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THE EFFECTS OF MINERALS ON COAL BENEFICIATION PROCESSES

Quarterly Report No. 10 for the Period January 1—March 31, 1980

By
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October 15, 1980

Work Performed Under Contract No. AC22-77ET10559

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U. S. DEPARTMENT OF ENERGY

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October 15, 1980

PREPARED FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Under Contract No. DE-AC22-77ET10559

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OBJECTIVE AND SCOPE

The purpose of this research program is to examine the effect of coal cleaning and preparation on the distribution of mineral materials in coal and the influence of the mineral materials on the coal cleaning operation. The research program will involve the examination of, for coal mineral materials: (1) the natural occurrence and distribution of mineral materials in run-of-mine coal, (2) the changes in these characteristics during cleaning and preparation, (3) the specific effects of coal mineral materials on individual cleaning and preparation processes, and (4) improved methods for controlling their distribution.

In order to accomplish these objectives samples will be obtained from three commercial coal preparation plants which are: (1) handling coal from major (by volume) coal seams, (2) handling coal most likely to be used in future large scale coal conversion processes, and (3) using a range of different types of modern cleaning methods. At least one of these plants shall process a coal likely to be used as a feed to a D.O.E.-supported conversion process or similar to a type of coal likely to be used.

SUMMARY OF PROGRESS TO DATE

All basic data acquisition relevant to characterization of the contract samples physically and chemically has been completed. Assessment of this data and inter-relationships with mineralogical characterization data is concurrently on-going, with final petrographic data acquisition for the contract to be affected during the next quarter. This remaining analytical work is the detailed maceral analysis of the Illinois No. 6 samples.

Work during this quarter focused on coarse and fine coal heavy-media pilot-scale cleaning operations using a heavy-media drum separation and a heavy-media cyclone. Chemical and mineralogical effects produced by these tests are reported herein, completing Task 4 testing of the effects of laboratory pilot cleaning on mineral composition and distribution. Results for froth flotation, size by gravity, jigging, and tabling for this task have been previously reported.

Also completed during the work period was the chemical characterization of the Illinois No. 6 slurry-fines sample. Mineralogical data for this sample were reported in Progress Report Number 9.

DESCRIPTION OF TECHNICAL PROGRESS

Work during Quarter No. 10 was primarily concentrated on completing heavy-media pilot-scale cleaning tests of the coal samples obtained from District 3, District 7, and District 10 using the appropriate feed sizes for two types of unit operations, i.e. heavy-media cycloning and heavy-media drum cleaning.

Also completed during the quarter was the chemical characterization of the Illinois No. 6 "blackwater" sludge material collected from the District 10 plant settling-pond feeder circuit.

Heavy-Media Pilot-Scale Tests

In the past quarter, heavy-media pilot-scale tests were performed on coarse and fine fractions of coal samples from District 3, District 7, and District 10. Coarse coal, 2" x 10 mesh, was cleaned using a 36" x 24" heavy-media drum separator and the fine coal fraction, 10 mesh x 100 mesh, was cleaned with a 3" diameter heavy-media cyclone. Samples of the clean coal and refuse products from all of the individual tests were collected, dried and weighed, and submitted for chemical and mineralogical analyses.

HMS Drum Cleaning

The coarse-coal cleaning tests were conducted using a 36" x 24" WEMCO heavy-media drum separator. The drum used for the tests, originally manufactured as a 36" x 48" three-product, two-compartment separator, was converted to the single-compartment, two-product configuration by extending the refuse launder from the first compartment in order to by-pass the middling compartment. Trial tests utilizing the configuration provided

results, which indicated the conversion was successful.

Prior to the actual pilot-scale cleaning tests, approximately 500 lbs. of 2" x 0 raw coal feed obtained from selected plants cleaning Pittsburgh, Pocahontas No. 3, and Illinois No. 6 coals was screened on a double-deck screen to produce approximately 50 lbs. of 2" x 10 mesh coal for the coarse coal tests and 25 lbs. of 10 mesh x 100 mesh coal for the fine coal cleaning tests.

