oils+Asphaltenes	3714.9	523.4	2054.9	2763.0
Oils (on fraction)	3265.4	495.0	1611.4	2383.0
(on total)	3265.4	495.0	1611.4	2383.0
Asphalt. (on fract.)	449.5	28.4	443.5	379.9
(on total)	449.5	28.4	443.5	379.9
Pre-Asphaltenes			57.1	30.7
Insolubles	2998.7		488.1	167.9
IOM (on fraction)	2688.4		169.0	28.2
(on total)	2688.4		169.0	28.2
Ash (on fraction)	310.4		319.1	139.7
(on total)	310.4		319.1	139.7
TOTAL (as is)	7000.0	1233.6	2600.0	3120.0
TOTAL (MAF)	6403.3	523.4	2280.5	2821.9

Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		36.01	49.21	15.92	101.14		43.70	43.70
182 - 343	148.60	194.90	98.63	1043.71	1337.24	66.87	980.21	980.21
343 - 524	3566.33	292.46	1212.66	1734.02	3239.14	3116.83	3477.56	3477.56
524+			920.39	28.21	948.61	531.23	1741.90	1124.65
TOTAL	3714.93	523.37	2280.89	2821.88	5628.12	3714.93	6243.37	5628.12

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
4.17%	4.17%		2.31%	6.48%				2.53%	2.53%
53.03%	7.63%	29.94%	40.26%	77.83%	58.02%	8.34%	32.76%	44.05%	85.15%
46.61%	7.21%	23.48%	34.72%	65.42%	51.00%	7.89%	25.69%	37.99%	71.57%
6.42%	0.41%	6.46%	5.54%	12.41%	7.02%	0.45%	7.07%	6.06%	13.58%
		0.83%	0.45%	1.28%			0.91%	0.49%	1.40%
42.80%		5.54%	1.76%	7.30%					
38.37%		2.46%	0.41%	2.87%	41.96%		2.69%	0.45%	3.14%
4.43%		3.08%	1.35%	4.43%					
100.00%	11.80%	38.32%	44.76%	92.89%					
					100.00%	8.34%	38.36%	47.51%	92.22%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-014 M.B. No.: YP-02/C1



Remarks:

RUN No.: DOE-BU-014			M.B.No.: YP-03/ C1	
	Date	Time	Date	Time
START:			Dec. 09, 93	21:00
END:			Dec. 10, 93	05:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	41.81%
Solvent	V-1074	58.19%
Catalyst 1	Aluminate	2.00%
Catalyst 2	FeO+DMDS	2.00%
Other		

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		14600.00
End of Mass Ballance		7710.00
Rate	(G/HR)	861
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	
Reactor Temp.:	(C)	
TE-201I	(BTTM)	410
TE-202I		411
TE-203I		411
TE-204I	(Top)	389
Liquid Level	(mm)	540
Separator Temperature:	(C)	47
CO-Feed Rate:	L/MIN)	4.03
Water Feed Rate:	(ML/MIN)	1.22
Temperature:	(C)	180
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		522.10
Nitrogen Rate:	L/MIN)	3.93
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	140
Reactor Temp.:	(C)	
TE-301I	(BTTM)	438
TE-302I		440
TE-303I		440
TE-304I		438
TE-305I		438
TE-306I		438
TE-307I		434
TE-308I	(Top)	432
TE-309I	(VAP)	432
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.08
Temperature:	(C)	398
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1240
End of Mass Ballance		5360
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-480
End of Mass Ballance		1460
Sulfiding Agent	(mL/HR)	10.47

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydogen	2.02	4.28	99.18	34.81
CO2	44.01	13.03	0.08	22.30
CO	28.01	23.81	0.37	8.21
H2S	34.08			
Methane	16.04	0.50	0.94	0.56
Ethylen	28.05		0.03	0.48
Ethene	30.07		0.25	0.48
Propane	44.01		0.18	1.53
Propylene	42.08			
I-Butane	58.12		0.01	0.14
n-Butane	58.12		0.08	1.25
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.11	3.34
Nitrogen	28.02			
TOTAL		41.61	101.24	73.1045
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		5653.0	3703.0	9314.0
End of M.B. : (L)		10593.0	21350.0	9316.0
Total : (L)		4940.0	17647.0	2.0
Temperature: (C)		22.7	22.1	23.7
Meter Pressure : (mmH		694	699	699
Standard Volume: (L)		4165	15016	2
Nitrogen to R-200: (L)		1886		
Net Gas Out: (L)		2279	15016	2

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	411	439
Catalyst		Aluminate	FeO+DMDS
Feed	wt % maf coal	41.81%	
WHSV	(kg / hr) / l	1.76	1.06
CO Rate	kg / kg maf coal	0.92	
	moles / 100g maf coal	3.27	
consumed	moles / 100g maf coal	1.06	
Water Rate	kg / kg maf coal	0.92	
	moles / 100g maf coal	5.08	
Hydrogen	kg / kg maf coal		0.56
	moles / 100g maf coal		27.79
consumed	wt % maf coal	1.35%	5.63%

RUN No.: DOE-BU-014 M.B.No.: YP-03/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	6890	First Stage Liquid:	522
CO-Gas:	2416	First Stage Product Gas:	3072
Water:	585	Second Stage Liquid:	4120
Hydrogen:	1475	Second Stage Reactor Bottoms:	1940
Catalyst:		Second Stage Product Gas:	1717
S-Agent	84	Dissolved Gas:	2
TOTAL IN:	11449	TOTAL OUT:	11372
Catalyst ml	276	OVERALL BALANCE:	99.3%

WATER BALANCE

TOTAL IN:	816	TOTAL OUT:	988
		WATER BALANCE:	121.1%

Coal Conversion	wt.% maf	92.4%
Ash Balance	wt.%	139.7%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	172.53	176.07	2.79%	176.07	6.67%
COx	260.30	265.64	4.21%	265.64	10.06%
H2S					
C1 to C3	228.16	232.84	3.69%	232.84	8.82%
C4 +	89.53	91.37	1.45%	91.37	3.46%
Oil	4469.38	4561.07	72.24%	1332.09	50.46%
Asphaltene	885.66	903.83	14.32%	459.34	17.40%
Presasphalt.	65.78	67.13	1.06%	67.13	2.54%
IOM	195.64	199.66	3.16%	199.66	7.56%
Total	6366.98	6497.60	102.92%	2824.13	106.98%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross	Total Net				Total Gross	Total Net		
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		144.33	147.29	147.29	5.58%		89.53	91.37	91.37	3.46%
182 - 343	146.94	1428.82	1458.13	1311.19	49.67%	66.12	902.67	921.19	855.06	32.39%
343 - 524	3526.53	3544.24	3616.95	90.42	3.43%	3082.04	3616.94	3691.14	609.10	23.07%
524+		588.61	600.68	600.68	22.75%	525.31	1096.85	1119.36	594.05	22.50%
TOTAL	3673.47	5705.99	5823.05	2149.58	81.43%	3673.47	5705.99	5823.05	2149.58	81.43%
IBP - 524	3673.47	5117.39	5222.37	1548.90	58.67%	3148.16	4609.14	4703.69	1555.53	58.92%

RUN No.: DOE-BU-014 M.B.No.: YP-03/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydrogen	4.275						4.275	100.046	99.053	99.798	97.710	97.641	96.931	98.190	31.289	38.321					34.805
CO2	13.029						13.029	0.061	0.061	0.061	0.076	0.085	0.097	0.082	22.467	22.085					22.256
CO	23.612						23.612	0.335	0.352	0.371	0.368	0.398	0.392	0.372	6.068	6.361					6.214
H2S																					
Methane	0.495						0.495	0.969	0.961	0.868	0.883	0.868	1.010	0.936	0.580	0.538					0.558
Ethylen								0.031	0.030	0.032	0.030	0.030	0.030	0.031	0.911	0.068					0.489
Ethane								0.241	0.237	0.256	0.257	0.258	0.251	0.250	0.080	0.866					0.473
Propane								0.198	0.193	0.201	0.199	0.119	0.199	0.185	1.541	1.523					1.532
Propylene																					
i-Butane								0.012	0.015	0.011	0.011	0.010	0.016	0.013	0.145	0.143					0.144
n-Butane								0.084	0.082	0.084	0.085	0.083	0.084	0.084	1.257	1.244					1.251
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane																					
n-Pentane								0.110	0.107	0.110	0.110	0.110	0.109	0.109	3.280	3.404					3.342
Nitrogen																					
TOTAL	41.811						41.811	102.127	102.021	101.812	99.747	99.620	102.119	101.241	69.626	76.583					73.105

RUN No.: DOE-BU-014 M.B.No.: YP-03/ C1

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.53 (g/mole)				Average Mol Weight: 2.56 (g/mole)				Average Mol Weight: 23.37 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.27	21.10	0.69	99.18	97.98	1325.93	77.24	34.81	47.61	0.07	4.12
CO2	44.01	13.03	31.31	1401.30	45.62	0.08	0.08	23.84	1.39	22.30	30.50	1.01	57.44
CO	28.01	23.81	57.22	1629.96	53.06	0.37	0.37	69.02	4.02	8.21	11.24	0.24	13.47
H2S	34.08												
Methane	16.04	0.50	1.19	19.42	0.63	0.94	0.92	99.38	5.79	0.56	0.76	0.01	0.52
Ethylen	28.05					0.03	0.03	5.66	0.33	0.48	0.66	0.01	0.80
Ethane	30.07					0.25	0.25	49.75	2.90	0.48	0.66	0.01	0.84
Propane	44.01					0.18	0.18	53.84	3.14	1.53	2.10	0.07	3.95
Propylene	42.08												
i-Butane	58.12					0.01	0.01	4.81	0.28	0.14	0.20	0.01	0.49
n-Butane	58.12					0.08	0.08	32.18	1.87	1.25	1.71	0.08	4.25
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15												
n-Pentane	72.15					0.11	0.11	52.21	3.04	3.34	4.57	0.25	14.12
Nitrogen	28.02												
TOTAL		41.61	100.00	3071.78	100.00	101.24	100.00	1716.63	100.00	73.10	100.00	1.76	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	28.06	28.06	28.06	28.06
Produced	[moles]			3.78	-17.62
Total	[moles]	28.06	28.06	31.84	10.45
Stochiom.	[grams]	786.08	505.72	1235.10	56.69
Produced	[grams]			166.19	-35.59
Total	[grams]	786.08	505.72	1401.30	21.10

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	19.42	208.63	0.11	228.16
C4 +	[grams]		89.20	0.33	89.53
Total	[grams]	19.42	297.83	0.44	317.69

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	35.59	1474.66	1326.01	148.66	184.24

RUN No.: DOE-BU-014 **M.B.No.: YP-03/ C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
	Type	BTH	V-1074					
Total Feed / Product				6890	522	1940	4120	
Total Sample	[grams]			53.71	14.7	56.15	60.92	
Water	[grams]			1.8	8.7	0.1	2.5	
Oils+Asphaltenes	[grams]			28.64	5.97	42.92	55.09	
Oils	[wt%] calc	100.00%	87.90%	87.90%	94.57%	77.71%	85.41%	
Asphaltene	[wt%]		12.10%	12.10%	5.43%	22.29%	14.59%	
Pre-Asphaltenes	[grams]					1.16	0.38	
Insolubles	[grams]			23.54		13.23	3.36	
IOM	[wt%] calc			87.29%		35.73%	12.40%	
Ash	[wt%]			11.58%		63.52%	86.60%	
Moisture	[wt%]			1.13%		0.75%	1.00%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				6.88%	1.38%	0.53%	
182 - 343			1.80%	4.00%	37.24%	6.48%	33.65%	14.40%
343 - 524			83.90%	96.00%	55.88%	65.64%	65.82%	57.70%
524+			14.30%			26.50%		27.90%
Elemental Analysis:	[wt.%]			IBP - 182	182 - 343	343 - 524	524+	
Carbon		75.70%	87.80%	84.40%	85.20%	88.30%	87.50%	
Hydrogen		5.60%	8.50%	13.20%	10.00%	8.90%	6.70%	
Nitrogen		1.03%	0.85%	0.25%	0.66%	0.76%	1.35%	
Sulphur		0.43%	0.05%	0.11%	0.05%	0.05%	1.20%	
Oxygen (diff)		17.24%	2.80%	2.04%	4.09%	1.99%	3.25%	

RUN No.: DOE-BU-014 M.B.No.: YP-03/ C1

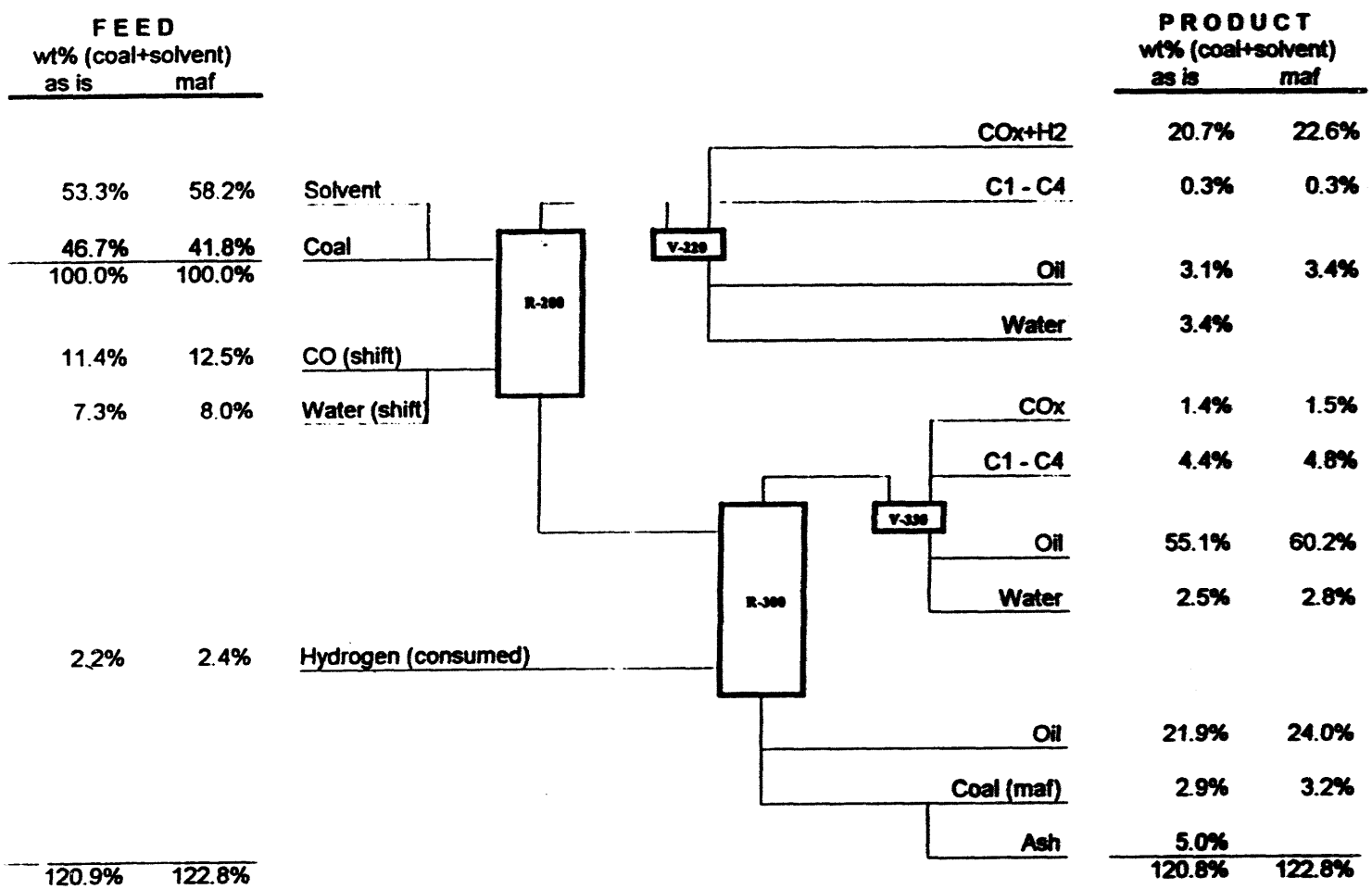
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	53.71	14.70	56.15	60.92
Water	1.80	8.73	0.10	2.50
Oils+Asphaltenes	28.64	5.97	41.76	54.71
Oils	25.17	5.64	32.19	46.68
Asphaltenes	3.46	0.32	9.57	8.04
Pre-Asphaltenes			1.18	0.38
Insolubles	23.27		13.13	3.33
IOM	20.58		4.79	0.45
Ash	2.70		8.34	2.88
TOTAL	53.71	14.7	56.15	60.92
	in wt% of analysis sample			
Water	3.35%	59.40%	0.18%	4.10%
Oils+Asphaltenes	53.32%	40.60%	74.37%	89.81%
Oils (on fraction)	87.90%	94.57%	77.09%	85.31%
(on total)	46.86%	38.40%	57.33%	76.62%
Asphalt. (on fract.)	12.10%	5.43%	22.91%	14.69%
(on total)	6.45%	2.20%	17.04%	13.19%
Pre-Asphaltenes			2.07%	0.62%
Insolubles	43.33%		23.39%	5.46%
IOM (on fraction)	88.42%		36.48%	13.40%
(on total)	38.31%		8.53%	0.73%
Ash (on fraction)	11.58%		63.52%	86.60%
(on total)	5.02%		14.85%	4.73%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	6890	522	1940	4120
Water	230.9	310.1	3.5	169.1
Oils+Asphaltenes	3673.5	212.0	1442.8	3700.3
Oils (on fraction)	3229.0	200.5	1112.3	3156.6
(on total)	3229.0	200.5	1112.3	3156.6
Asphalt. (on fract.)	444.5	11.5	330.5	543.6
(on total)	444.5	11.5	330.5	543.6
Pre-Asphaltenes			40.1	25.7
Insolubles	2985.6		453.7	225.0
IOM (on fraction)	2639.9		165.5	30.1
(on total)	2639.9		165.5	30.1
Ash (on fraction)	345.7		288.2	194.8
(on total)	345.7		288.2	194.8
TOTAL (as is)	6890.0	522.1	1940.0	4120.0
TOTAL (MAF)	6313.4	212.0	1648.4	3758.1

Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		14.58	20.46	19.75	54.80			
182 - 343	146.94	78.94	98.09	1253.79	1428.82	66.12	902.67	902.67
343 - 524	3526.53	118.45	973.36	2452.43	3544.24	3082.04	3816.94	3816.94
524+			558.46	30.15	588.61	525.31	1748.92	1098.85
TOTAL	3673.47	211.98	1648.37	3756.11	5616.46	3673.47	6268.52	5616.46

Feed	Products (normalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (normalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
3.42%	3.42%	0.05%	2.50%	5.97%				2.79%	2.79%
53.26%	3.14%	21.36%	54.77%	79.26%	58.19%	3.43%	23.32%	59.81%	86.58%
46.83%	2.97%	16.46%	48.72%	68.15%	51.15%	3.24%	17.98%	51.03%	72.24%
6.45%	0.17%	4.89%	8.05%	13.11%	7.04%	0.19%	5.34%	8.79%	14.32%
		0.59%	0.38%	0.97%			0.65%	0.42%	1.06%
43.30%		5.44%	2.47%	7.91%					
38.29%		2.45%	0.45%	2.90%	41.81%		2.68%	0.49%	3.16%
5.01%		2.99%	2.02%	5.01%					
100.00%	6.59%	27.44%	60.12%	94.12%					
					100.00%	3.43%	29.64%	63.50%	93.58%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-014 M.B. No.: YP-03/C1



FEED wt% (coal+solvent) as is	maf		PRODUCT wt% (coal+solvent) as is	maf
53.3%	58.2%	Solvent	COx+H2 20.7%	22.6%
46.7%	41.8%	Coal	C1 - C4 0.3%	0.3%
100.0%	100.0%		Oil 3.1%	3.4%
			Water 3.4%	
11.4%	12.5%	CO (shift)		
7.3%	8.0%	Water (shift)	COx 1.4%	1.5%
			C1 - C4 4.4%	4.8%
			Oil 55.1%	60.2%
			Water 2.5%	2.8%
2.2%	2.4%	Hydrogen (consumed)		
			Oil 21.9%	24.0%
			Coal (maf) 2.9%	3.2%
			Ash 5.0%	
120.9%	122.8%		120.8%	122.8%

Remarks:

RUN No.: DOE-BU-014			M.B.No.: YP-04/ C1	
	Date	Time	Date	Time
START:			Dec. 10, 93	10:00
END:			Dec. 10, 93	17:10
DURATION (hours):				7.17

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	41.81%
Solvent	V-1074	56.19%
Catalyst 1	Aluminate	2.00%
Catalyst 2	FeO+DMDS	2.00%
Other		

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		5530.00
End of Mass Ballance		2760.00
Rate	(G/HR)	847
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	311
Reactor Temp.:	(C)	
TE-201I	(BTTM)	410
TE-202I		410
TE-203I		410
TE-204I	(Top)	389
Liquid Level	(mm)	540
Separator Temperature:	(C)	48
CO-Feed Rate:	L/MIN)	4.05
Water Feed Rate:	(ML/MIN)	1.28
Temperature:	(C)	180
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		819.40
Nitrogen Rate:	L/MIN)	3.91
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	144
Reactor Temp.:	(C)	
TE-301I	(BTTM)	444
TE-302I		445
TE-303I		446
TE-304I		444
TE-305I		444
TE-306I		443
TE-307I		440
TE-308I	(Top)	436
TE-309I	(VAP)	436
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.20
Temperature:	(C)	390
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		2480
End of Mass Ballance		6160
Bottoms Product (WT-340(G)		
Start of Mass Ballance		-380
End of Mass Ballance		1050
Sulfiding Agent	(mL/HR)	11.69

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydrogen	2.02	4.28	97.06	34.81
CO2	44.01	13.03	0.07	22.30
CO	28.01	23.81	0.39	8.21
H2S	34.08			
Methane	16.04	0.50	1.05	0.56
Ethylen	28.05		0.04	0.48
Ethane	30.07		0.33	0.48
Propene	44.01		0.26	1.53
Propylene	42.08			
I-Butane	58.12		0.01	0.14
n-Butane	58.12		0.11	1.25
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.13	3.34
Nitrogen	28.02			
TOTAL		41.61	99.45	73.1045
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		3727.0	2400.0	9315.0
End of M.B. : (L)		8163.0	18394.0	9317.0
Total : (L)		4436.0	15994.0	2.0
Temperature: (C)		22.7	22.1	23.7
Meter Pressure : (mmH		694	699	699
Standard Volume: (L)		3740	13609	2
Nitrogen to R-200: (L)		1683		
Net Gas Out: (L)		2057	13609	2

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	410	445
Catalyst		Aluminate	FeO+DMDS
Feed	wt % maf coal	41.81%	
WHSV	(kg / hr) / l	1.73	1.04
CO Rate	kg / kg maf coal	0.94	
	moles / 100g maf coal	3.34	
consumed	moles / 100g maf coal	1.09	
Water Rate	kg / kg maf coal	0.94	
	moles / 100g maf coal	5.20	
Hydrogen	kg / kg maf coal		0.57
	moles / 100g maf coal		28.35
consumed	wt % maf coal	1.37%	5.50%

RUN No.: DOE-BU-014 M.B.No.: YP-04/ C1

OVERALL MASS BALANCE

Material In:	Gramme	Material Out:	Gramme
Feed Slurry	6070	First Stage Liquid:	819
CO-Gas:	2179	First Stage Product Gas:	2773
Water:	551	Second Stage Liquid:	3660
Hydrogen:	1326	Second Stage Reactor Bottoms:	1430
Catalyst:		Second Stage Product Gas:	1618
S-Agent	84	Dissolved Gas:	2
TOTAL IN:	10208	TOTAL OUT:	10322
Catalyst mf	243	OVERALL BALANCE:	101.1%

WATER BALANCE

TOTAL IN:	754	TOTAL OUT:	939
		WATER BALANCE:	124.6%

Coal Conversion	wt.% maf	93.7%
Ash Balance	wt.%	132.3%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	184.49	181.35	3.26%	181.35	7.80%
COx	241.22	237.10	4.26%	237.10	10.19%
H2S					
C1 to C3	254.72	250.37	4.50%	250.37	10.77%
C4 +	97.75	96.08	1.73%	96.08	4.13%
Oil	4108.44	4038.40	72.61%	1193.72	51.33%
Asphaltene	728.14	715.73	12.87%	324.14	13.94%
Preasphalt.	58.35	57.35	1.03%	57.35	2.47%
IOM	148.04	145.51	2.62%	145.51	6.26%
Total	5821.13	5721.90	102.88%	2485.63	106.88%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		166.24	163.41	163.41	7.03%		170.94	168.03	168.03	7.22%
182 - 343	129.45	1386.98	1363.33	1233.88	53.05%	58.25	929.01	913.18	854.92	36.76%
343 - 524	3106.83	3157.66	3104.03	-2.80	-0.12%	2715.24	2961.58	2911.10	195.86	8.42%
524+		429.31	422.00	422.00	18.14%	462.79	1079.17	1060.78	597.99	25.71%
TOTAL	3236.28	5140.39	5052.76	1816.48	78.10%	3236.28	5140.71	5053.08	1816.80	78.12%
IBP - 524	3236.28	4711.07	4630.77	1394.49	59.96%	2773.49	4061.54	3992.30	1218.81	52.41%

RUN No.: DOE-BU-014 M.B.No.: YP-04/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydrogen	4.275						4.275	97.184	97.238	97.148	97.118	96.902	96.919	97.081	31.269	38.321					34.805
CO_2	13.029						13.029	0.083	0.087	0.082	0.077	0.071	0.065	0.074	22.497	22.095					22.296
CO	23.812						23.812	0.425	0.342	0.412	0.401	0.406	0.347	0.389	8.066	8.361					8.214
H_2S																					
Methane	0.495						0.495	1.068	1.042	1.029	1.078	1.034	1.025	1.046	0.580	0.538					0.559
Ethylen								0.035	0.038	0.035	0.035	0.035	0.037	0.036	0.911	0.058					0.485
Ethane								0.325	0.338	0.324	0.326	0.320	0.320	0.326	0.060	0.898					0.479
Propane								0.253	0.263	0.252	0.257	0.252	0.258	0.255	1.541	1.523					1.532
Propylene																					
i-Butane								0.009	0.009	0.010	0.010	0.011	0.009	0.010	0.145	0.143					0.144
n-Butane								0.104	0.108	0.105	0.107	0.107	0.107	0.106	1.257	1.244					1.251
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.127	0.129	0.127	0.128	0.127	0.128	0.128	3.280	3.404					3.342
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	99.583	99.574	99.522	99.530	99.267	99.213	99.451	68.628	78.583					73.105

RUN No.: DOE-BU-014 **M.B.No.: YP-04/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.61 (g/mole)				Average Mol Weight: 2.67 (g/mole)				Average Mol Weight: 23.37 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.27	19.05	0.69	97.08	97.62	1197.47	73.99	34.81	47.61	0.07	4.12
CO2	44.01	13.03	31.31	1264.84	45.62	0.07	0.07	19.93	1.23	22.30	30.50	1.01	57.44
CO	28.01	23.81	57.22	1471.23	53.06	0.39	0.39	66.56	4.11	8.21	11.24	0.24	13.47
H2S	34.08												
Methane	16.04	0.50	1.19	17.53	0.63	1.05	1.05	102.45	6.33	0.56	0.76	0.01	0.52
Ethylen	28.05					0.04	0.04	6.14	0.38	0.48	0.66	0.01	0.80
Ethane	30.07					0.33	0.33	59.83	3.70	0.48	0.66	0.01	0.84
Propane	44.01					0.26	0.26	68.66	4.24	1.53	2.10	0.07	3.95
Propylene	42.08												
i-Butane	58.12					0.01	0.01	3.43	0.21	0.14	0.20	0.01	0.49
n-Butane	58.12					0.11	0.11	37.74	2.33	1.25	1.71	0.08	4.25
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.13	0.13	56.25	3.48	3.34	4.57	0.25	14.12
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.61	100.00	2772.64	100.00	99.45	100.00	1618.46	100.00	73.10	100.00	1.76	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	25.25	25.25	25.25	25.25
Produced	[moles]			3.49	-15.82
Total	[moles]	25.25	25.25	28.74	9.43
Stochiom.	[grams]	707.32	455.05	1111.37	51.01
Produced	[grams]			153.47	-31.96
Total	[grams]	707.32	455.05	1264.84	19.05

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	17.53	237.08	0.11	254.72
C4 +	[grams]		97.41	0.33	97.75
Total	[grams]	17.53	334.49	0.44	352.46

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	31.96	1325.50	1197.55	127.98	159.92

RUN No.: DOE-BU-014 **M.B.No.: YP-04/ C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				6070	819	1430	3680	
Total Sample	[grams]			53.71	14.7	53.85	63.83	
Water	[grams]			1.8	5.4		3.2	
Oils+Asphaltenes	[grams]			28.64	9.34	40.74	57.11	
Oils	[wt%] calc	100.00%	87.90%	87.90%	94.57%	76.06%	86.61%	
Asphaltene	[wt%]		12.10%	12.10%	5.43%	23.94%	13.39%	
Pre-Asphaltenes	[grams]					1.09	0.51	
Insolubles	[grams]			23.54		13.19	3.53	
IOM	[wt%] calc			87.29%		35.57%	10.55%	
Ash	[wt%]			11.58%		63.83%	89.10%	
Moisture	[wt%]			1.13%		0.60%	0.35%	
Distill. THF-Extract	[wt.%]		D-1160		Simulated Distillation			Cr.S.D.
IBP - 182	deg C				6.88%	1.50%	0.50%	1.30%
182 - 343			1.80%	4.00%	37.24%	6.17%	34.21%	16.50%
343 - 524			83.90%	96.00%	55.88%	66.30%	65.29%	52.60%
524+			14.30%			26.00%		29.60%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-014 M.B.No.: YP-04/ C1

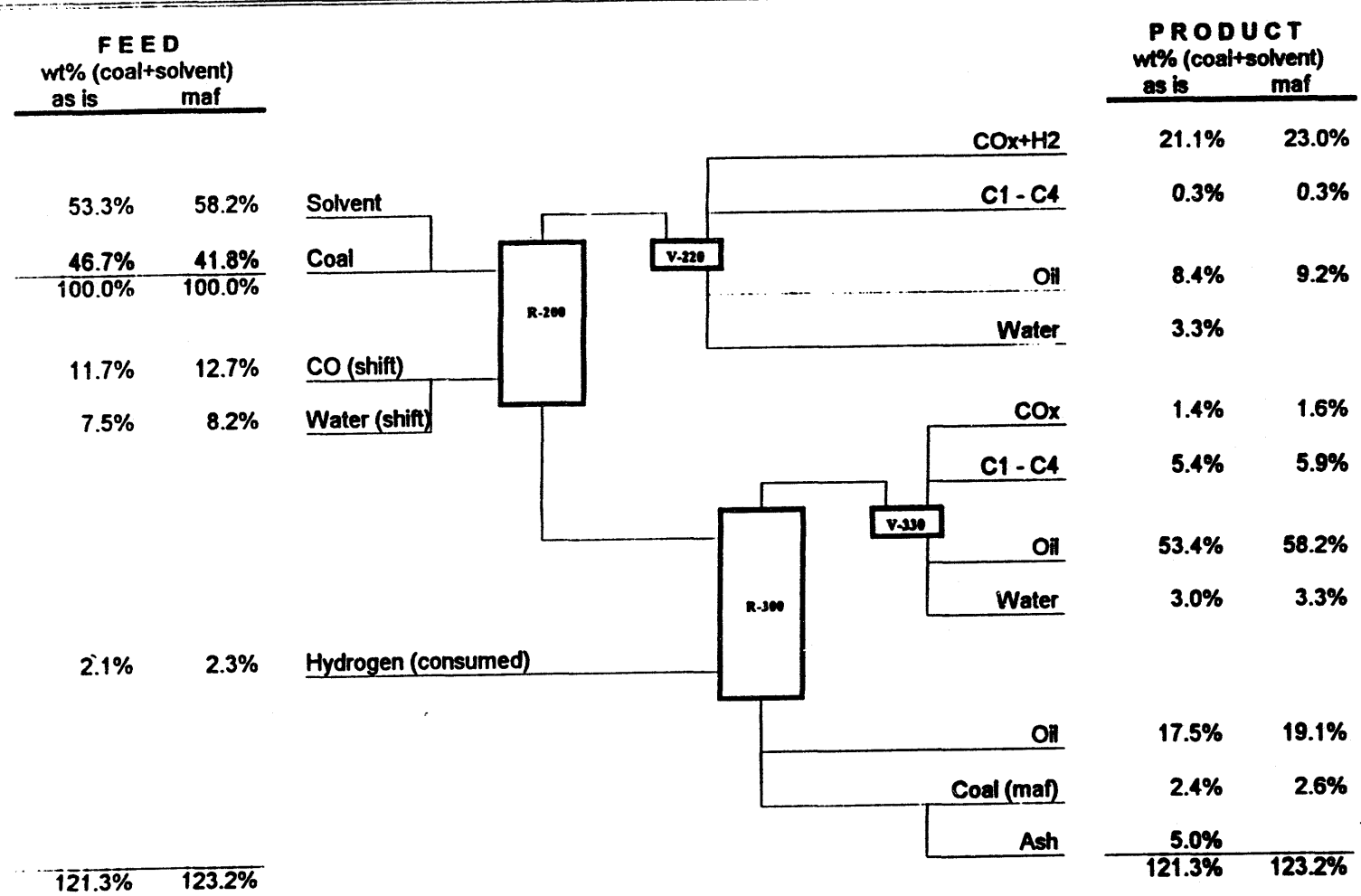
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	53.71	14.70	53.85	63.83
Water	1.80	5.36		3.20
Oils+Asphaltenes	28.64	9.34	39.65	56.60
Oils	25.17	8.83	29.90	48.96
Asphaltenes	3.46	0.51	9.75	7.65
Pre-Asphaltenes			1.09	0.51
Insolubles	23.27		13.11	3.52
IOM	20.58		4.74	0.38
Ash	2.70		8.37	3.13
TOTAL	53.71	14.7	53.85	63.83
	in wt% of analysis sample			
Water	3.35%	36.49%		5.01%
Oils+Asphaltenes	53.32%	63.51%	73.63%	88.68%
Oils (on fraction)	87.90%	94.57%	75.40%	86.49%
(on total)	46.86%	60.06%	55.52%	76.70%
Asphalt. (on fract.)	12.10%	5.43%	24.60%	13.51%
(on total)	6.45%	3.45%	18.11%	11.98%
Pre-Asphaltenes			2.02%	0.80%
Insolubles	43.33%		24.35%	5.51%
IOM (on fraction)	88.42%		36.17%	10.90%
(on total)	38.31%		8.81%	0.60%
Ash (on fraction)	11.58%		63.83%	89.10%
(on total)	5.02%		15.54%	4.91%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	6070	819	1430	3680
Water	203.4	299.0		184.5
Oils+Asphaltenes	3236.3	520.4	1052.9	3263.3
Oils (on fraction)	2844.7	492.1	793.9	2822.4
(on total)	2844.7	492.1	793.9	2822.4
Asphalt. (on fract.)	391.6	28.3	259.0	440.9
(on total)	391.6	28.3	259.0	440.9
Pre-Asphaltenes			28.9	29.4
Insolubles	2630.3		348.2	202.8
IOM (on fraction)	2325.7		125.9	22.1
(on total)	2325.7		125.9	22.1
Ash (on fraction)	304.6		222.2	180.7
(on total)	304.6		222.2	180.7
TOTAL (as is)	6070.0	819.4	1430.0	3680.0
TOTAL (MAF)	5562.0	520.4	1207.8	3314.8

Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		35.80	16.23	16.46	68.49		73.20	73.20
182 - 343	129.45	193.79	66.75	1126.43	1386.98	58.25	929.01	929.01
343 - 524	3106.83	290.79	717.26	2149.81	3157.86	2715.24	2961.58	2961.58
524+			407.21	22.11	429.31	462.79	1666.59	1079.17
TOTAL	3236.28	520.38	1207.44	3314.81	5042.64	3238.28	5630.38	5042.97