The tests with the heavy-media drum separator were performed under open circuit conditions, i.e. feed was passed through the drum once without recirculation. The magnetite slurry was introduced into the drum from a 200 gallon baffled sump. The slurry consisted of 930 lbs. magnetite to 178 gallons of water to produce a gravity of approximately 1.45. Media in the sump was constantly circulated by a high-speed mixer. The drum was filled with slurry to overflowing and the media suspension in the drum was allowed to reach equilibrium before feed coal was introduced. Once the suspension was stable, coal was hand-fed onto the launder and additional magnetite slurry from the 200 gallon sump was used to assist the feed down the launder and to provide make-up media for the drum. Both the clean coal and refuse products were collected in 50 gallon drums over the course of each test. After the completion of the 3 tests, the coal and refuse samples were carefully drained and water rinsed on a 100 mesh (150 millimicron) screen to remove any magnetite from the samples. This step resulted in washing a significant amount of clay slimes from the Illinois No. 6 sample. The samples of coal and refuse were then dried in an oven, weighed, and submitted for chemical and mineralogical analyses.

Tables 1 and 2 contain the test yields, and proximate and sulfur-breakdown data for the samples. (Feeds shown were back-calculated based on the products and yield). Significant reductions in ash were noted in

TABLE 1
PILOT PLANT STUDY
ANALYSES OF WEMCO HEAVY MEDIA DRUM SEPARATOR TESTS
2" x 10M FEED COALS

<u>Sample</u>	<u>Yield (%)</u>	<u>Moisture (%)</u>	<u>Ash (%)</u> ¹	<u>Volatile Matter (%)</u> ¹	<u>Fixed Carbon (%)</u> ¹	<u>Btu</u> ¹	<u>Total Sulfur (%)</u> ¹
Pittsburgh/ Wemco Feed	-	1.0	9.08	38.35	52.57	13,894	2.59
Pittsburgh/ Wemco Product	88.5	0.9	6.2	39.4	54.4	14,372	2.34
Pittsburgh/ Wemco Refuse	11.5	0.6	31.2	30.3	38.5	10,219	4.48
Pocahontas No. 3/ Wemco Feed	-	1.0	43.59	12.84	43.57	8,110	0.54
Pocahontas No. 3/ Wemco Product	45.1	0.6	4.5	18.0	77.5	15,097	0.73
Pocahontas No. 3/ Wemco Refuse	54.9	0.3	75.7	8.6	15.7	2,371	0.39
Illinois No. 6/ Wemco Feed	-	7.9	9.71	41.72	48.57	12,720	4.41
Illinois No. 6/ Wemco Product	94.8	7.5	8.0	42.5	49.5	12,984	4.04
Illinois No. 6/ Wemco Refuse	5.2	2.1	40.8	27.5	31.7	7,918	11.07

¹
Dry Basis.

TABLE 2

PILOT PLANT STUDY

SULFUR ANALYSES¹ OF WEMCO HEAVY MEDIA DRUM SEPARATOR TESTS
2" x 10M FEED COALS

<u>Sample</u>	<u>Yield (%)</u>	<u>Total Sulfur</u>	<u>Sulfate Sulfur</u>	<u>Pyritic Sulfur</u>	<u>Total Inorganic Sulfur</u>	<u>Organic Sulfur</u>
Pittsburgh/ Wemco Feed	-	2.59	0.03	1.04	1.07	1.52
Pittsburgh/ Wemco Product	88.5	2.34	0.03	0.74	0.77	1.57
Pittsburgh/ Wemco Refuse	11.5	4.46	0.06	3.33	3.39	1.07
Pocahontas No. 3/ Wemco Feed	-	0.54	0.01	0.17	0.18	0.36
Pocahontas No. 3/ Wemco Product	45.1	0.73	0.01	0.09	0.10	0.63
Pocahontas No. 3/ Wemco Refuse	54.9	0.39	0.01	0.24	0.25	0.14
Illinois No. 6/ Wemco Feed	-	4.41	0.15	1.25	1.40	3.01
Illinois No. 6/ Wemco Product	94.8	4.04	0.14	0.81	0.95	3.09
Illinois No. 6/ Wemco Refuse	5.2	11.07	0.30	9.27	9.57	1.50