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
3.30%	3.30%		2.99%	6.29%				3.26%	3.26%
53.35%	8.43%	17.06%	52.87%	78.37%	58.19%	9.20%	18.61%	57.67%	85.48%
46.89%	7.97%	12.86%	45.73%	66.57%	51.15%	8.70%	14.03%	49.88%	72.61%
6.45%	0.46%	4.20%	7.14%	11.80%	7.04%	0.50%	4.58%	7.79%	12.87%
		0.47%	0.48%	0.95%			0.51%	0.52%	1.03%
43.36%		4.81%	2.61%	7.42%					
38.34%		2.04%	0.36%	2.40%	41.81%		2.23%	0.39%	2.62%
5.02%		2.77%	2.25%	5.02%					
100.00%	11.73%	22.34%	58.95%	93.02%					
					100.00%	9.20%	21.34%	61.84%	92.38%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-014 M.B. No.: YP-04/C1



Remarks:

RUN No.: DOE-BU-015			M.B.No.: YP-01/ C1	
	Date	Time	Date	Time
START:			Dec. 14, 93	05:00
END:			Dec. 14, 93	13:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	38.42%
Solvent	V-1074	61.58%
Catalyst 1	Aluminate	2.00%
Catalyst 2	Molybdate	0.28%
Other	CS2	

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		10440.00
End of Mass Ballance		4920.00
Rate	(G/HR)	690
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	311
Reactor Temp.:	(C)	
TE-201I	(BTTM)	411
TE-202I		411
TE-203I		411
TE-204I	(Top)	395
Liquid Level	(mm)	470
Separator Temperature:	(C)	46
CO-Feed Rate:	L/MIN)	4.03
Water Feed Rate:	(ML/MIN)	1.26
Temperature:	(C)	184
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		910.40
Nitrogen Rate:	L/MIN)	3.90
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	138
Reactor Temp.:	(C)	
TE-301I	(BTTM)	432
TE-302I		431
TE-303I		430
TE-304I		429
TE-305I		429
TE-306I		429
TE-307I		425
TE-308I	(Top)	425
TE-309I	(VAP)	425
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.05
Temperature:	(C)	391
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1270
End of Mass Ballance		3150
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-320
End of Mass Ballance		2100
Sulfiding Agent	(mL/HR)	9.02

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydogen	2.02	4.28	98.31	69.87
CO2	44.01	13.03	0.17	5.84
CO	28.01	23.81	0.30	3.97
H2S	34.08			
Methane	16.04	0.05	0.49	1.44
Ethylen	28.05		0.02	0.06
Ethane	30.07		0.18	0.98
Propane	44.01		0.12	1.20
Propylene	42.08			
I-Butane	58.12		0.01	0.01
n-Butane	58.12		0.06	0.84
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.09	1.69
Nitrogen	28.02			
TOTAL		41.17	99.73	85.898
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		9938.0	5390.0	7632.0
End of M.B. : (L)		14852.0	24254.0	7711.0
Total : (L)		4914.0	18864.0	79.0
Temperature: (C)		22.0	22.0	23.0
Meter Pressure : (mmH		694	694	694
Standard Volume: (L)		4153	15942	67
Nitrogen to R-200: (L)		1870		
Net Gas Out: (L)		2283	15942	67

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	411	430
Catalyst		Aluminate	Molybdate
Feed	wt % maf coal	38.42%	
WHSV	(kg / hr) / l	1.62	0.85
CO Rate	kg / kg maf coal	1.22	
	moles / 100g maf coal	4.34	
consumed	moles / 100g maf coal	1.38	
Water Rate	kg / kg maf coal	1.22	
	moles / 100g maf coal	6.75	
Hydrogen	kg / kg maf coal		0.74
	moles / 100g maf coal		36.88
consumed	wt % maf coal	1.71%	2.61%

RUN No.: DOE-BU-015 M.B.No.: YP-01/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	5520	First Stage Liquid:	910
CO-Gas:	2417	First Stage Product Gas:	3093
Water:	607	Second Stage Liquid:	1880
Hydrogen:	1473	Second Stage Reactor Bottoms:	2420
Catalyst:		Second Stage Product Gas:	1736
S-Agent	72	Dissolved Gas:	27
TOTAL IN:	10090	TOTAL OUT:	10066
Catalyst m/	126	OVERALL BALANCE:	99.8%

WATER BALANCE

TOTAL IN:	761	TOTAL OUT:	809
		WATER BALANCE:	106.3%

Coal Conversion	wt.% maf	82.6%
Ash Balance	wt.%	96.6%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	46.18	47.68	0.92%	47.68	2.40%
COx	338.93	335.43	6.48%	335.43	16.88%
H2S					
C1 to C3	141.33	139.87	2.70%	139.87	7.04%
C4 +	77.33	76.53	1.48%	76.53	3.85%
Oil	3667.19	3629.31	70.16%	829.13	41.72%
Asphaltene	632.28	625.75	12.10%	240.28	12.09%
Preasphalt.	59.73	59.11	1.14%	59.11	2.97%
IOM	348.70	345.10	6.67%	345.10	17.37%
Total	5313.67	5258.79	101.66%	2073.14	104.32%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		127.15	125.83	125.83	6.33%		141.53	140.07	140.07	7.05%
182 - 343	127.43	1203.13	1190.71	1063.28	53.50%	57.34	893.89	884.66	827.32	41.63%
343 - 524	3058.22	2591.36	2564.59	-493.63	-24.84%	2672.76	2726.12	2697.97	25.21	1.27%
524+		863.59	854.67	854.67	43.01%	455.55	1023.68	1013.11	557.56	28.06%
TOTAL	3185.65	4785.23	4735.81	1550.16	78.00%	3185.65	4785.23	4735.81	1550.16	78.00%
IBP - 524	3185.65	3921.64	3881.13	695.49	35.00%	2730.10	3761.55	3722.69	992.60	49.95%

RUN No.: DOE-BU-015 M.B.No.: YP-01/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%		vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydogen	4.275						4.275	98.383	97.804	98.298	98.844	98.504	98.448	98.310	73.403	68.340					68.872
CO2	13.029						13.029	0.160	0.142	0.151	0.131	0.220	0.198	0.167	6.650	5.022					5.841
CO	23.612						23.612	0.342	0.300	0.339	0.203	0.383	0.248	0.299	4.432	3.504					3.968
H2S																					
Methane	0.050						0.050	0.513	0.443	0.489	0.459	0.492	0.531	0.488	1.588	1.291					1.440
Ethylen								0.021	0.021	0.021	0.019	0.017	0.018	0.020	0.063	0.050					0.057
Ethane								0.188	0.178	0.179	0.168	0.187	0.198	0.183	1.113	0.858					0.985
Propane								0.143	0.139	0.014	0.128	0.138	0.143	0.117	1.394	1.003					1.199
Propylene																					
i-Butane								0.009	0.007	0.007	0.007	0.007	0.008	0.007	0.008	0.002					0.005
n-Butane								0.062	0.058	0.059	0.054	0.057	0.060	0.058	0.995	0.689					0.842
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.088	0.085	0.085	0.081	0.086	0.091	0.086	2.201	1.182					1.692
n-Pentane																					
Nitrogen																					
TOTAL	41.166						41.166	99.880	98.977	99.642	99.894	100.089	99.930	99.755	91.857	78.939					85.898

RUN No.: DOE-BU-015 **M.B.No.: YP-01/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.69 (g/mole)				Average Mol Weight: 2.44 (g/mole)				Average Mol Weight: 9.17 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.38	21.37	0.69	98.31	98.57	1416.44	81.61	69.87	81.34	4.88	17.92
CO2	44.01	13.03	31.65	1418.90	45.88	0.17	0.17	52.42	3.02	5.84	6.80	8.89	32.64
CO	28.01	23.81	57.84	1650.44	53.37	0.30	0.30	59.77	3.44	3.97	4.62	3.84	14.11
H2S	34.08												
Methane	16.04	0.05	0.12	1.96	0.06	0.49	0.49	55.81	3.22	1.44	1.68	0.80	2.93
Ethylen	28.05					0.02	0.02	3.90	0.22	0.06	0.07	0.05	0.20
Ethane	30.07					0.18	0.18	39.18	2.26	0.98	1.15	1.02	3.76
Propane	44.01					0.12	0.12	36.77	2.12	1.20	1.40	1.82	6.70
Propylene	42.08												
i-Butane	58.12					0.01	0.01	2.97	0.17	0.01	0.01	0.01	0.04
n-Butane	58.12					0.06	0.06	24.18	1.39	0.84	0.98	1.69	6.21
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.09	0.09	44.26	2.55	1.69	1.97	4.22	15.49
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.17	100.00	3092.67	100.00	99.73	100.00	1735.71	100.00	85.90	100.00	27.22	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	27.38	27.38	27.38	27.38
Produced	[moles]			4.86	-16.80
Total	[moles]	27.38	27.38	32.24	10.58
Stochiom.	[grams]	766.85	493.35	1204.89	55.30
Produced	[grams]			214.01	-33.93
Total	[grams]	766.85	493.35	1418.90	21.37

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	1.96	135.67	3.70	141.33
C4 +	[grams]		71.41	5.92	77.33
Total	[grams]	1.96	207.08	9.62	218.66

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	33.93	1473.27	1421.32	51.95	85.88

RUN No.: DOE-BU-015 **M.B.No.: YP-01/C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				5520	910	2420	1880	
Total Sample	[grams]			50.33	14.7	54.33	64.49	
Water	[grams]			1.4	4.3	0.1	1.5	
Oils+Asphaltenes	[grams]			29.05	10.38	42.97	61.82	
Oils	[wt%] calc	100.00%	87.90%	87.90%	96.12%	77.93%	89.74%	
Asphaltene	[wt%]		12.10%	12.10%	3.88%	22.07%	10.26%	
Pre-Asphaltenes	[grams]					1.21	0.2	
Insolubles	[grams]			19.99		11.35	1.19	
IOM	[wt%] calc			90.60%		65.69%	43.18%	
Ash	[wt%]			8.88%		33.50%	55.52%	
Moisture	[wt%]			0.53%		0.81%	1.30%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				4.95%	0.45%	0.52%	1.30%
182 - 343			1.80%	4.00%	54.69%	5.12%	41.81%	18.10%
343 - 524			83.90%	96.00%	40.36%	67.53%	57.67%	55.20%
524+			14.30%			26.90%		25.40%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-015 M.B.No.: YP-01/ C1

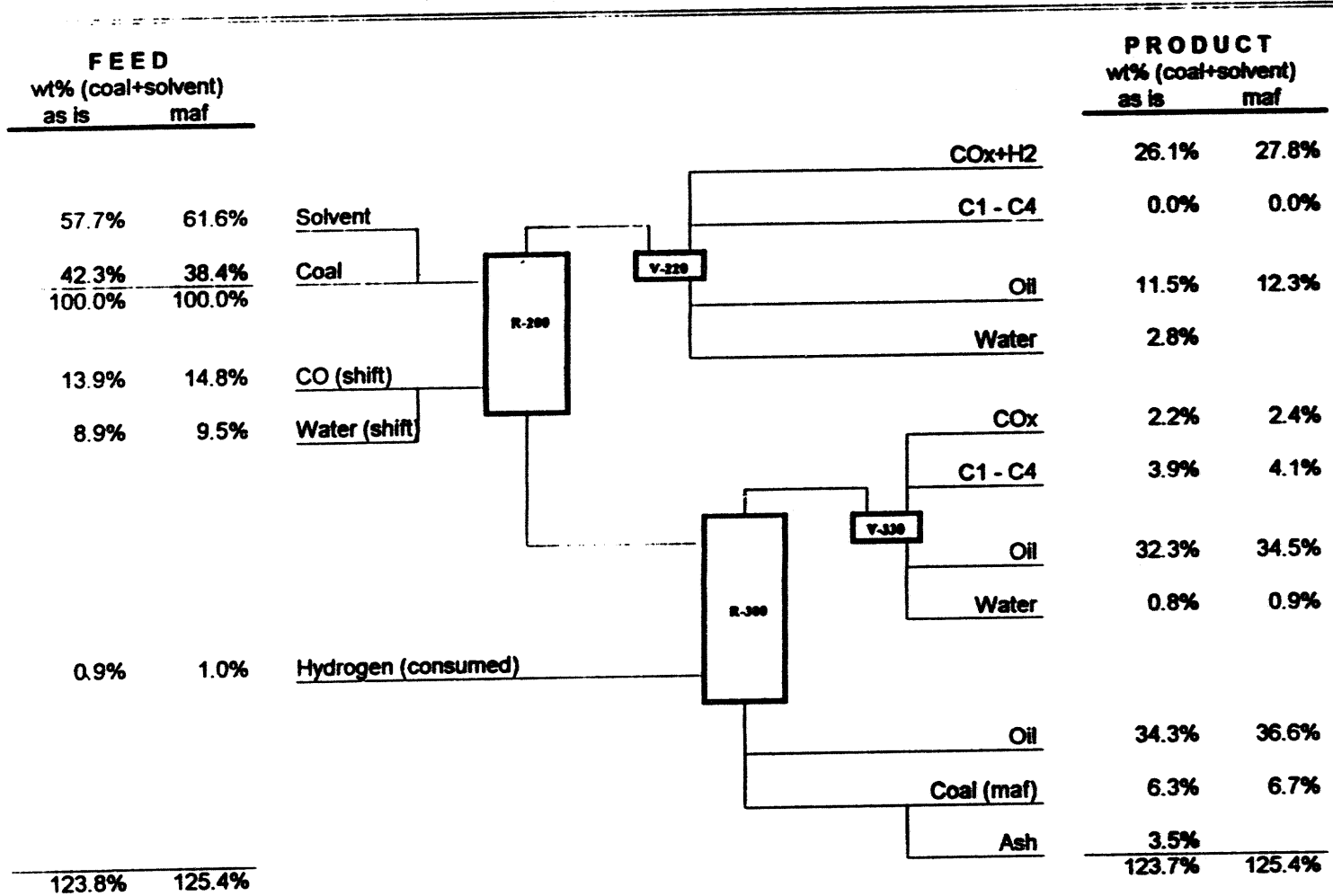
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	50.33	14.70	54.33	64.49
Water	1.40	4.32	0.10	1.50
Oils+Asphaltenes	29.05	10.38	41.76	61.62
Oils	25.53	9.98	32.28	55.27
Asphaltenes	3.51	0.40	9.48	6.34
Pre-Asphaltenes			1.21	0.20
Insolubles	19.88		11.26	1.17
IOM	18.12		7.49	0.52
Ash	1.76		3.77	0.65
TOTAL	50.33	14.7	54.33	64.49
	in wt% of analysis sample			
Water	2.78%	29.36%	0.18%	2.33%
Oils+Asphaltenes	57.71%	70.64%	76.87%	95.54%
Oils (on fraction)	87.90%	96.12%	77.29%	89.71%
(on total)	50.73%	67.90%	59.41%	85.71%
Asphalt. (on fract.)	12.10%	3.88%	22.71%	10.29%
(on total)	6.98%	2.74%	17.46%	9.83%
Pre-Asphaltenes			2.23%	0.31%
Insolubles	39.51%		20.72%	1.82%
IOM (on fraction)	91.13%		66.50%	44.48%
(on total)	36.00%		13.78%	0.81%
Ash (on fraction)	8.88%		33.50%	55.52%
(on total)	3.51%		6.94%	1.01%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	5520	910	2420	1880
Water	153.5	267.3	4.5	43.7
Oils+Asphaltenes	3185.6	643.1	1860.2	1796.2
Oils (on fraction)	2800.2	618.1	1437.7	1611.3
(on total)	2800.2	618.1	1437.7	1611.3
Asphalt. (on fract.)	385.5	25.0	422.4	184.9
(on total)	385.5	25.0	422.4	184.9
Pre-Asphaltenes			53.9	5.8
Insolubles	2180.8		501.5	34.2
IOM (on fraction)	1987.3		333.5	15.2
(on total)	1987.3		333.5	15.2
Ash (on fraction)	193.5		168.0	19.0
(on total)	193.5		168.0	19.0
TOTAL (as is)	5520.0	910.4	2420.0	1880.0
TOTAL (MAF)	5172.9	843.1	2247.6	1817.3

Distillation Profile THF-Extract						D-1180		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		31.83	8.61	9.37	49.82		64.20	64.20
182 - 343	127.43	351.70	98.00	753.43	1203.13	57.34	893.89	893.89
343 - 524	3058.22	259.55	1292.58	1039.23	2591.36	2672.76	2726.12	2726.12
524+			846.36	15.23	863.59	455.55	1254.41	1023.68
TOTAL	3185.65	643.08	2247.58	1817.26	4707.90	3185.65	4938.63	4707.90

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
2.75%	2.75%	0.08%	0.78%	3.62%				0.92%	0.92%
57.73%	11.53%	33.36%	32.21%	77.11%	61.56%	12.30%	35.59%	34.36%	82.26%
50.74%	11.09%	25.76%	28.90%	65.77%	54.13%	11.83%	27.51%	30.83%	70.16%
6.99%	0.45%	7.58%	3.32%	11.34%	7.45%	0.48%	8.08%	3.54%	12.10%
		0.97%	0.10%	1.07%			1.03%	0.11%	1.14%
39.52%		9.13%	0.63%	9.76%					
36.01%		5.98%	0.27%	6.25%	38.42%		6.38%	0.29%	6.67%
3.51%		3.15%	0.36%	3.51%					
100.00%	14.28%	43.54%	33.73%	91.56%					
					100.00%	12.30%	43.00%	35.69%	90.99%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-015 M.B. No.: YP-01-C1



Remarks:

RUN No.: DOE-BU-015	M.B.No.: YP-02/ C1

26-Apr-9

	Date	Time	Date	Time
START:			Dec. 14, 93	19:00
END:			Dec. 15, 93	03:00
DURATION (hours):				8.00

Feed:	Type	Wt% (maf)
Coal	BTH	40.61%
Solvent	V-1074	59.39%
Catalyst 1	Aluminate	2.00%
Catalyst 2	Molybdate	0.28%
Other	CS2	