¹
Percent, dry basis.

all samples although this was most apparent in the Pocahontas No. 3 coal. This sample was the most conducive to HMS drum cleaning although product yield was less than 50 percent. The tendency of this coal to increase in sulfur content with cleaning was again evident and is a function of concentrating the organic sulfur inherent in the clean coal fraction. The low yield for this coal is a reflection of the large amount of roof and floor mined with the coal. This harder rock material tends to be in the +10 mesh fraction of the sample.

Heavy-media cleaning of coals such as the District 10 Illinois No. 6 sample would not be recommended due to the excessive clay fines present in the coal. The presence of such a large amount of fine clay in the plant water circuit would greatly inhibit magnetite recovery as well as changing the gravity and viscosity of the media. Heavy-media techniques could, however, be employed on coal such as the high-grade District 7 sample, where the excellent quality of the coal would justify the added expense. Whether enough additional benefit could be derived from using heavy-media cleaning on the District 3 coal sample versus the product derived from water-only cleaning is questionable.

Mineral abundances in the WEMCO HMS Drum Separator feed coal, product coal, and refuse were determined using XRPD analysis. The mineral abundances in the feed coal to the drum separator were established by mathematically recombining the XRPD analyses of the +1 inch x 1/4 inch, and the 1/4 inch x 8 mesh float-sink fractions. Table 3 presents the mineral abundances as weight percents of the LTA. In Table 4 these values are shown recalculated to pounds of each mineral in one short ton of feed coal. The minerals analyzed in the product and refuse from each test were proportioned using the yield values to calculate the amount of minerals produced from processing one short ton of the feed coal.

Mineral abundance trends in the drum separator tests were similar to trends interpreted from the float-sink data. Illite was greatly concentrated in the refuse of the Pocahontas No. 3 coal, but was dispersed in both fractions of the Pittsburgh coal. Most illite was missing from the product coal and refuse of the Illinois No. 6 test as in other tests. Kaolinite was concentrated in the products of the Pittsburgh and Illinois No. 6 coals. As in other tests using larger size Pocahontas No. 3 coal, the kaolinite predominately reported to the refuse because of the large amounts of kaolinite contained in the roof and floor rock in the large sizes. Quartz followed the kaolinite trend in the Pocahontas No. 3 coal, but was dispersed between the clean coal and refuse in the other two coals. Calcite was concentrated in the refuse fractions of all three coals. Pyrite was heavily concentrated in the refuse of the Pittsburgh coal, but largely occurred in the clean fraction of the Illinois No. 6 coal.

Differences between the sum of the product and refuse mineral matter in Table 4 and the feed coal mineral matter are greater for these tests than others, and indicate greater error in calculating the feed coal mineral abundances. As in other tests a large quantity of the illite was missing from the product and refuse of the Illinois No. 6 coal due to particle disintegration caused by water spraying to remove the magnetite.

Heavy-Media Cyclone Tests

The fine-coal cleaning tests were performed with a 3" diameter heavy media cyclone using a closed circuit. Fifty gallons of 1.45 G. heavy media was prepared using approximately 45 gallons of water and 233 pounds of magnetite. Media was recirculated for approximately 10 minutes prior to the introduction of 10 mesh x 100 mesh (U.S.) feed coal into the circuit. The fine coal (25 lbs.) was gradually fed into the circuit and allowed to circulate for a few minutes. The cyclone overflow was then adjusted to permit

Table 3

Mineral weight percent values of the feed coals and yields of the WEMCO HMS Drum Separator tests.

	LOW TEMPERATURE ASH	ILLITE	KAOLINITE	QUARTZ	CALCITE	DOLOMITE	SIDERITE	PYRITE	FELDSPAR	MUSCOVITE	APATITE	BASSANITE
	wt. %	wt. % ¹	wt. %	wt. %	wt. %	wt. %	wt. % ²	wt. %	%nc ³	%nc	%nc	%nc
PITTSBURGH COAL -- District 3												
Feed Coal (+1 inch X 8 mesh) ⁴	16.2	30	16	19	6	3	--	18	6	--	2	3
WEMCO HMS Drum Separator Product	7.8	40	28	17	7	5	--	0	0	--	0	0
WEMCO HMS Drum Separator Refuse	35.9	28	11	28	13	6	--	20	0	--	0	0
POCAHONTAS NO.3 COAL -- District 7												
Feed Coal (+1 inch X 8 mesh)	37.1	32	25	25	3	--	4	1	4	3	--	8
WEMCO HMS Drum Separator Product	5.2	26	37	14	4	--	4	4	9	0	--	3
WEMCO HMS Drum Separator Refuse	81.0	36	22	40	2	--	0	0	0	0	--	0
ILLINOIS NO.6 COAL -- District 10												
Feed Coal (+1 inch X 8 mesh)	31.1	35	10	7	5	--	--	17	--	--	--	--
WEMCO HMS Drum Separator Product	10.9	18	15	23	3	--	--	23	--	--	--	--
WEMCO HMS Drum Separator Refuse	49.3	18	14	23	10	--	--	10	--	--	--	--

¹ Mineral values are expressed as weight percent of the low temperature ash.

² The symbol "--" indicates that the mineral was not present in that coal.

³ Standard curves were not available for some minerals. These were assigned relative values representing the mineral's contribution to the total X-ray count.

⁴ The WEMCO Heavy Media Drum Separator feed coal was actually 2 inch X 10 mesh, but these were not sampled. The feed coal analyses were calculated from the +1 inch X 8 mesh float-sink fractions

Table 4

Mineral values expressed as pounds per short ton of feed coal for the WEMCO HMS Drum Separator tests.

	COAL REPORTING	MINERAL MATTER	ILLITE	KAOLINITE	QUARTZ	CALCITE	DOLOMITE	SIDERITE	PYRITE	FELDSPAR	MUSCOVITE	APATITE	BASSANITE
	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb
PITTSBURGH COAL													
<i>Feed Coal</i> ¹	2000	324	97	52	62	19	10	-- ⁴	58	19	--	6	10
<i>WEMCO Separator Product</i> ²	1770	138	55	39	23	10	7	--	0	0	--	0	0
<i>WEMCO Separator Refuse</i> ³	230	83	23	9	23	11	5	--	17	0	--	0	0
POCAHONTAS NO.3 COAL													
<i>Feed Coal</i>	2000	742	237	186	186	22	--	30	7	30	22	--	59
<i>WEMCO Separator Product</i>	902	47	12	17	7	2	--	2	2	4	0	--	1
<i>WEMCO Separator Refuse</i>	1098	889	320	196	356	18	--	0	0	0	0	--	0
ILLINOIS NO.6 COAL													
<i>Feed Coal</i>	2000	622	218	62	44	31	--	--	106	--	--	--	--
<i>WEMCO Separator Product</i>	1896	207	37	31	48	6	--	--	48	--	--	--	--
<i>WEMCO Separator Refuse</i>	104	51	9	7	12	12	--	--	5	--	--	--	--

¹ Mineral values are expressed as pounds of the mineral in one short ton of feed coal.

² Mineral values are expressed as pounds of the mineral reporting with the cleaned coal resulting from cleaning one short ton of feed coal.

³ Mineral values are expressed as pounds of the mineral reporting with the refuse resulting from cleaning one short ton of feed coal.