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		15500.00
End of Mass Ballance		7580.00
Rate	(G/HR)	978
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	288
Reactor Temp.:	(C)	
TE-201I	(BTTM)	411
TE-202I		412
TE-203I		412
TE-204I	(Top)	392
Liquid Level	(mm)	470
Separator Temperature:	(C)	46
CO-Feed Rate:	L/MIN)	4.04
Water Feed Rate:	(ML/MIN)	1.57
Temperature:	(C)	184
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1382.30
Nitrogen Rate:	L/MIN)	3.93
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	148
Reactor Temp.:	(C)	
TE-301I	(BTTM)	436
TE-302I		435
TE-303I		435
TE-304I		433
TE-305I		432
TE-306I		432
TE-307I		428
TE-308I	(Top)	426
TE-309I	(VAP)	425
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.13
Temperature:	(C)	391
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1250
End of Mass Ballance		5190
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-530
End of Mass Ballance		1570
Sulfiding Agent	(mL/HR)	10.47

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydogen	2.02	4.28	100.35	15.89
CO2	44.01	13.03	0.11	11.22
CO	28.01	23.81	0.43	36.91
H2S	34.08			
Methane	16.04	0.50	0.66	0.56
Ethylen	28.05		0.03	0.02
Ethane	30.07		0.25	0.28
Propane	44.01		0.18	0.18
Propylene	42.08		0.03	
I-Butane	58.12		0.01	0.01
n-Butane	58.12		0.08	0.07
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.11	0.11
Nitrogen	28.02			
TOTAL		41.61	102.25	65.35175
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		8304.0	8910.0	7744.0
End of M.B. : (L)		13183.0	25740.0	7796.0
Total : (L)		4879.0	16830.0	52.0
Temperature: (C)		22.1	21.6	23.1
Meter Pressure : (mmH		700	700	700
Standard Volume: (L)		4157	14365	44
Nitrogen to R-200: (L)		1887		
Net Gas Out: (L)		2270	14365	44

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	412	434
Catalyst		Aluminate	Molybdate
Feed	wt % maf coal	40.61%	
WHSV	(kg / hr) / l	2.29	1.20
CO Rate	kg / kg maf coal	0.84	
	moles / 100g maf coal	3.01	
consumed	moles / 100g maf coal	0.99	
Water Rate	kg / kg maf coal	0.84	
	moles / 100g maf coal	4.68	
Hydrogen	kg / kg maf coal		0.51
	moles / 100g maf coal		25.56
consumed	wt % maf coal	1.28%	7.13%

RUN No.: DOE-BU-015 M.B.No.: YP-02/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	7520	First Stage Liquid:	1392
CO-Gas:	2424	First Stage Product Gas:	3080
Water:	752	Second Stage Liquid:	3940
Hydrogen:	1477	Second Stage Reactor Bottoms:	2100
Catalyst:		Second Stage Product Gas:	1639
S-Agent	84	Dissolved Gas:	48
TOTAL IN:	12256	TOTAL OUT:	12199
Catalyst m/	176	OVERALL BALANCE:	97.0%

WATER BALANCE

TOTAL IN:	1221	TOTAL OUT:	1363
		WATER BALANCE:	111.6%

Coal Conversion	wt.% maf	89.8%
Ash Balance	wt.%	108.1%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	141.75	148.01	2.09%	148.01	5.15%
COx	292.78	305.71	4.32%	305.71	10.64%
H2S					
C1 to C3	197.28	205.99	2.91%	205.99	7.17%
C4 +	84.07	87.78	1.24%	87.78	3.05%
Oil	5041.09	5263.60	74.37%	1568.85	54.59%
Asphaltene	892.38	931.78	13.17%	423.17	14.72%
Preasphalt.	78.87	82.35	1.16%	82.35	2.87%
IOM	281.25	293.66	4.15%	293.66	10.22%
Total	7009.47	7318.88	103.41%	3115.51	108.40%

Simulated Distillation Profile THF-Extract						Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		192.84	201.36	201.36	7.01%		178.23	186.09	186.09	6.47%
182 - 343	168.13	1718.09	1793.93	1625.79	56.57%	75.66	1210.58	1264.02	1188.36	41.35%
343 - 524	4035.23	3783.57	3950.58	-84.65	-2.95%	3526.62	3685.55	3848.24	321.62	11.19%
524+		683.16	713.31	713.31	24.82%	601.08	1303.30	1360.82	759.74	26.43%
TOTAL	4203.36	6377.66	6659.18	2455.82	85.45%	4203.36	6377.66	6659.18	2455.82	85.45%
IBP - 524	4203.36	5694.50	5945.86	1742.50	60.63%	3602.28	5074.38	5298.35	1696.07	59.01%

RUN No.: DOE-BU-015 M.B.No.: YP-02/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 4						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydogen	4.275						4.275	103.330	100.989	101.101	101.003	97.812	97.872	100.351	22.954	13.972	13.557	13.482			15.991
CO2	13.029						13.029	0.128	0.147	0.103	0.103	0.099	0.100	0.113	7.732	12.313	12.293	12.522			11.215
CO	23.812						23.812	0.495	0.439	0.389	0.370	0.452	0.463	0.435	34.427	37.323	38.019	37.874			36.911
H2S																					
Methane	0.495						0.495	0.661	0.708	0.658	0.658	0.619	0.629	0.655	0.513	0.552	0.614	0.628			0.577
Ethylen								0.029	0.029	0.028	0.029	0.028	0.028	0.029	0.017	0.014	0.015	0.014			0.015
Ethane								0.254	0.273	0.256	0.254	0.241	0.245	0.254	0.242	0.267	0.301	0.291			0.275
Propane								0.196	0.203	0.195	0.128	0.181	0.183	0.181	0.160	0.181	0.199	0.192			0.183
Propylene											0.193			0.032							
i-Butane								0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.004	0.006	0.007	0.006			0.006
n-Butane								0.083	0.085	0.083	0.082	0.076	0.077	0.081	0.069	0.070	0.073	0.072			0.071
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.120	0.120	0.117	0.115	0.106	0.109	0.115	0.112	0.106	0.107	0.105			0.106
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	105.303	102.997	102.936	102.941	99.622	99.712	102.252	66.230	64.808	65.185	65.186			65.352

RUN No.: DOE-BU-015 **M.B.No.: YP-02/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight:		16.49 (g/mole)		Average Mol Weight:		2.56 (g/mole)		Average Mol Weight:		24.45 (g/mole)	
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydrogen	2.02	4.28	10.27	21.02	0.69	100.35	98.14	1270.80	77.52	15.99	24.47	0.97	2.02
CO2	44.01	13.03	31.31	1395.89	45.62	0.11	0.11	31.27	1.91	11.22	17.16	14.88	30.89
CO	28.01	23.81	57.23	1623.67	53.06	0.43	0.43	76.33	4.66	36.91	56.48	31.17	64.70
H2S	34.08												
Methane	16.04	0.50	1.19	19.33	0.63	0.66	0.64	65.88	4.02	0.58	0.88	0.28	0.58
Ethylen	28.05					0.03	0.03	5.01	0.31	0.02	0.02	0.01	0.03
Ethane	30.07					0.25	0.25	47.85	2.92	0.28	0.42	0.25	0.52
Propane	44.01					0.18	0.18	49.94	3.05	0.18	0.28	0.24	0.50
Propylene	42.08					0.03	0.03	8.49	0.52				
i-Butane	58.12					0.01	0.01	2.25	0.14	0.01	0.01	0.01	0.02
n-Butane	58.12					0.08	0.08	29.51	1.80	0.07	0.11	0.12	0.26
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.11	0.11	51.94	3.17	0.11	0.16	0.23	0.49
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.61	100.00	3059.91	100.00	102.25	100.00	1639.28	100.00	65.35	100.00	48.18	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	28.56	28.56	28.56	28.56
Produced	[moles]			3.16	-18.15
Total	[moles]	28.56	28.56	31.72	10.41
Stochiom.	[grams]	799.86	514.58	1256.76	57.68
Produced	[grams]			139.13	-36.66
Total	[grams]	799.86	514.58	1395.89	21.02

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	19.33	177.17	0.78	197.28
C4 +	[grams]		83.70	0.37	84.07
Total	[grams]	19.33	260.87	1.15	281.35

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	36.66	1476.59	1271.77	204.82	241.48

RUN No.: DOE-BU-015 **M.B.No.: YP-02/ C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				7820	1392	2100	3940	
Total Sample	[grams]			51.68	14.7	57.61	63.93	
Water	[grams]			3.1	7.5		2.3	
Oils+Asphaltenes	[grams]			27.78	7.24	46.52	58.92	
Oils	[wt%] calc	100.00%	87.90%	87.90%	96.12%	78.13%	86.37%	
Asphaltene	[wt%]		12.10%	12.10%	3.88%	21.87%	13.63%	
Pre-Asphaltenes	[grams]					1.2	0.57	
Insolubles	[grams]			20.91		11.2	2.75	
IOM	[wt%] calc			90.79%		53.90%	34.15%	
Ash	[wt%]			8.69%		45.10%	64.50%	
Moisture	[wt%]			0.52%		1.00%	1.35%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				4.95%	3.30%	0.52%	1.40%
182 - 343			1.80%	4.00%	54.69%	6.00%	34.19%	18.00%
343 - 524			83.90%	96.00%	40.36%	67.00%	65.29%	54.80%
524+			14.30%			23.70%		25.80%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-015 M.B.No.: YP-02/ C1

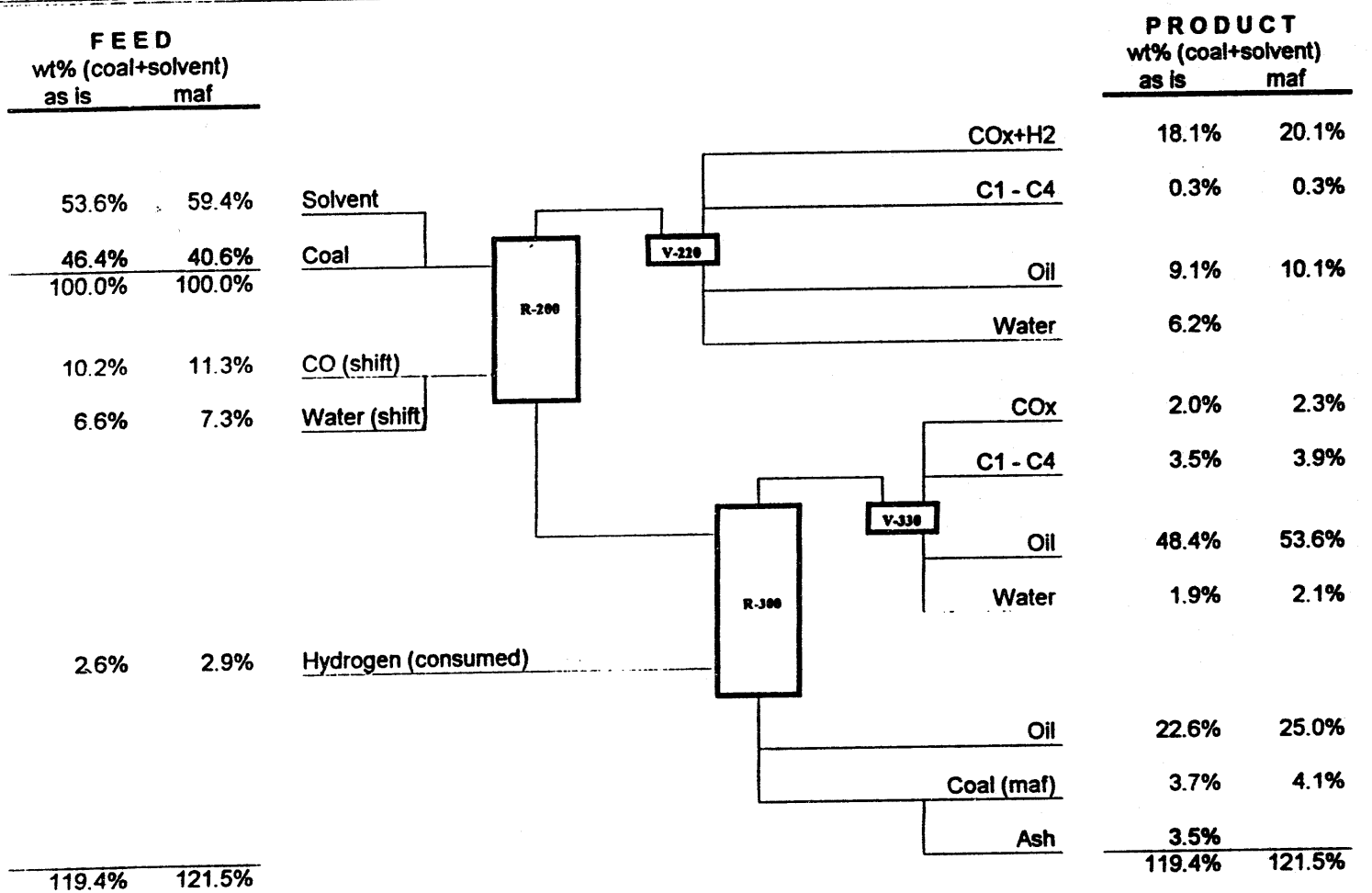
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	51.68	14.70	57.61	63.93
Water	3.10	7.46		2.30
Oils+Asphaltenes	27.78	7.24	45.32	58.35
Oils	24.42	6.96	35.15	50.32
Asphaltenes	3.36	0.28	10.17	8.03
Pre-Asphaltenes			1.20	0.57
Insolubles	20.80		11.09	2.71
IOM	18.99		6.09	0.96
Ash	1.81		5.00	1.75
TOTAL	51.68	14.7	57.61	63.93
	in wt% of analysis sample			
Water	6.00%	50.77%		3.60%
Oils+Asphaltenes	53.75%	49.23%	78.67%	91.27%
Oils (on fraction)	87.90%	96.12%	77.55%	86.24%
(on total)	47.25%	47.32%	61.01%	78.71%
Asphalt. (on fract.)	12.10%	3.88%	22.45%	13.76%
(on total)	6.50%	1.91%	17.66%	12.56%
Pre-Asphaltenes			2.08%	0.89%
Insolubles	40.25%		19.25%	4.24%
IOM (on fraction)	91.31%		54.90%	35.50%
(on total)	36.75%		10.57%	1.51%
Ash (on fraction)	8.69%		45.10%	64.50%
(on total)	3.50%		8.68%	2.74%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	7820	1392	2100	3940
Water	469.1	706.8		141.7
Oils+Asphaltenes	4203.4	685.5	1652.1	3595.9
Oils (on fraction)	3694.8	658.9	1281.2	3101.0
(on total)	3694.8	658.9	1281.2	3101.0
Asphalt. (on fract.)	508.6	26.6	370.9	494.9
(on total)	508.6	26.6	370.9	494.9
Pre-Asphaltenes			43.7	35.1
Insolubles	3147.6		404.2	167.2
IOM (on fraction)	2874.0		221.9	59.4
(on total)	2874.0		221.9	59.4
Ash (on fraction)	273.5		182.3	107.8
(on total)	273.5		182.3	107.8
TOTAL (as is)	7820.0	1392.3	2100.0	3940.0
TOTAL (MAF)	7077.4	685.5	1917.7	3690.4

Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		33.93	55.96	18.88	108.77		94.16	94.16
182 - 343	168.13	374.88	101.75	1241.46	1718.09	75.66	1210.58	1210.58
343 - 524	4035.23	276.65	1136.20	2370.72	3783.57	3526.62	3685.55	3685.55
524+			623.80	59.35	683.16	601.08	1735.17	1303.30
TOTAL	4203.36	685.46	1917.71	3690.41	6293.59	4203.36	6725.46	6293.59

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
6.25%	6.25%		1.89%	8.13%				2.09%	2.09%
53.61%	9.13%	22.00%	47.89%	79.02%	59.39%	10.11%	24.37%	53.05%	87.54%
47.12%	8.77%	17.06%	41.30%	67.13%	52.20%	9.72%	18.90%	45.75%	74.37%
6.49%	0.35%	4.94%	6.59%	11.88%	7.19%	0.39%	5.47%	7.30%	13.17%
		0.58%	0.47%	1.05%			0.65%	0.52%	1.16%
40.14%		5.15%	2.09%	7.23%					
36.66%		2.95%	0.79%	3.75%	40.61%		3.27%	0.88%	4.15%
3.49%		2.19%	1.30%	3.49%					
100.00%	15.37%	27.73%	52.33%	95.43%					
					100.00%	10.11%	28.29%	56.54%	94.94%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-015 M.B. No.: YP-02/C1



Remarks:

RUN No.: DOE-BU-015			M.B.No.: YP-03/ C1	
	Date	Time	Date	Time
START:			Dec. 15, 93	07:00
END:			Dec. 15, 93	15:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	42.94%
Solvent	V-1074	57.06%
Catalyst 1	Aluminate	2.00%
Catalyst 2	Molybdate	0.28%
Other	CS2	

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		14720.00
End of Mass Ballance		7920.00
Rate	(G/HR)	850
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	289
Reactor Temp.:	(C)	
TE-201I	(BTTM)	410
TE-202I		412
TE-203I		412
TE-204I	(Top)	389
Liquid Level	(mm)	540
Separator Temperature:	(C)	47
CO-Feed Rate:	L/MIN)	4.03
Water Feed Rate:	(ML/MIN)	1.51
Temperature:	(C)	193
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1535.30
Nitrogen Rate:	L/MIN)	3.91
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	136
Reactor Temp.:	(C)	
TE-301I	(BTTM)	436
TE-302I		436
TE-303I		435
TE-304I		434
TE-305I		433
TE-306I		433
TE-307I		429
TE-308I	(Top)	426
TE-309I	(VAP)	426
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.00
Temperature:	(C)	394
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1230
End of Mass Ballance		4222
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-830
End of Mass Ballance		1340
Sulfiding Agent	(mL/HR)	10.08