⁴ The symbol "--" indicates that the mineral was not present in that coal.

a refuse product containing very little visible coal material. Once this state had been reached, samples of clean coal and refuse products were collected. At the end of each test the two products were drained and rinsed over a 100 mesh screen to remove all magnetite. As in the coarse coal tests, the samples were oven-dried at 105 C weighed, and processed for chemical and mineralogical analyses. It should be noted that during the drain and rinse steps, a substantial amount of clay slimes were again removed from the product and refuse of the Illinois No. 6 seam sample. This could not be avoided, however, because of the magnetite loadings which would have otherwise remained in the sample.

As shown in Tables 5 and 6, heavy-media cycloning was effective for improving the product of each coal cleaned. Similar data trends are evident with each coal. Yields were approximately 93%, ash was decreased by 33 percent for the Pittsburgh and Illinois No. 6 samples and by 59 percent for the Pocahontas No. 3 coal. Other product trends were as expected, with increases in volatile matter, fixed carbon and Btu while sulfur either decreased (Pittsburgh, 18%; and Illinois No. 6, 12%) or remained the same (Pocahontas No. 3). The very low Btu's of the refuse indicate misplaced coal was minimized by heavy-media cycloning.

Mineral abundances in the heavy media cyclone feed coal, product coal, and refuse were determined using X-ray powder diffraction (XRPD). The actual 10 mesh x 100 mesh feed coal to the cyclone was not sampled, however, the XRPD analyses of the 8 mesh x 28 mesh and the 28 mesh x 100 mesh float-sink fractions were mathematically recombined to establish the mineral abundances in the feed coal. The 8 mesh x 100 mesh fraction should closely approximate the 10 mesh x 100 mesh feed coal. Table 7 presents the mineral abundances as weight percents of the low temperature ash (LTA). In Table 8 these values are shown recalculated to pounds of each mineral in one short ton of feed coal. The minerals in the

TABLE 5
PILOT PLANT STUDY
ANALYSES OF HEAVY MEDIA CYCLONE TESTS
10M x 100M FEED COALS

<u>Sample</u>	<u>Yield (%)</u>	<u>Moisture (%)</u>	<u>Ash (%)</u> ¹	<u>Volatile Matter (%)</u> ¹	<u>Fixed Carbon (%)</u> ¹	<u>Btu</u> ¹	<u>Total Sulfur (%)</u> ¹
Pittsburgh/ Cyclone Feed	-	1.0	12.5	35.86	51.59	13,315	2.92
Pittsburgh/ Cyclone Product	93.6	2.1	8.4	37.3	54.3	14,002	2.38
Pittsburgh/ Cyclone Refuse	6.4	0.6	73.3	14.8	11.9	3,261	10.82
Pocahontas No. 3/ Cyclone Feed	-	1.0	10.7	16.76	72.48	14,004	0.68
Pocahontas No. 3/ Cyclone Product	92.3	1.1	4.4	17.4	78.2	15,173	0.68
Pocahontas No. 3/ Cyclone Refuse	7.7	0.6	86.9	9.1	3.9	-(2)	0.67
Illinois No. 6/ Cyclone Feed	-	7.5	11.9	40.23	47.79	12,028	4.59
Illinois No. 6/ Cyclone Product	93.2	11.2	8.0	42.0	50.0	12,807	4.02
Illinois No. 6/ Cyclone Refuse	6.8	0.9	66.5	16.0	17.5	1,350	12.35

¹

Dry Basis

²

Ash in this sample was too high for Btu test.

TABLE 6
PILOT PLANT STUDY
SULFUR ANALYSES OF HEAVY MEDIA CYCLONE TESTS
10M x 100M FEED COALS

<u>Sample</u>	<u>Yield (%)</u>	<u>Total Sulfur</u>	<u>Sulfate Sulfur</u>	<u>Pyritic Sulfur</u>	<u>Total Inorganic Sulfur</u>	<u>Organic Sulfur</u>
Pittsburgh/ Cyclone Feed	-	2.92	0.03	1.41	1.44	1.48
Pittsburgh/ Cyclone Product	93.6	2.38	0.03	0.80	0.83	1.55
Pittsburgh/ Cyclone Refuse	6.4	10.82	0.10	10.28	10.38	0.44
Pocahontas No. 3/ Cyclone Feed	-	0.68	0.01	0.09	0.10	0.58
Pocahontas No. 3/ Cyclone Product	92.3	0.68	0.01	0.05	0.06	0.62
Pocahontas No. 3/ Cyclone Refuse	7.7	0.67	0.01	0.63	0.64	0.03
Illinois No. 6/ Cyclone Feed	-	4.59	0.18	1.44	1.62	2.97
Illinois No. 6/ Cyclone Product	93.2	4.02	0.15	0.74	0.89	3.13
Illinois No. 6/ Cyclone Refuse	6.8	12.25	0.63	11.06	11.69	0.56

product and refuse from each test were proportioned from one short ton of feed coal using the yield values.

Mineral abundance trends in the heavy media cyclone tests were generally similar to trends interpreted from the float-sink data. Illite was concentrated in the refuse of the Pittsburgh and Pocahontas No. 3 coals, but the refuse from the Illinois No. 6 coal was very low in illite. This was caused by the disintegration of illite aggregates in the Illinois No. 6 coal to submicron-size particles which exited the test with the wash water. Table II shows that this phenomenon produced a net loss of 90% of the illite from the product and refuse of the Illinois No. 6 coal. Kaolinite was concentrated in the products of these tests. Substantial kaolinite did not report to the refuse of the Pocahontas No. 3 coal as it did in other tests (see the Coal Preparation Pilot Plant section of Report No. 9 of this series), because little of the kaolinite-illite-mixture roof and floor rock was in the fine coal sizes used in these tests. In the Pittsburgh coal, quartz was finely disseminated in both the product and the refuse as in the float-sink tests. Quartz in the Illinois No. 6 coal, however, largely reported with the clean coal. Quartz included in the illite-rich grains which should have reported to the refuse was also lost to the wash water when those grains disintegrated. Calcite was greatly concentrated in the refuse fractions of all three coals tested. Pyrite was greatly concentrated in the refuse, but on a weight basis, most of the pyrite reported with the products of these tests because of the high yields.

Differences between the sum of the product and refuse mineral matter in Table II and the feed coal mineral matter indicated moderate errors (about 20% error) due to combining 10 independent analyses to establish the feed coal values for the Pittsburgh and Pocahontas No. 3 coals. Approximately 40% of the

Table 7

Mineral weight percent values of the feed coals and yields of the heavy media cyclone tests.

	LOW TEMPERATURE ASH	ILLITE	KAOLINITE	QUARTZ	CALCITE	DOLOMITE	SIDERITE	PYRITE	FELDSPAR	MUSCOVITE	APATITE	BASSANITE
	wt. %	wt. % ¹	wt. %	wt. %	wt. %	wt. %	wt. % ²	wt. %	%nc ³	%nc	%nc	%nc
PITTSBURGH COAL -- District 3												
Feed Coal (8 mesh X 100 mesh) ⁴	12.8	24	16	16	10	4	--	23	2	--	2	4
Heavy Media Cyclone Product	10.0	3	17	14	5	3	--	19	0	--	2	7
Heavy Media Cyclone Refuse	91.5	20	5	14	39	4	--	16	0	--	0	0
POCAHONTAS NO.3 -- District 7												
Feed Coal (8 mesh X 100 mesh)	9.7	27	28	24	5	--	3	2	5	2	--	7
Heavy Media Cyclone Product	5.0	28	40	16	5	--	2	0	7	0	--	2
Heavy Media Cyclone Refuse	95.5	38	21	29	9	--	1	0	2	0	--	0
ILLINOIS NO.6 COAL -- District 10												
Feed Coal (8 mesh X 100 mesh)	28.3	33	13	22	12	--	--	13	--	--	--	--
Heavy Media Cyclone Product	10.7	3	13	24	4	--	--	20	--	--	--	--
Heavy Media Cyclone Refuse	91.0	0	5	9	48	--	--	10	--	--	--	--

¹ Mineral abundances are expressed as weight percent of the low temperature ash.