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydrogen	2.02	4.28	97.46	15.99
CO2	44.01	13.03	0.18	11.22
CO	28.01	23.81	0.44	36.91
H2S	34.08			
Methane	16.04	0.50	0.61	0.58
Ethylen	28.05		0.03	0.02
Ethane	30.07		0.25	0.28
Propane	44.01		0.18	0.18
Propylene	42.08			
I-Butane	58.12		0.01	0.01
n-Butane	58.12		0.08	0.07
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.11	0.11
Nitrogen	28.02			
TOTAL		41.61	99.34	65.35175
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		6043.0	5709.0	7825.0
End of M.B. : (L)		10886.0	22960.0	7878.0
Total : (L)		4843.0	17251.0	53.0
Temperature: (C)		22.2	21.6	23.0
Meter Pressure : (mmH		704	704	704
Standard Volume: (L)		4149	14809	45
Nitrogen to R-200: (L)		1878		
Net Gas Out: (L)		2271	14809	45

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	412	435
Catalyst		Aluminate	Molybdate
Feed	wt % maf coal	42.94%	
WHSV	(kg / hr) / l	1.74	1.04
CO Rate	kg / kg maf coal	0.92	
	moles / 100g maf coal	3.29	
consumed	moles / 100g maf coal	1.08	
Water Rate	kg / kg maf coal	0.92	
	moles / 100g maf coal	5.11	
Hydrogen	kg / kg maf coal		0.56
	moles / 100g maf coal		27.89
consumed	wt % maf coal	1.37%	6.12%

RUN No.: DOE-BU-015 M.B.No.: YP-03/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	6600	First Stage Liquid:	1535
CO-Gas:	2415	First Stage Product Gas:	3061
Water:	724	Second Stage Liquid:	2992
Hydrogen:	1471	Second Stage Reactor Bottoms:	2170
Catalyst:		Second Stage Product Gas:	1701
S-Agent	81	Dissolved Gas:	49
TOTAL IN:	11491	TOTAL OUT:	11508
Catalyst m/	155	OVERALL BALANCE:	100.2%

WATER BALANCE

TOTAL IN:	1120	TOTAL OUT:	1244
		WATER BALANCE:	111.1%

Coal Conversion	wt.% maf	92.3%
Ash Balance	wt.%	97.4%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	123.81	121.77	1.99%	121.77	4.64%
COx	336.09	330.56	5.41%	330.56	12.60%
H2S					
C1 to C3	193.69	190.51	3.12%	190.51	7.26%
C4 +	82.99	81.62	1.34%	81.62	3.11%
Oil	4616.28	4540.32	74.30%	1475.08	56.22%
Asphaltene	803.74	790.51	12.94%	368.56	14.05%
Preasphalt.	52.36	51.49	0.84%	51.49	1.96%
IOM	204.27	200.91	3.29%	200.91	7.66%
Total	6413.22	6307.69	103.22%	2820.50	107.49%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		188.72	185.61	185.61	7.07%		174.27	171.41	171.41	6.53%
182 - 343	139.49	1743.30	1714.61	1575.13	60.03%	62.77	1235.42	1215.09	1152.32	43.92%
343 - 524	3347.71	3109.81	3058.64	-289.06	-11.02%	2925.75	3146.36	3094.59	168.83	6.43%
524+		717.80	705.99	705.99	26.91%	498.67	1203.58	1183.77	685.11	26.11%
TOTAL	3487.19	5759.63	5664.86	2177.67	82.99%	3487.19	5759.63	5664.86	2177.67	82.99%
IBP - 524	3487.19	5041.83	4958.87	1471.68	56.09%	2988.52	4556.05	4481.09	1492.56	56.88%

RUN No.: DOE-BU-015 M.B.No.: YP-03/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-350)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 4						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydogen	4.275						4.275	98.248	98.381	98.405	93.794	97.882	98.083	97.498	22.954	13.972	13.557	13.482			15.991
CO2	13.029						13.029	0.690	0.087	0.083	0.083	0.090	0.103	0.179	7.732	12.313	12.283	12.522			11.215
CO	23.812						23.812	0.422	0.442	0.335	0.401	0.512	0.545	0.443	34.427	37.323	36.019	37.874			36.911
H2S																					
Methane	0.495						0.495	0.605	0.624	0.597	0.579	0.634	0.638	0.613	0.513	0.552	0.614	0.628			0.577
Ethylen								0.030	0.030	0.029	0.028	0.028	0.029	0.029	0.017	0.014	0.015	0.014			0.015
Ethane								0.232	0.239	0.328	0.220	0.245	0.247	0.252	0.242	0.287	0.301	0.291			0.275
Propane								0.178	0.181	0.176	0.169	0.185	0.184	0.179	0.160	0.181	0.199	0.192			0.183
Propylene																					
i-Butane								0.006	0.008	0.008	0.004	0.008	0.008	0.006	0.004	0.008	0.007	0.008			0.006
n-Butane								0.077	0.078	0.078	0.073	0.079	0.078	0.077	0.069	0.070	0.073	0.072			0.071
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.105	0.106	0.105	0.100	0.109	0.109	0.106	0.112	0.106	0.107	0.105			0.108
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	100.593	100.154	100.121	95.431	99.750	100.002	99.342	66.230	64.809	65.185	65.188			65.352

RUN No.: DOE-BU-015 **M.B.No.: YP-03/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-360)			
		Average Mol Weight:		16.53 (g/mole)		Average Mol Weight:		2.57 (g/mole)		Average Mol Weight:		24.45 (g/mole)	
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.27	21.03	0.69	97.46	98.10	1309.54	77.00	15.99	24.47	1.00	2.02
CO2	44.01	13.03	31.31	1396.24	45.62	0.18	0.18	52.50	3.09	11.22	17.16	15.26	30.89
CO	28.01	23.81	57.23	1624.07	53.06	0.44	0.45	82.51	4.85	36.91	56.48	31.97	64.70
H2S	34.08												
Methane	16.04	0.50	1.19	19.33	0.63	0.61	0.62	65.39	3.84	0.58	0.88	0.29	0.58
Ethylen	28.05					0.03	0.03	5.41	0.32	0.02	0.02	0.01	0.03
Ethane	30.07					0.25	0.25	50.41	2.96	0.28	0.42	0.28	0.52
Propane	44.01					0.18	0.18	52.35	3.08	0.18	0.28	0.25	0.50
Propylene	42.08												
i-Butane	58.12					0.01	0.01	2.19	0.13	0.01	0.01	0.01	0.02
n-Butane	53.12					0.08	0.08	29.70	1.75	0.07	0.11	0.13	0.26
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15												
n-Pentane	72.15					0.11	0.11	50.71	2.98	0.11	0.16	0.24	0.49
Nitrogen	28.02												
TOTAL		41.61	100.00	3060.67	100.00	99.34	100.00	1700.72	100.00	65.35	100.00	49.41	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	28.23	28.23	28.23	28.23
Produced	[moles]			3.50	-17.82
Total	[moles]	28.23	28.23	31.73	10.41
Stochiom.	[grams]	790.71	508.70	1242.39	57.02
Produced	[grams]			153.85	-36.00
Total	[grams]	790.71	508.70	1396.24	21.03

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	19.33	173.56	0.80	193.69
C4 +	[grams]		82.61	0.38	82.99
Total	[grams]	19.33	256.17	1.18	276.68

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	36.00	1471.17	1310.54	160.63	196.62

RUN No.: DOE-BU-015 **M.B.No.: YP-03/ C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				6800	1535	2170	2992	
Total Sample	[grams]			53.22	14.7	53.19	65.25	
Water	[grams]			3.1	5.9		2.7	
Oils+Asphaltenes	[grams]			27.29	8.85	44.32	59.76	
Oils	[wt%] calc	100.00%	87.90%	87.90%	96.12%	78.25%	86.33%	
Asphaltene	[wt%]		12.10%	12.10%	3.88%	21.75%	13.67%	
Pre-Asphaltenes	[grams]					0.8	0.43	
Insolubles	[grams]			22.97		8.92	2.8	
IOM	[wt%] calc			89.34%		45.14%	29.96%	
Ash	[wt%]			10.04%		54.28%	69.60%	
Moisture	[wt%]			0.62%		0.58%	0.44%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				4.95%	2.50%	0.54%	1.50%
182 - 343			1.80%	4.00%	54.69%	6.00%	41.22%	20.30%
343 - 524			83.90%	96.00%	40.36%	63.10%	58.24%	51.70%
524+			14.30%			28.40%		26.50%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-015 M.B.No.: YP-03/ C1

	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	53.22	14.70	53.19	65.25
Water	3.10	5.85		2.70
Oils+Asphaltenes	27.29	8.85	43.52	59.33
Oils	23.99	8.50	33.88	51.16
Asphaltenes	3.30	0.34	9.64	8.17
Pre-Asphaltenes			0.80	0.43
Insolubles	22.83		8.87	2.79
IOM	20.54		4.05	0.85
Ash	2.29		4.81	1.94
TOTAL	53.22	14.7	53.19	65.25
	in wt% of analysis sample			
Water	5.82%	39.83%		4.14%
Oils+Asphaltenes	51.28%	60.17%	81.82%	90.93%
Oils (on fraction)	87.90%	96.12%	77.85%	86.23%
(on total)	45.08%	57.84%	63.70%	78.41%
Asphalt. (on fract.)	12.10%	3.88%	22.15%	13.77%
(on total)	6.21%	2.33%	18.12%	12.52%
Pre-Asphaltenes			1.50%	0.66%
Insolubles	42.89%		16.67%	4.27%
IOM (on fraction)	89.96%		45.72%	30.40%
(on total)	38.59%		7.62%	1.30%
Ash (on fraction)	10.04%		54.28%	69.60%
(on total)	4.31%		9.05%	2.97%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	6800	1535	2170	2992
Water	396.1	611.5		123.8
Oils+Asphaltenes	3487.2	923.8	1775.6	2720.6
Oils (on fraction)	3065.2	888.0	1382.3	2346.0
(on total)	3065.2	888.0	1382.3	2346.0
Asphalt. (on fract.)	422.0	35.8	393.3	374.6
(on total)	422.0	35.8	393.3	374.6
Pre-Asphaltenes			32.6	19.7
Insolubles	2916.7		361.8	127.8
IOM (on fraction)	2623.9		165.4	38.9
(on total)	2623.9		165.4	38.9
Ash (on fraction)	292.8		196.4	89.0
(on total)	292.8		196.4	89.0
TOTAL (as is)	6800.0	1535.3	2170.0	2992.0
TOTAL (MAF)	6111.1	923.8	1973.6	2778.2

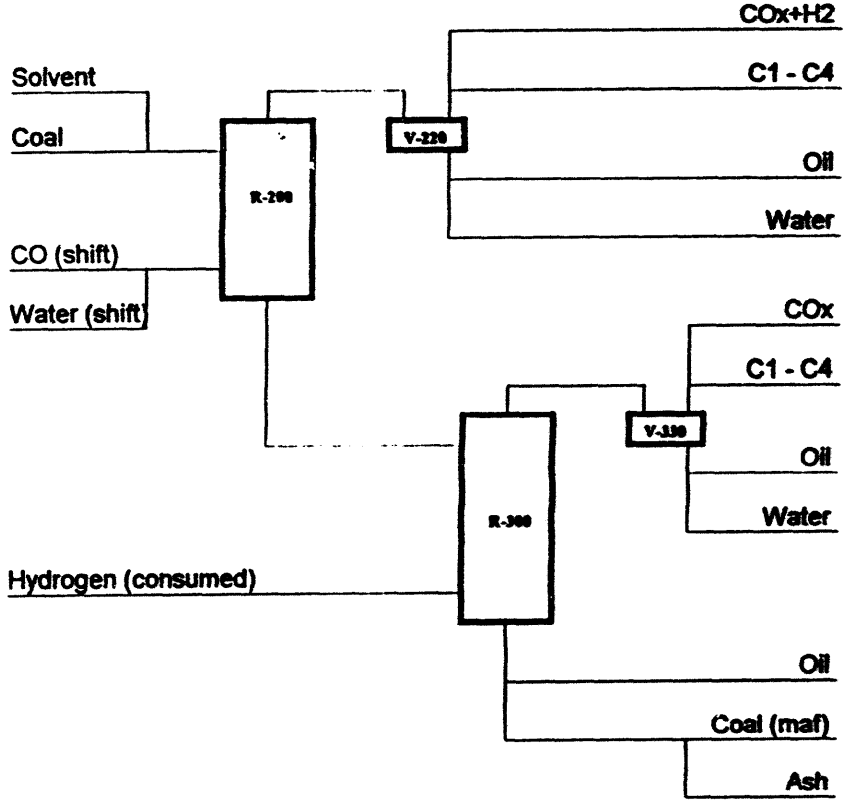
Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		45.73	45.21	14.80	105.73		91.29	91.29
182 - 343	139.49	505.23	108.49	1129.58	1743.30	62.77	1235.42	1235.42
343 - 524	3347.71	372.85	1140.97	1595.99	3109.81	2925.75	3146.36	3146.36
524+			678.94	38.86	717.80	498.67	1612.74	1203.58
TOTAL	3487.19	923.80	1973.62	2779.23	5676.64	3487.19	6085.80	5676.64

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
5.73%	5.73%		1.79%	7.53%				1.99%	1.99%
51.33%	13.37%	25.71%	39.39%	78.47%	57.08%	14.87%	28.58%	43.79%	87.23%
45.12%	12.86%	20.01%	33.97%	66.83%	50.16%	14.29%	22.25%	37.76%	74.30%
6.21%	0.52%	5.69%	5.42%	11.64%	6.90%	0.58%	6.33%	6.03%	12.94%
		0.47%	0.29%	0.76%			0.53%	0.32%	0.84%
42.93%		5.36%	1.91%	7.27%					
38.62%		2.39%	0.56%	2.96%	42.94%		2.66%	0.63%	3.29%
4.31%		2.97%	1.34%	4.31%					
100.00%	19.11%	31.54%	43.37%	94.02%					
					100.00%	14.87%	31.76%	48.72%	93.36%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-015 M.B. No.: YP-03/C1

FEED wt% (coal+solvent) as is	maf	
51.3%	57.1%	Solvent
48.7%	42.9%	Coal
100.0%	100.0%	
11.6%	12.9%	CO (shift)
7.5%	8.3%	Water (shift)
2.4%	2.6%	Hydrogen (consumed)
121.5%	123.9%	



PRODUCT wt% (coal+solvent)	as is	maf
COx+H2	20.8%	23.2%
C1 - C4	0.3%	0.3%
Oil	13.4%	14.9%
Water	5.7%	
COx	2.6%	2.9%
C1 - C4	3.7%	4.1%
Oil	39.7%	44.1%
Water	1.8%	2.0%
Oil	26.2%	29.1%
Coal (maf)	3.0%	3.3%
Ash	4.3%	
	121.5%	123.9%

Remarks:

RUN No.: DOE-BU-015			M.B.No.: YP-04/ C1	
	Date	Time	Date	Time
START:			Dec. 15, 93	21:00
END:			Dec. 16, 93	05:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTR	44.70%
Solvent	V-1074	55.30%
Catalyst 1	Aluminate	2.00%
Catalyst 2	Molybdate	0.25%
Other	CS2	

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		10550.00
End of Mass Ballance		3300.00
Rate	(G/HR)	910
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	298
Reactor Temp.:	(C)	
TE-201I	(BTTM)	409
TE-202I		406
TE-203I		409
TE-204I	(Top)	387
Liquid Level	(mm)	540
Separator Temperature:	(C)	47
CO-Feed Rate:	L/MIN)	4.03
Water Feed Rate:	(ML/MIN)	1.40
Temperature:	(C)	192
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1490.10
Nitrogen Rate:	L/MIN)	3.93
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	144
Reactor Temp.:	(C)	
TE-301I	(BTTM)	430
TE-302I		430
TE-303I		430
TE-304I		428
TE-305I		428
TE-306I		428
TE-307I		425
TE-308I	(Top)	422
TE-309I	(VAP)	422
Liquid level	(mm)	900
Seperator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.11
Temperature:	(C)	394
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1290
End of Mass Ballance		4700
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-770
End of Mass Ballance		1510
Sulfiding Agent	(mL/HR)	10.08

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydrogen	2.02	4.28	98.51	55.28
CO2	44.01	13.03	0.07	11.42
CO	28.01	23.61	0.39	21.03
H2S	34.06			
Methane	16.04	0.50	0.56	1.61
Ethylen	28.05		0.03	0.07
Ethane	30.07		0.21	1.10
Propane	44.01		0.12	1.19
Propylene	42.08			
I-Butane	58.12		0.01	0.00
n-Butane	58.12		0.07	0.66
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.10	1.16
Nitrogen	28.02			
TOTAL		41.61	100.07	93.557
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		4347.0	5962.0	7912.0
End of M.B. : (L)		9175.0	22620.0	7988.0
Total : (L)		4828.0	16658.0	76.0
Temperature: (C)		22.0	21.4	22.8
Meter Pressure : (mmH		707	707	707
Standard Volume: (L)		4157	14543	65
Nitrogen to R-200: (L)		1884		
Net Gas Out: (L)		2272	14543	65

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	409	429
Catalyst		Aluminate	Molybdate
Feed	wt % maf coal	44.70%	
WHSV	(kg / hr) / l	1.86	1.11
CO Rate	kg / kg maf coal	0.82	
	moles / 100g maf coal	2.93	
consumed	moles / 100g maf coal	0.96	
Water Rate	kg / kg maf coal	0.82	
	moles / 100g maf coal	4.56	
Hydrogen	kg / kg maf coal		0.50
	moles / 100g maf coal		24.94
consumed	wt % maf coal	1.23%	6.18%

RUN No.: DOE-BU-015 M.B.No.: YP-04/ C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	7280	First Stage Liquid:	1490
CO-Gas:	2420	First Stage Product Gas:	3083
Water:	670	Second Stage Liquid:	3410
Hydrogen:	1476	Second Stage Reactor Bottoms:	2280
Catalyst:		Second Stage Product Gas:	1567
S-Agent	61	Dissolved Gas:	45
TOTAL IN:	11925	TOTAL OUT:	11865
Catalyst m/	168	OVERALL BALANCE:	99.7%