² The symbol "--" indicates that the mineral was not present in that coal.

³ Standard curves were not available for some minerals. These were assigned relative values representing the mineral's contribution to the total X-ray count.

⁴ The Heavy Media Cyclone feed coal was actually 10 mesh X 100 mesh, but these were not sampled. The feed coal analyses were calculated from the 8 mesh X 100 mesh float-sink fractions.

Table 8

Mineral values expressed as pounds per short ton of feed coal for the heavy media cyclone tests.

	COAL REPORTING	MINERAL MATTER	ILLITE	KAOLINITE	QUARTZ	CALCITE	DOLOMITE	SIDERITE	PYRITE	FELDSPAR	MUSCOVITE	APATITE	BASSANITE
	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb
PITTSBURGH COAL													
<i>Feed Coal</i> ¹	2000	256	61	41	41	26	10	-- ⁴	59	5	--	5	10
<i>Cyclone Product</i> ²	1872	187	6	32	26	9	6	--	36	0	--	4	13
<i>Cyclone Refuse</i> ³	128	117	23	6	16	46	5	--	19	0	--	0	0
POCAHONTAS NO.3 COAL													
<i>Feed Coal</i>	2000	194	52	54	47	10	--	6	4	10	4	--	14
<i>Cyclone Product</i>	1846	92	26	37	15	5	--	2	0	6	0	--	2
<i>Cyclone Refuse</i>	154	147	56	31	43	13	--	1	0	3	0	--	0
ILLINOIS NO.6													
<i>Feed Coal</i>	2000	566	187	73	124	68	--	--	74	--	--	--	--
<i>Cyclone Product</i>	1864	199	6	26	48	8	--	--	40	--	--	--	--
<i>Cyclone Refuse</i>	136	124	0	6	11	59	--	--	12	--	--	--	--

¹ Mineral values are expressed as pounds of the mineral in one short ton of feed coal.

² Mineral values are expressed as pounds of the mineral reporting with the cleaned coal resulting from cleaning one short ton of feed coal.

³ Mineral values are expressed as pounds of the mineral reporting with the refuse resulting from cleaning one short ton of feed coal.

⁴ The symbol "--" indicates that the mineral was not present in that coal.

mineral matter in the Illinois No. 6 product and refuse was missing in these analyses. This was probably due to the disintegration of illite particles during cleaning, and the exit of the illite and its accessory minerals with the wash water.

Blackwater Fines Characterization

The Illinois No. 6 seam washwater was sampled in 5 gallon increments over a three-hour period as it left the plant via a sampling pipe. Collected increments were taken each twenty minutes and were combined to form a single composite sample. Sampling was concurrent with beltline feed and refuse sampling at the plant. The subsequently determined slurry solids comprised 12.7 percent by weight of the sample.

The sample was thoroughly mixed during the sample preparation processing and a 3 gallon aliquot was then taken for analytical determinations. This composite sample fraction was vacuum filtered and oven dried at 105 C, mortared, mixed, and analyzed as shown in Table 9.

TABLE 9

ANALYSIS OF ILLINOIS NO. 6 SLURRY FINES¹

Proximate Analysis

Moisture	3.8
Ash	50.0
Volatile Matter	20.3
Fixed Carbon	29.7

Btu 6,527

Ultimate Analysis

Carbon	38.07
Hydrogen	2.08
Nitrogen	2.92
Oxygen	0.50
Sulfur	2.43

Sodium 0.56
Potassium 2.63

Sulfur Forms

Sulfate S	0.10
Pyrite S	1.13
Total Inorganic S	1.23
Organic S	1.20
Total S	2.43

¹Percent, dry basis

As shown in Table 21 of Quarterly Report No. 9, the mineralogy of the ash constituents for the slurry fines was dominated by quartz, kaolinite, pyrite and calcite, in decreasing order of abundance. Illite is conspicuously absent, especially since significant concentrations were evident in most size/gravity fractions of the coal, and it is suspected that it may have been lost in the filtering process as a colloidal suspension in the filtrate.