WATER BALANCE

TOTAL IN:	1024	TOTAL OUT:	1182
		WATER BALANCE:	115.4%

Coal Conversion	wt.% maf	91.4%
Ash Balance	wt.%	96.8%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	157.25	156.10	2.37%	156.10	5.30%
COx	274.39	272.38	4.14%	272.38	9.25%
H2S					
C1 to C3	162.30	161.11	2.45%	161.11	5.47%
C4 +	79.23	78.65	1.19%	78.65	2.67%
Oil	4946.67	4910.55	74.56%	1709.43	58.07%
Asphaltene	920.90	914.18	13.88%	473.52	16.08%
Preasphalt.	56.99	56.57	0.86%	56.57	1.92%
IOM	256.29	254.41	3.86%	254.41	8.64%
Total	6854.01	6803.96	103.31%	3162.18	107.42%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		189.39	188.01	188.01	6.39%		172.57	171.31	171.31	5.82%
182 - 343	145.67	1757.28	1744.45	1598.78	54.31%	65.55	1320.07	1310.43	1244.87	42.29%
343 - 524	3496.10	3544.63	3518.75	22.64	0.77%	3055.45	3513.51	3487.85	432.40	14.69%
524+		768.77	763.15	763.15	25.92%	520.77	1253.93	1244.77	724.00	24.59%
TOTAL	3641.78	6260.07	6214.36	2572.59	87.39%	3641.78	6260.07	6214.36	2572.59	87.39%
IBP - 524	3641.78	5491.31	5451.21	1809.43	61.46%	3121.00	5006.14	4969.59	1848.59	62.79%

RUN No.: DOE-BU-015 M.B.No.: YP-04/ C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 4							Number of Samples: 3						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydogen	4.275						4.275	98.578	98.491	98.535	98.452			98.514	55.360	52.511	57.973				55.284
CO2	13.029						13.029	0.077	0.075	0.077	0.070			0.075	12.893	9.888	11.493				11.425
CO	23.812						23.812	0.372	0.393	0.398	0.387			0.388	19.552	23.419	20.112				21.028
H2S																					
Methane	0.495						0.495	0.558	0.556	0.564	0.560			0.560	1.770	1.526	1.542				1.613
Ethylen								0.028	0.024	0.026	0.026			0.026	0.082	0.065	0.067				0.071
Ethane								0.212	0.211	0.218	0.210			0.213	1.289	1.007	1.023				1.100
Propane								0.159	0.156	0.160	0.016			0.123	1.392	1.074	1.095				1.187
Propylene																					
i-Butane								0.006	0.005	0.006	0.005			0.006		0.003	0.003				0.002
n-Butane								0.069	0.067	0.069	0.068			0.068	0.830	0.620	0.623				0.691
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.102	0.101	0.102	0.101			0.102	1.344	1.035	1.091				1.157
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	100.159	100.080	100.155	99.895			100.072	94.501	91.148	95.022				93.557

RUN No.: DOE-BU-015 **M.B.No.: YP-04/ C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.51 (g/mole)				Average Mol Weight: 2.46 (g/mole)				Average Mol Weight: 15.40 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydogen	2.02	4.28	10.27	21.04	0.69	98.51	98.44	1290.46	80.81	55.28	59.09	3.48	7.75
CO2	44.01	13.03	31.31	1397.19	45.62	0.07	0.07	21.33	1.34	11.42	12.21	15.65	34.91
CO	28.01	23.81	57.23	1625.18	53.06	0.39	0.39	70.39	4.41	21.03	22.48	18.33	40.89
H2S	34.08												
Methane	16.04	0.50	1.19	19.35	0.63	0.56	0.56	58.20	3.64	1.61	1.72	0.81	1.80
Ethylen	28.05					0.03	0.03	4.73	0.30	0.07	0.08	0.06	0.14
Ethane	30.07					0.21	0.21	41.49	2.60	1.10	1.18	1.03	2.30
Propane	44.01					0.12	0.12	35.02	2.19	1.19	1.27	1.63	3.63
Propylene	42.08												
i-Butane	58.12					0.01	0.01	2.17	0.14	0.00	0.00	0.00	0.01
n-Butane	58.12					0.07	0.07	25.72	1.61	0.69	0.74	1.25	2.79
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.10	0.10	47.49	2.97	1.16	1.24	2.60	5.79
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.61	100.00	3062.76	100.00	100.07	100.00	1596.99	100.00	93.56	100.00	44.83	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	28.37	28.37	28.37	28.37
Produced	[moles]			3.38	-17.95
Total	[moles]	28.37	28.37	31.75	10.42
Stochiom.	[grams]	794.60	511.20	1248.50	57.30
Produced	[grams]			148.69	-36.26
Total	[grams]	794.60	511.20	1397.19	21.04

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	19.35	139.43	3.52	162.30
C4 +	[grams]		75.38	3.85	79.23
Total	[grams]	19.35	214.81	7.37	241.53

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	36.26	1475.98	1293.94	182.04	218.30

RUN No.: DOE-BU-015 **M.B.No.: YP-04/ C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				7280	1490	2280	3410	
Total Sample	[grams]			53.37	14.7	52.26	60.72	
Water	[grams]			2.6	5.1		2.8	
Oils+Asphaltenes	[grams]			26.70	9.64	42.86	54.81	
Oils	[wt%] calc	100.00%	87.90%	87.90%	96.12%	75.82%	86.00%	
Asphaltene	[wt%]		12.10%	12.10%	3.88%	24.18%	14.00%	
Pre-Asphaltenes	[grams]					0.92	0.3	
Insolubles	[grams]			24.26		9.47	3.13	
IOM	[wt%] calc			88.88%		48.00%	31.81%	
Ash	[wt%]			10.35%		51.31%	67.69%	
Moisture	[wt%]			0.78%		0.69%	0.51%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				4.95%	2.40%	0.55%	1.40%
182 - 343			1.80%	4.00%	54.69%	5.90%	36.15%	19.80%
343 - 524			83.90%	96.00%	40.36%	64.29%	63.30%	52.70%
524+			14.30%			27.41%		26.10%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-015 **M.B.No.: YP-04/ C1**

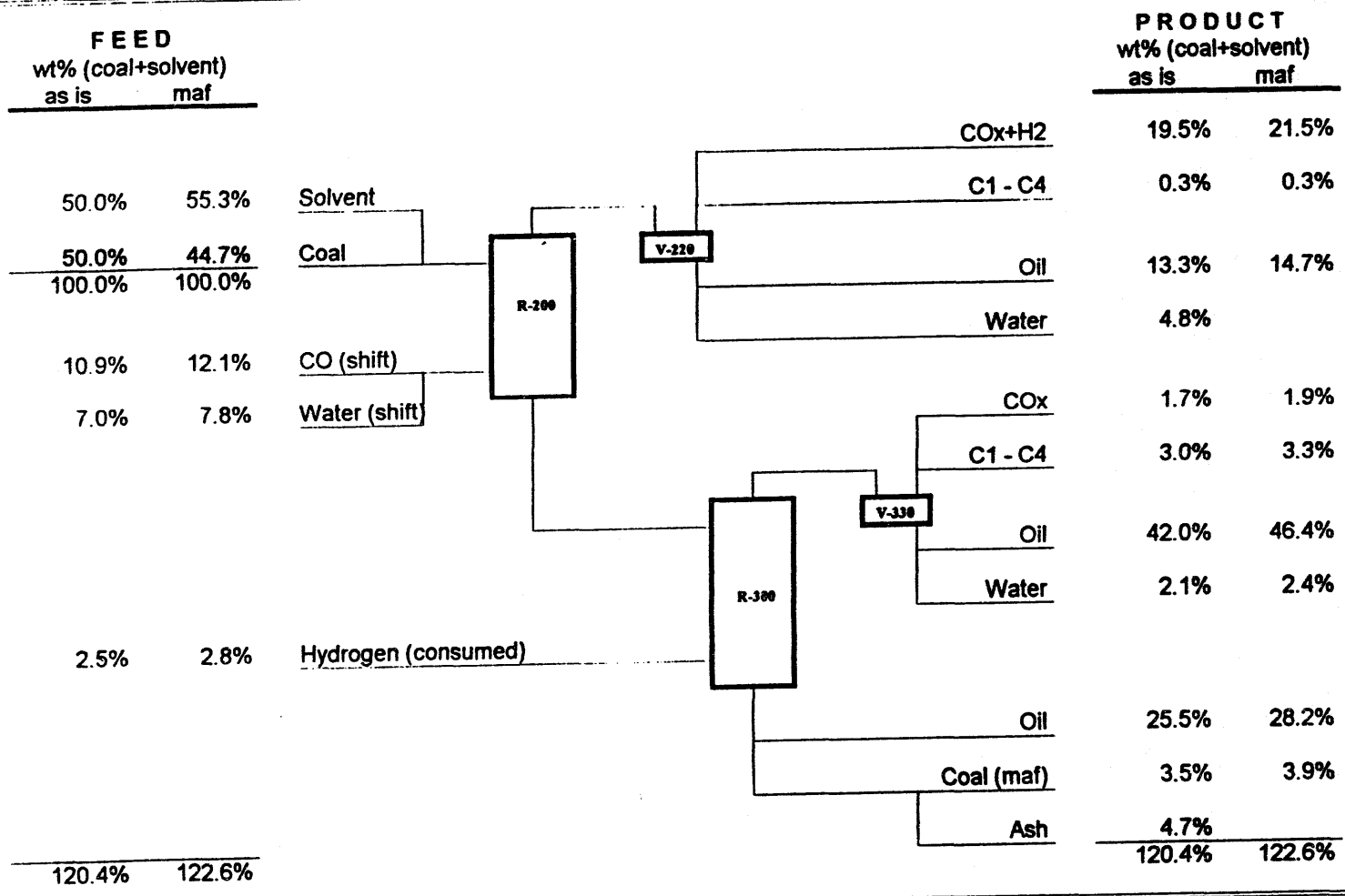
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	53.37	14.70	52.26	60.72
Water	2.60	5.06		2.80
Oils+Asphaltenes	26.70	9.64	41.94	54.51
Oils	23.47	9.26	31.57	46.83
Asphaltenes	3.23	0.37	10.36	7.67
Pre-Asphaltenes			0.92	0.30
Insolubles	24.07		9.40	3.11
IOM	21.58		4.58	1.01
Ash	2.49		4.83	2.11
TOTAL	53.37	14.7	52.26	60.72
	in wt% of analysis sample			
Water	4.87%	34.43%		4.61%
Oils+Asphaltenes	50.02%	65.57%	80.24%	89.77%
Oils (on fraction)	87.90%	96.12%	75.29%	85.92%
(on total)	43.97%	63.02%	60.42%	77.13%
Asphalt. (on fract.)	12.10%	3.88%	24.71%	14.08%
(on total)	6.05%	2.54%	19.83%	12.64%
Pre-Asphaltenes			1.76%	0.49%
Insolubles	45.10%		18.00%	5.13%
IOM (on fraction)	89.66%		48.69%	32.31%
(on total)	40.44%		8.76%	1.66%
Ash (on fraction)	10.35%		51.31%	67.69%
(on total)	4.67%		9.23%	3.47%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	7280	1490	2280	3410
Water	354.7	513.1		157.2
Oils+Asphaltenes	3641.8	977.0	1829.6	3061.0
Oils (on fraction)	3201.1	939.1	1377.5	2630.1
(on total)	3201.1	939.1	1377.5	2630.1
Asphalt. (on fract.)	440.7	37.9	452.1	430.9
(on total)	440.7	37.9	452.1	430.9
Pre-Asphaltenes			40.1	16.8
Insolubles	3283.6		410.3	174.9
IOM (on fraction)	2943.9		199.8	56.5
(on total)	2943.9		199.8	56.5
Ash (on fraction)	339.7		210.5	118.4
(on total)	339.7		210.5	118.4
TOTAL (as is)	7280.0	1490.1	2280.0	3410.0
TOTAL (MAF)	6585.7	977.0	2069.5	3134.4

Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		48.36	44.87	16.93	110.16		93.34	93.34
182 - 343	145.67	534.32	110.31	1112.65	1757.28	65.55	1320.07	1320.07
343 - 524	3496.10	394.32	1202.03	1948.29	3544.63	3055.45	3513.51	3513.51
524+			712.26	56.51	768.77	520.77	1740.09	1253.93
TOTAL	3641.78	977.00	2069.47	3134.37	6180.84	3641.78	6667.00	6180.84

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
4.84%	4.84%		2.14%	6.98%				2.37%	2.37%
50.04%	13.33%	24.96%	41.75%	80.04%	55.30%	14.73%	27.58%	46.14%	88.45%
43.99%	12.81%	18.79%	35.88%	67.48%	48.61%	14.16%	20.76%	39.65%	74.56%
6.06%	0.52%	6.17%	5.88%	12.56%	6.69%	0.57%	6.81%	6.50%	13.88%
		0.55%	0.23%	0.78%			0.61%	0.25%	0.86%
45.12%		5.71%	2.45%	8.16%					
40.45%		2.73%	0.77%	3.50%	44.70%		3.01%	0.85%	3.86%
4.67%		2.99%	1.68%	4.67%					
100.00%	18.16%	31.22%	48.58%	95.96%					
					100.00%	14.73%	31.19%	49.62%	95.54%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-015 M.B. No.: YP-04/C1



Remarks:

RUN No.: DOE-BU-015			M.B.No.: YP-05/C1	
	Date	Time	Date	Time
START:			Dec. 16, 93	12:00
END:			Dec. 16, 93	20:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	41.88%
Solvent	V-1074	58.12%
Catalyst 1	Aluminate	2.00%
Catalyst 2	Molybdate	0.28%
Other	CS2	

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		13180.00
End of Mass Ballance		6020.00
Rate	(G/HR)	895
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	283
Reactor Temp.:	(C)	
TE-201I	(BTTM)	409
TE-202I		411
TE-203I		411
TE-204I	(Top)	389
Liquid Level	(mm)	540
Separator Temperature:	(C)	46
CO-Feed Rate:	L/MIN)	4.03
Water Feed Rate:	(ML/MIN)	1.62
Temperature:	(C)	188
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1553.20
Nitrogen Rate:	L/MIN)	3.93
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	137
Reactor Temp.:	(C)	
TE-301I	(BTTM)	440
TE-302I		440
TE-303I		440
TE-304I		439
TE-305I		438
TE-306I		437
TE-307I		434
TE-308I	(Top)	431
TE-309I	(VAP)	430
Liquid level	(mm)	900
Separator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.11
Temperature:	(C)	402
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1200
End of Mass Ballance		5310
Bottoms Product (WT-34	(G)	
Start of Mass Ballance		-880
End of Mass Ballance		870
Sulfiding Agent	(mL/HR)	10.49

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydogen	2.02	4.28	98.45	47.23
CO2	44.01	13.03	0.09	11.53
CO	28.01	23.81	0.46	26.57
H2S	34.08			
Methane	16.04	0.05	0.72	1.26
Ethylen	28.05		0.04	0.05
Ethane	30.07		0.29	0.82
Propane	44.01		0.22	0.89
Propylene	42.08			
i-Butane	58.12		0.01	0.00
n-Butane	58.12		0.09	0.55
i-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
i-Pentane	72.15			
n-Pentane	72.15		0.13	1.45
Nitrogen	28.02			
TOTAL		41.17	100.49	90.3605
Gas Meter Readings		DTM-260	DTM-360	DTM-350
Start of M.B. : (L)		2290.0	7356.0	8038.0
End of M.B. : (L)		7132.0	24481.8	8100.0
Total : (L)		4842.0	17125.8	62.0
Temperature: (C)		21.8	21.4	22.8
Meter Pressure : (mmH		704	704	704
Standard Volume: (L)		4154	14711	53
Nitrogen to R-200: (L)		1884		
Net Gas Out: (L)		2269	14711	53

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	411	440
Catalyst		Aluminate	Molybdate
Feed	wt % maf coal	41.88%	
WHSV	(kg / hr) / l	1.83	1.10
CO Rate	kg / kg maf coal	0.89	
	moles / 100g maf coal	3.17	
consumed	moles / 100g maf coal	1.02	
Water Rate	kg / kg maf coal	0.89	
	moles / 100g maf coal	4.93	
Hydrogen	kg / kg maf coal		0.54
	moles / 100g maf coal		26.94
consumed	wt % maf coal	1.28%	6.39%

RUN No.: DOE-BU-015 M.B.No.: YP-05/C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	7160	First Stage Liquid:	1553
CO-Gas:	2420	First Stage Product Gas:	3074
Water:	779	Second Stage Liquid:	4110
Hydrogen:	1476	Second Stage Reactor Bottoms:	1750
Catalyst:		Second Stage Product Gas:	1709
S-Agent	84	Dissolved Gas:	41
TOTAL IN:	11918	TOTAL OUT:	12238
Catalyst mf	163	OVERALL BALANCE:	102.7%

WATER BALANCE

TOTAL IN:	1134	TOTAL OUT:	1239
		WATER BALANCE:	109.2%

Coal Conversion	wt.% maf	92.6%
Ash Balance	wt.%	92.4%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	104.90	98.64	1.52%	98.64	3.62%
COx	329.56	309.91	4.76%	309.91	11.37%
H2S					
C1 to C3	206.77	194.44	2.99%	194.44	7.13%
C4 +	100.46	94.47	1.45%	94.47	3.47%
Oil	5250.68	4937.61	75.86%	1612.45	59.15%
Asphaltene	871.89	819.90	12.60%	362.18	13.29%
Preasphalt.	61.03	57.39	0.88%	57.39	2.11%
IOM	218.65	205.61	3.16%	205.61	7.54%
Total	7143.93	6717.98	103.21%	2935.09	107.67%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		188.91	177.65	177.65	6.52%		188.60	177.35	177.35	6.51%
182 - 343	151.32	2136.34	2008.97	1857.65	68.15%	68.09	1572.95	1479.17	1411.08	51.77%
343 - 524	3631.57	3534.11	3323.39	-308.18	-11.31%	3173.84	3491.69	3283.50	109.65	4.02%
524+		643.33	604.98	604.98	22.19%	540.95	1249.47	1174.97	634.02	23.26%
TOTAL	3782.89	6502.70	6114.98	2332.10	85.55%	3782.89	6502.70	6114.98	2332.10	85.55%
IBP - 524	3782.89	5859.37	5510.01	1727.12	63.36%	3241.93	5253.23	4940.01	1698.08	62.29%

RUN No.: DOE-BU-015 M.B.No.: YP-05/C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 6							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydogen	4.275						4.275	98.938	98.773	98.317	98.246	98.224	98.180	98.446	50.202	44.257					47.230
CO2	13.029						13.029	0.096	0.089	0.084	0.083	0.102	0.084	0.090	11.882	11.379					11.531
CO	23.812						23.812	0.480	0.456	0.422	0.416	0.513	0.485	0.462	26.816	26.518					26.567
H2S																					
							0.050	0.737	0.736	0.728	0.713	0.708	0.713	0.723	1.338	1.184					1.261
Methane	0.050							0.032	0.031	0.029	0.031	0.070	0.030	0.037	0.052	0.046					0.049
Ethylen								0.291	0.290	0.286	0.281	0.294	0.280	0.287	0.882	0.787					0.925
Ethane								0.220	0.225	0.224	0.220	0.219	0.221	0.222	0.964	0.816					0.890
Propane																					
Propylene								0.005	0.005	0.005	0.005	0.007	0.005	0.005	0.004	0.003					0.004
i-Butane								0.094	0.095	0.095	0.093	0.094	0.093	0.094	0.594	0.509					0.552
n-Butane																					
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.126	0.127	0.127	0.125	0.124	0.124	0.126	1.555	1.353					1.454
n-Pentane																					
Nitrogen							41.166	101.017	100.827	100.317	100.213	100.355	100.215	100.491	93.889	88.832					90.361
TOTAL	41.166																				

RUN No.: DOE-BU-015 **M.B.No.: YP-05/C1**

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.59 (g/mole)				Average Mol Weight: 2.60 (g/mole)				Average Mol Weight: 17.37 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
Hydrogen	2.02	4.28	10.38	21.24	0.69	98.45	97.97	1299.07	76.02	47.23	52.27	2.50	6.08
CO2	44.01	13.03	31.65	1410.56	45.88	0.09	0.09	25.78	1.51	11.53	12.76	13.28	32.33
CO	28.01	23.81	57.84	1640.73	53.37	0.46	0.46	84.54	4.95	26.57	29.40	19.48	47.41
H2S	34.08												
Methane	16.04	0.05	0.12	1.95	0.06	0.72	0.72	75.71	4.43	1.26	1.40	0.53	1.29
Ethylen	28.05					0.04	0.04	6.81	0.40	0.05	0.05	0.04	0.09
Ethane	30.07					0.29	0.29	56.38	3.30	0.82	0.91	0.65	1.58
Propane	44.01					0.22	0.22	63.68	3.73	0.89	0.98	1.03	2.50
Propylene	42.08												
i-Butane	58.12					0.01	0.01	2.02	0.12	0.00	0.00	0.01	0.01
n-Butane	58.12					0.09	0.09	35.69	2.09	0.55	0.61	0.84	2.04
i-Butene	56.11												
n-Butene	56.11												
C2-Butene	56.11												
i-Pentane	72.15					0.13	0.12	59.15	3.46	1.45	1.61	2.75	6.68
n-Pentane	72.15												
Nitrogen	28.02												
TOTAL		41.17	100.00	3074.48	100.00	100.49	100.00	1708.83	100.00	90.36	100.00	41.09	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
Stochiom.	[moles]	27.81	27.81	27.81	27.81
Produced	[moles]			4.24	-17.30
Total	[moles]	27.81	27.81	32.05	10.52
Stochiom.	[grams]	779.05	501.20	1224.07	56.18
Produced	[grams]			186.49	-34.94
Total	[grams]	779.05	501.20	1410.56	21.24

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	1.95	202.57	2.24	206.77
C4 +	[grams]		96.87	3.59	100.46
Total	[grams]	1.95	299.44	5.83	307.22

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	34.94	1475.80	1301.57	174.23	209.17

RUN No.: DOE-BU-015 **M.B.No.: YP-05/C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				7160	1553	1750	4110	
Total Sample	[grams]			50.3	14.7	52.27	62.69	
Water	[grams]			2.5	6.0		1.6	
Oils+Asphaltenes	[grams]			26.58	8.71	43.00	58.33	
Oils	[wt%] calc	100.00%	87.90%	87.90%	96.12%	74.80%	87.62%	
Asphaltene	[wt%]		12.10%	12.10%	3.88%	25.20%	12.38%	
Pre-Asphaltenes	[grams]					1.02	0.41	
Insolubles	[grams]			21.37		9.39	2.78	
IOM	[wt%] calc			89.55%		47.82%	35.96%	
Ash	[wt%]			9.78%		50.91%	63.40%	
Moisture	[wt%]			0.68%		1.27%	0.64%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				4.95%	1.60%	0.52%	1.30%
182 - 343			1.80%	4.00%	54.69%	6.40%	40.30%	23.20%
343 - 524			83.90%	96.00%	40.36%	62.50%	59.18%	51.50%
524+			14.30%			29.50%		24.00%
Elemental Analysis:	[wt.%]			IBP - 182	182 - 343	343 - 524	524+	
Carbon		75.70%	87.80%	83.90%	84.80%	86.90%	84.40%	
Hydrogen		5.60%	8.50%	13.30%	9.90%	9.70%	7.30%	
Nitrogen		1.03%	0.85%	0.23%	0.61%	0.76%	1.05%	
Sulphur		0.43%	0.05%	0.78%	0.23%	0.11%	0.13%	
Oxygen (diff)		17.24%	2.80%	1.79%	4.46%	2.53%	7.12%	

RUN No.: DOE-BU-015 M.B.No.: YP-05/C1

	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	50.30	14.70	52.27	62.69
Water	2.50	5.99		1.60
Oils+Asphaltenes	26.58	8.71	41.98	57.92
Oils	23.36	8.37	31.14	50.70
Asphaltenes	3.22	0.34	10.84	7.22
Pre-Asphaltenes			1.02	0.41
Insolubles	21.22		9.27	2.76
IOM	19.15		4.55	1.01
Ash	2.07		4.72	1.75
TOTAL	50.3	14.7	52.27	62.69
	in wt% of analysis sample			
Water	4.97%	40.77%		2.55%
Oils+Asphaltenes	52.83%	59.23%	80.31%	92.39%
Oils (on fraction)	87.90%	96.12%	74.19%	87.53%
(on total)	46.44%	56.93%	59.58%	80.87%
Asphalt. (on fract.)	12.10%	3.88%	25.81%	12.47%
(on total)	6.39%	2.30%	20.73%	11.52%
Pre-Asphaltenes			1.95%	0.65%
Insolubles	42.20%		17.74%	4.41%
IOM (on fraction)	90.23%		49.09%	36.60%
(on total)	38.07%		8.71%	1.61%
Ash (on fraction)	9.78%		50.91%	63.40%
(on total)	4.12%		9.03%	2.79%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	7160	1553	1750	4110
Water	355.9	633.2		104.9
Oils+Asphaltenes	3782.9	920.0	1405.5	3797.1
Oils (on fraction)	3325.2	884.3	1042.7	3323.7
(on total)	3325.2	884.3	1042.7	3323.7
Asphalt. (on fract.)	457.7	35.7	362.8	473.4
(on total)	457.7	35.7	362.8	473.4
Pre-Asphaltenes			34.1	26.9
Insolubles	3021.2		310.4	181.1
IOM (on fraction)	2725.9		152.4	66.3
(on total)	2725.9		152.4	66.3
Ash (on fraction)	295.3		158.0	114.8
(on total)	295.3		158.0	114.8
TOTAL (as is)	7160.0	1553.2	1750.0	4110.0
TOTAL (MAF)	6508.8	920.0	1592.0	3890.3

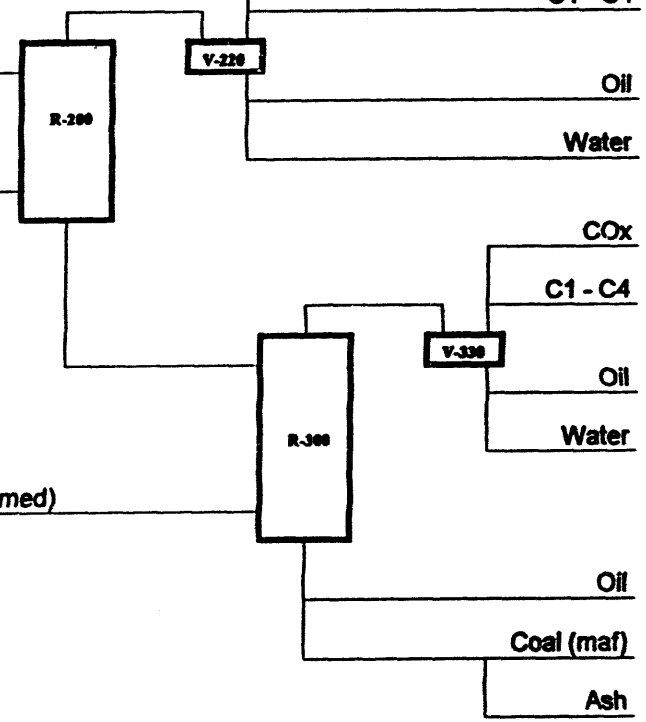
Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		45.54	23.03	19.88	88.46		88.14	88.14
182 - 343	151.32	503.13	92.14	1541.08	2136.34	68.09	1572.95	1572.95
343 - 524	3631.57	371.30	899.76	2263.05	3534.11	3173.84	3491.69	3491.69
524+			577.05	66.28	643.33	540.95	1627.19	1249.47
TOTAL	3782.89	919.97	1591.98	3890.29	6402.24	3782.89	6779.97	6402.24

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
4.69%	4.69%		1.38%	6.07%				1.52%	1.52%
52.99%	12.12%	18.51%	50.02%	80.65%	58.12%	13.29%	20.31%	54.86%	88.46%
46.58%	11.65%	13.74%	43.78%	69.17%	51.09%	12.78%	15.06%	48.02%	75.86%
6.41%	0.47%	4.78%	6.24%	11.49%	7.03%	0.52%	5.24%	6.84%	12.60%
		0.45%	0.35%	0.80%			0.49%	0.39%	0.88%
42.32%		4.40%	2.61%	7.02%					
38.18%		2.01%	0.87%	2.88%	41.88%		2.20%	0.96%	3.16%
4.14%		2.40%	1.74%	4.14%					
100.00%	16.81%	23.37%	54.37%	94.54%					
					100.00%	13.29%	23.00%	57.72%	94.01%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-015 M.B. No.: YP-05-C1

FEED wt% (coal+solvent) as is	maf		PRODUCT wt% (coal+solvent) as is	maf
53.0%	58.1%	Solvent		
47.0%	41.9%	Coal		
100.0%	100.0%			
10.9%	12.0%	CO (shift)		
7.0%	7.7%	Water (shift)		
2.4%	2.7%	Hydrogen (consumed)		
120.4%	122.3%			
		COx+H2	19.9%	21.8%
		C1 - C4	0.0%	0.0%
		Oil	12.1%	13.3%
		Water	4.7%	
		COx	1.9%	2.1%
		C1 - C4	4.0%	4.4%
		Oil	50.4%	55.2%
		Water	1.4%	1.5%
		Oil	19.0%	20.8%
		Coal (maf)	2.9%	3.2%
		Ash	4.1%	
			120.4%	122.3%



Remarks:

RUN No.: DOE-BU-015			M.B.No.: YP-06/C1	
	Date	Time	Date	Time
START:			Dec. 16, 93	23:00
END:			Dec. 17, 93	07:00
DURATION (hours):				8.00

26-Apr-94

Feed:	Type	Wt% (maf)
Coal	BTH	41.62%
Solvent	V-1074	56.38%
Catalyst 1	Aluminate	2.00%
Catalyst 2	Molybdate	0.26%
Other	CS2	

OPERATING PARAMETERS:		
FEED TANK WI-110):	(G)	
Start of Mass Ballance		12720.00
End of Mass Ballance		5490.00
Rate	(G/HR)	904
FIRST STAGE:		
Operating Pressure:	(MPa)	10.34
Feed Temp.:	(C)	283
Reactor Temp.:	(C)	
TE-201I	(BTTM)	409
TE-202I		411
TE-203I		411
TE-204I	(Top)	387
Liquid Level	(mm)	540
Seperator Temperature:	(C)	46
CO-Feed Rate:	L/MIN)	4.03
Water Feed Rate:	(ML/MIN)	1.75
Temperature:	(C)	188
Catalyst Feed:	(ML/MIN)	
Liquid Product (WI-220):	(G)	
Start of Mass Ballance		
End of Mass Ballance		1524.30
Nitrogen Rate:	L/MIN)	3.92
SECOND STAGE:		
Operating Pressure:	(MPa)	17.24
Feed Temp.:	(C)	137
Reactor Temp.:	(C)	
TE-301I	(BTTM)	435
TE-302I		436
TE-303I		436
TE-304I		435
TE-305I		434
TE-306I		434
TE-307I		4300
TE-308I	(Top)	428
TE-309I	(VAP)	427
Liquid level	(mm)	900
Seperator Temperature:	(C)	45
Hydrogen Feed Rate:	(L/MIN)	34.09
Temperature:	(C)	402
Liquid Product (WI-330):	(G)	
Start of Mass Ballance		1300
End of Mass Ballance		5720
Bottome Product (WT-340):	(G)	
Start of Mass Ballance		-1210
End of Mass Ballance		210
Sulfiding Agent	(mL/HR)	10.42

MEASURED GAS COMPOSITIONS				
NAME	MW	Measured Volume %		
		Product Gas 11	Product Gas 21	Dissolved Gas 22
Hydrogen	2.02	4.28	96.47	74.34
CO2	44.01	13.03	0.10	13.69
CO	28.01	23.81	0.49	8.86
H2S	34.08			
Methane	16.04	0.50	0.60	2.06
Ethylen	28.05		0.03	0.12
Ethane	30.07		0.23	1.70
Propane	44.01		0.18	2.04
Propylene	42.08			
I-Butane	58.12		0.00	0.08
n-Butane	58.12		0.08	1.21
I-Butene	56.11			
n-Butene	56.11			
C2-Butene	56.11			
I-Pentane	72.15			
n-Pentane	72.15		0.11	2.50
Nitrogen	28.02			
TOTAL		41.61	97.28	106.6

Gas Meter Readings	DTM-260	DTM-360	DTM-350
Start of M.B. : (L)	7868.0	9373.0	8337.0
End of M.B. : (L)	12749.0	26395.6	8404.0
Total : (L)	4881.0	17022.6	67.0
Temperature: (C)	22.2	21.4	22.8
Meter Pressure : (mmH	706	706	706
Standard Volume: (L)	4173	14654	57
Nitrogen to R-200: (L)	1882		
Net Gas Out: (L)	2291	14654	57

Run Conditions			
Basis: MAF		First Stage	Second Stage
Pressure	Mpa	10.3	17.2
Temperatur	deg C	411	436
Catalyst		Aluminate	Molybdate
Feed	wt % maf coal	41.62%	
WHSV	(kg / hr) / l	1.85	1.11
CO Rate	kg / kg maf coal	0.87	
	moles / 100g maf coal	3.12	
consumed	moles / 100g maf coal	1.01	
Water Rate	kg / kg maf coal	0.87	
	moles / 100g maf coal	4.85	
Hydrogen	kg / kg maf coal		0.53
	moles / 100g maf coal		26.52
consumed	wt % maf coal	1.27%	6.33%

RUN No.: DOE-BU-015 M.B.No.: YP-06/C1

OVERALL MASS BALANCE

Material In:	Grammes	Material Out:	Grammes
Feed Slurry	7230	First Stage Liquid:	1524
CO-Gas:	2419	First Stage Product Gas:	3086
Water:	841	Second Stage Liquid:	4420
Hydrogen:	1475	Second Stage Reactor Bottoms:	1420
Catalyst:		Second Stage Product Gas:	1672
S-Agent	83	Dissolved Gas:	34
TOTAL IN:	12048	TOTAL OUT:	12158
Catalyst m/	165	OVERALL BALANCE:	100.9%

WATER BALANCE

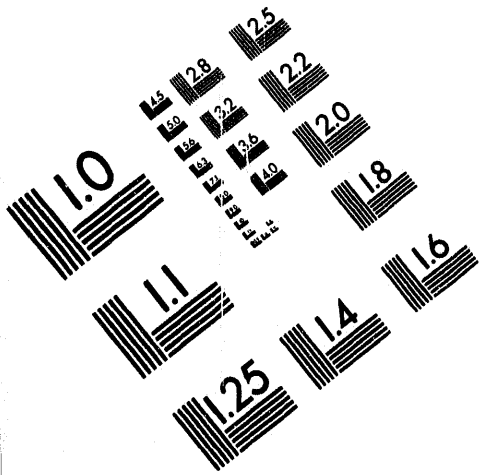
TOTAL IN:	1106	TOTAL OUT:	1246
		WATER BALANCE:	112.6%

Coal Conversion	wt.% maf	93.2%
Ash Balance	wt.%	87.7%

PRODUCT YIELDS

Description	Total Gross [grams] measured	Total Gross [grams] normalized	Total Gross wt. % maf feed	Total Net [grams] normalized	Total Net wt. % maf coal
H2O	139.52	134.95	2.03%	134.95	4.88%
COx	326.15	315.47	4.74%	315.47	11.40%
H2S					
C1 to C3	192.41	186.11	2.80%	186.11	6.72%
C4 +	90.30	87.34	1.31%	87.34	3.16%
Oil	5184.39	5014.57	75.42%	1602.73	57.91%
Asphaltene	898.99	869.54	13.08%	399.88	14.45%
Presasphalt.	64.43	62.32	0.94%	62.32	2.25%
IOM	195.65	189.24	2.85%	189.24	6.84%
Total	7091.84	6859.54	103.16%	2978.04	107.60%

Simulated Distillation Profile THF-Extract						Crude Sim. Dist. (Comp. Sample)				
Fraction	Feed	Product				Feed	Product			
		Total Gross		Total Net			Total Gross		Total Net	
			normalized					normalized		
[deg C]	[grams]	[grams]	[grams]	[grams]	wt. % maf coal	[grams]	[grams]	[grams]	[grams]	wt. % maf coal
C4 - 182		175.85	170.09	170.09	6.15%		198.46	191.96	191.96	6.94%
182 - 343	155.26	1987.51	1922.41	1767.15	63.85%	69.87	1412.83	1366.55	1296.69	46.85%
343 - 524	3726.23	3714.21	3592.55	-133.69	-4.83%	3256.57	3420.54	3308.50	51.93	1.88%
524+		546.18	537.96	537.96	19.44%	555.05	1401.92	1356.00	800.95	28.94%
TOTAL	3881.49	6433.76	6223.01	2341.52	84.60%	3881.49	6433.76	6223.01	2341.52	84.60%
IBP - 524	3881.49	5877.58	5685.05	1803.56	65.16%	3326.44	5031.84	4867.01	1540.57	55.66%



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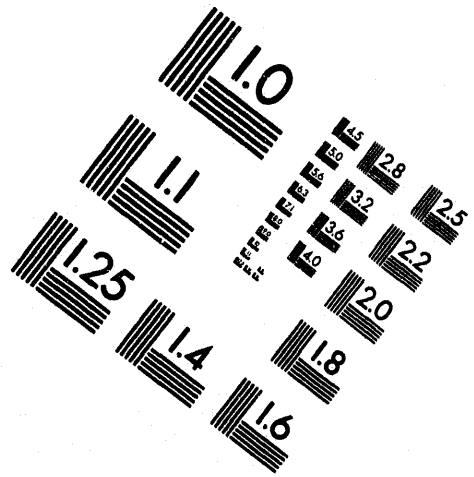

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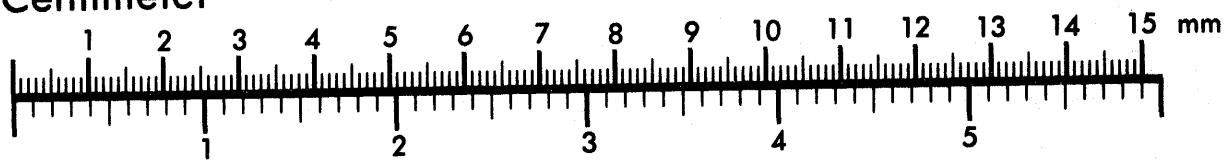

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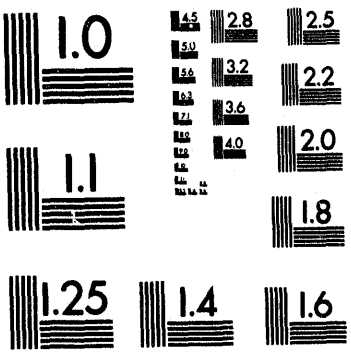

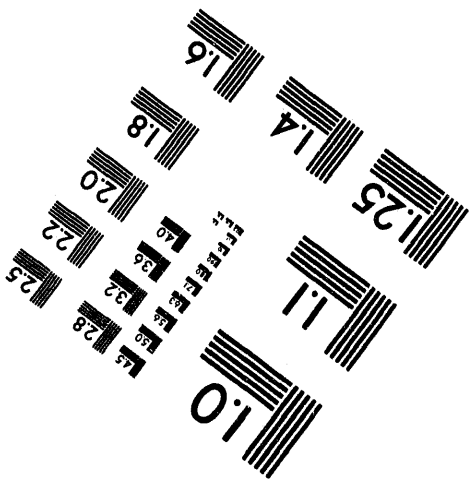

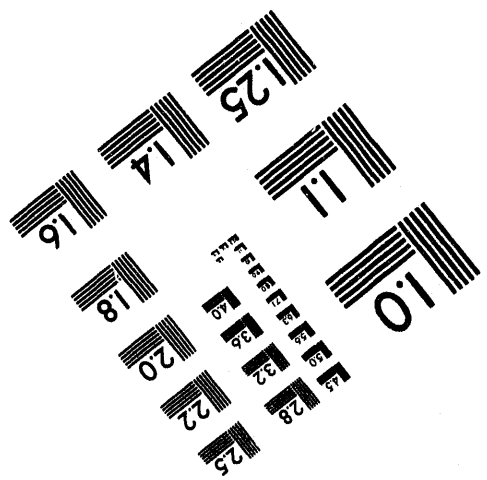

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RUN No.: DOE-BU-015 M.B.No.: YP-08/C1

GAS ANALYSIS

Name	First Stage Product Gas (DTM-260)							Second Stage Product Gas (DTM-360)							Dissolved Gas (DTM-350)						
	Number of Samples: 1							Number of Samples: 4							Number of Samples: 2						
	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	vol.%	Av.vol.%
Hydrogen	4.275						4.275	98.559	95.590	94.027	95.708			98.469	78.044	72.641					74.343
CO2	13.029						13.029	0.257	0.084	0.047	0.048			0.102	14.074	13.305					13.690
CO	23.812						23.812	0.847	0.360	0.353	0.405			0.491	10.258	7.464					8.861
H2S																					
Methane	0.495						0.495	0.623	0.605	0.586	0.585			0.600	2.072	2.040					2.056
Ethylen								0.027	0.028	0.028	0.028			0.028	0.122	0.119					0.121
Ethane								0.242	0.234	0.224	0.227			0.232	1.722	1.672					1.697
Propane								0.177	0.178	0.172	0.175			0.176	2.045	2.032					2.039
Propylene																					
i-Butane								0.003	0.004	0.003	0.003			0.003	0.002	0.166					0.084
n-Butane								0.077	0.076	0.073	0.074			0.075	1.229	1.185					1.207
i-Butene																					
n-Butene																					
C2-Butene																					
i-Pentane								0.118	0.110	0.107	0.107			0.111	2.509	2.499					2.504
n-Pentane																					
Nitrogen																					
TOTAL	41.611						41.611	98.930	97.229	95.620	97.360			97.288	110.077	105.123					108.600

RUN No.: DOE-BU-015 M.B.No.: YP-06/C1

GAS CALCULATIONS

Name	Mol.Weight	First Stage Product Gas (DTM-260)				Second Stage Product Gas (DTM-360)				Dissolved Gas (DTM-350)			
		Average Mol Weight: 16.58 (g/mole)				Average Mol Weight: 2.58 (g/mole)				Average Mol Weight: 13.45 (g/mole)			
		Volume		Weight (norm.)		Volume		Weight (norm.)		Volume		Weight (norm.)	
		meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%	meas. %	norm. %	(G)	%
ydogen	2.02	4.28	10.27	21.22	0.69	95.47	98.13	1296.21	77.55	74.34	69.74	3.61	10.47
O2	44.01	13.03	31.31	1408.70	45.62	0.10	0.10	30.02	1.80	13.69	12.84	14.48	42.02
O	28.01	23.81	57.23	1638.57	53.06	0.49	0.50	92.49	5.53	8.86	8.31	5.96	17.31
i2S	34.08												
Methane	16.04	0.50	1.19	19.51	0.63	0.60	0.62	64.66	3.87	2.06	1.93	0.79	2.30
thylen	28.05					0.03	0.03	5.23	0.31	0.12	0.11	0.08	0.24
thane	30.07					0.23	0.24	46.84	2.80	1.70	1.59	1.23	3.56
ropane	44.01					0.18	0.18	51.92	3.11	2.04	1.91	2.16	6.26
Propylene	42.08												
-Butane	58.12					0.00	0.00	1.27	0.08	0.08	0.08	0.12	0.34
-Butane	58.12					0.08	0.08	29.30	1.75	1.21	1.13	1.69	4.89
-Butene	56.11												
-Butene	56.11												
2-Butene	56.11												
-Pentane	72.15												
-Pentane	72.15					0.11	0.11	53.59	3.21	2.50	2.35	4.34	12.60
itrogen	28.02												
TOTAL		41.61	100.00	3087.99	100.00	97.28	100.00	1671.53	100.00	106.60	100.00	34.45	100.00

First Stage Shift Reaction

		CO	+ H2O	= CO2	+ H2
tochiom.	[moles]	27.85	27.85	27.85	27.85
roduced	[moles]			4.16	-17.34
otal	[moles]	27.85	27.85	32.01	10.50
tochiom.	[grams]	779.97	501.78	1225.50	56.25
roduced	[grams]			183.20	-35.03
otal	[grams]	779.97	501.78	1408.70	21.22

Hydocarbon Gases

		First	Second	Dissolved	Total
C1 to C3	[grams]	19.51	168.65	4.26	192.41
C4 +	[grams]		84.16	6.14	90.30
Total	[grams]	19.51	252.80	10.40	282.71

Hydrogen

		First Up-Take	Second In	Second Out	Second Up-Take	Total Up-Take
Hydrogen	[grams]	35.03	1475.10	1299.82	175.28	210.31

RUN No.: DOE-BU-015 **M.B.No.: YP-06/C1**

Liquid / Slurry Stream Analysis

		Coal	Solvent	Feed	V-220	V-340 (BTTMS)	V-330	Comp. Sample
Type		BTH	V-1074					
Total Feed / Product				7230	1524	1420	4420	
Total Sample	[grams]			54.56	14.7	49.02	63.36	
Water	[grams]			2.00	5.83		2.00	
Oils+Asphaltenes	[grams]			29.29	8.87	40.41	58.16	
Oils	[wt%] calc	100.00%	87.90%	87.90%	96.12%	74.22%	86.16%	
Asphaltene	[wt%]		12.10%	12.10%	3.88%	25.78%	13.84%	
Pre-Asphaltenes	[grams]					1.02	0.5	
Insolubles	[grams]			23.4		8.69	3.22	
IOM	[wt%] calc			89.20%		46.88%	33.62%	
Ash	[wt%]			10.24%		52.22%	65.74%	
Moisture	[wt%]			0.56%		0.91%	0.64%	
Distill. THF-Extract	[wt.%]		D-1160	Simulated Distillation				Cr.S.D.
IBP - 182	deg C				4.95%	1.20%	0.64%	1.60%
182 - 343			1.80%	4.00%	54.69%	5.60%	34.97%	20.90%
343 - 524			83.90%	96.00%	40.36%	62.40%	64.39%	50.60%
524+			14.30%			30.80%		26.90%
Elemental Analysis:	[wt.%]							
Carbon			87.80%					
Hydrogen			8.50%					
Nitrogen			0.85%					
Sulphur			0.05%					
Oxygen (diff)			2.80%					

RUN No.: DOE-BU-015 M.B.No.: YP-08/C1

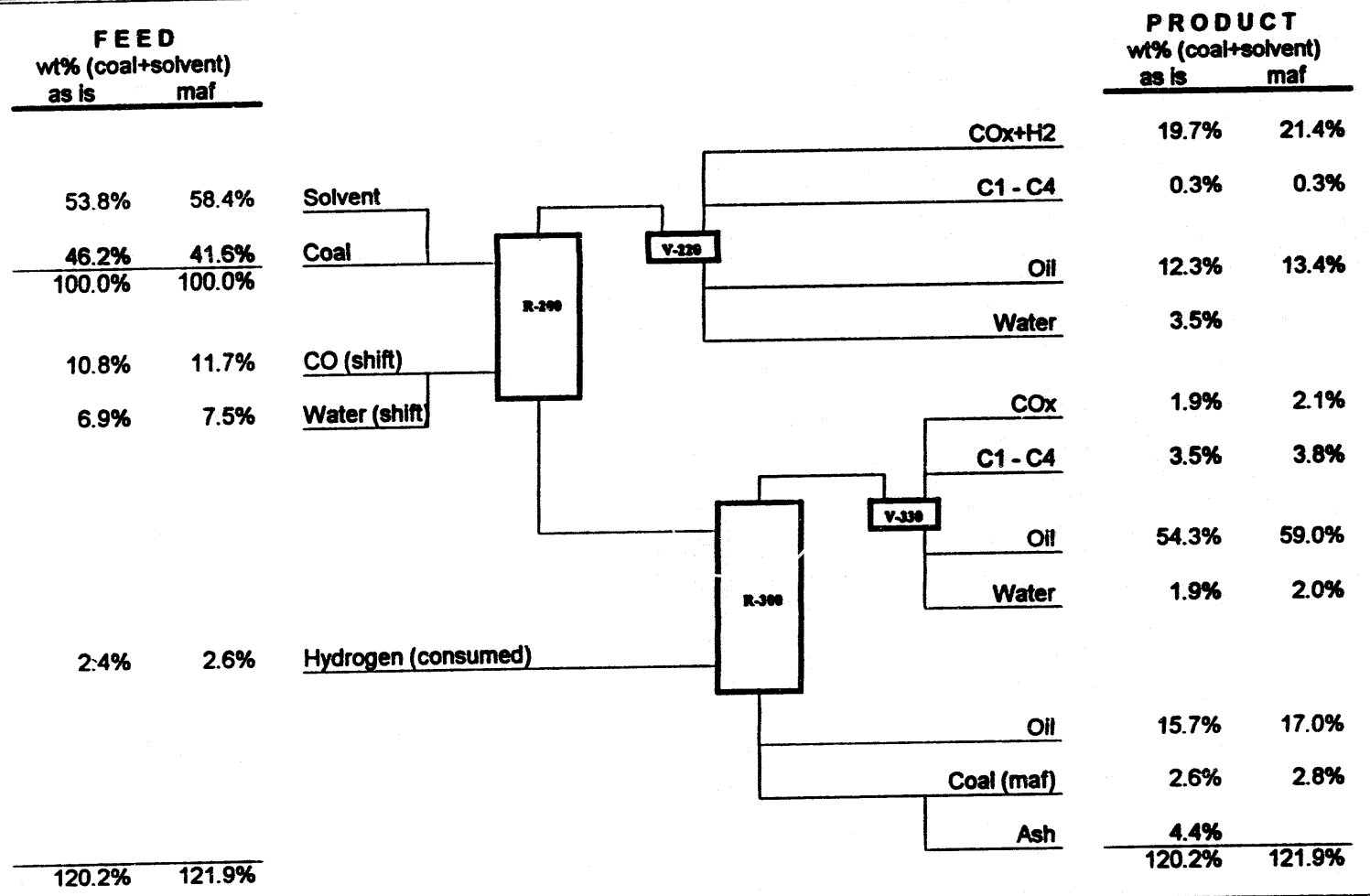
	Feed	Products V-220	V-340 (BTTMS)	V-330
	in grams of analysis sample			
Total Sample	54.56	14.70	49.02	63.36
Water	2.00	5.83		2.00
Oils+Asphaltenes	29.29	8.87	39.39	57.66
Oils	25.75	8.53	28.97	49.61
Asphaltenes	3.54	0.34	10.42	8.05
Pre-Asphaltenes			1.02	0.50
Insolubles	23.27		8.61	3.20
IOM	20.89		4.11	1.10
Ash	2.38		4.50	2.10
TOTAL	54.56	14.7	49.02	63.36
	in wt% of analysis sample			
Water	3.67%	39.65%		3.16%
Oils+Asphaltenes	53.69%	60.35%	80.35%	91.00%
Oils (on fraction)	87.90%	96.12%	73.55%	86.04%
(on total)	47.19%	58.01%	59.10%	78.30%
Asphalt. (on fract.)	12.10%	3.88%	26.45%	13.96%
(on total)	6.50%	2.34%	21.25%	12.70%
Pre-Asphaltenes			2.08%	0.79%
Insolubles	42.65%		17.57%	5.05%
IOM (on fraction)	89.76%		47.78%	34.26%
(on total)	38.28%		8.39%	1.73%
Ash (on fraction)	10.24%		52.22%	65.74%
(on total)	4.37%		9.17%	3.32%
TOTAL	100.00%	100.00%	100.00%	100.00%
	in grams of feed / product			
Total Feed / Product	7230	1524	1420	4420
Water	265.0	604.3		139.5
Oils+Asphaltenes	3881.5	920.0	1141.0	4022.4
Oils (on fraction)	3411.8	884.3	839.2	3460.9
(on total)	3411.8	884.3	839.2	3460.9
Asphalt. (on fract.)	469.7	35.7	301.8	561.5
(on total)	469.7	35.7	301.8	561.5
Pre-Asphaltenes			29.5	34.9
Insolubles	3083.5		249.5	223.2
IOM (on fraction)	2767.7		119.2	76.5
(on total)	2767.7		119.2	76.5
Ash (on fraction)	315.7		130.3	146.7
(on total)	315.7		130.3	146.7
TOTAL (as is)	7230.0	1524.3	1420.0	4420.0
TOTAL (MAF)	6849.2	920.0	1289.7	4133.8

Distillation Profile THF-Extract						D-1160		
Fractions deg C	Feed	Products V-220	V-340 (BTTMS)	V-330	Total	Feed	Product Comp. Sample as is	corr.
IBP - 182		45.54	14.05	25.97	85.55		108.16	108.16
182 - 343	155.26	503.13	65.55	1416.83	1987.51	69.87	1412.83	1412.83
343 - 524	3726.23	371.30	730.42	2612.49	3714.21	3256.57	3420.54	3420.54
524+			479.72	76.46	556.18	555.05	1818.43	1401.92
TOTAL	3881.49	919.97	1289.74	4133.75	6343.46	3881.49	6759.97	6343.46

Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total	Feed	Products (nomalized) V-220	V-340 (BTTMS)	V-330	Total
in wt% of total feed (as is)					in wt% of total feed (MAF)				
								2.03%	2.03%
3.55%	3.55%		1.87%	5.42%					
53.75%	12.32%	15.28%	53.88%	81.48%	58.38%	13.38%	16.60%	58.51%	88.49%
47.25%	11.84%	11.24%	46.36%	69.44%	51.31%	12.86%	12.21%	50.34%	75.42%
6.50%	0.46%	4.04%	7.52%	12.04%	7.06%	0.52%	4.39%	8.17%	13.08%
		0.40%	0.47%	0.86%			0.43%	0.51%	0.94%
42.70%		3.65%	3.34%	6.99%					
38.33%		1.60%	1.02%	2.62%	41.62%		1.73%	1.11%	2.85%
4.37%		2.06%	2.32%	4.37%					
100.00%	15.87%	19.33%	59.55%	94.76%					
					100.00%	13.38%	18.76%	62.16%	94.31%

PROCESS YIELD STRUCTURE

RUN No.: DOE-BU-015 M.B. No.: YP-06/C1



Remarks:

DATE
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8/2/94

END