Special Handling and Unique Mining Practices at Fola Coal Company

Mike Isabell
Environmental Manager

Fola Coal Company is a mountaintop mining operation in Clay and Nicholas Counties, employing over 300 people. Using six spreads of equipment to mine 12 seams, Fola produces approximately 4.5 million clean tons per year of low sulfur coal, which is sold on the steam market.

Coal seams recovered include the Freeport, three splits of the Kittanning, 5-Block, Clarion, Clarion Leader, Stockton A, Stockton, and three splits of the Coalburg. All seams are not always present and geologic layers vary across the property. The 5-Block and Coalburgs are the major mining horizons on all permits. In situ sulfur is >1% on the majority of these seams, with the exception of the Stockton, which has been tested as high as 6%.

Fola tries to maintain an operational balance of 60% direct ship coal, with the remaining 40% going to a 550-ton per hour preparation plant. Clean coal is transported from the plant directly to the train by an overland belt that is approximately 6,500 feet in length and drops over 500 feet in elevation to a batch loadout. Loading time for a unit train of 115 cars of 100-ton capacity averages three hours.

Mining techniques involve the use of an O&K hydraulic shovel with a 30 cubic yard bucket, a 1200 Komatsu loader, two Caterpillar 994 loaders and two Caterpillar 992 G loaders. Haulage power is provided by a variety of trucks ranging from 100-ton to 210- ton capacities on roads maintained to slopes no greater than 12%. A fleet of seven D-11 dozers, including a D-11 C carry dozer, produces an average of 350 bcy per hour per machine. Benching, sloping and reclamation activities are carried out by six D-10 dozers. Operations are designed with a target raw strip ratio of approximately 11 to 1 with daily production averages topping 150,000 bcy of overburden moved per day. This mining method provides unique opportunities for handling overburden in an area were steep slopes are the norm and variability in the quality of the material changes from cut to cut.

Fola began mining on Surface Mine One in 1993. Overburden analysis for this permit revealed no unusual problems, with a majority of the overburden layers testing in the 0 to +15 tons/1000 tons range (neutral to excess alkalinity) using standard acid-base accounting procedures (Sobek et al., 1978). As the reclamation phase of the permit came to completion, manganese levels began to increase in outflows from two valley fills.

A permit for Surface Mine Two was issued in 1994 using the same overburden techniques, but included a more detailed handling plan for placement of pit cleanings and toxic strata associated with the Stockton seam. After several years of mining on Surface Mine Two, poor water quality began to appear in an area referred to as North Ridge. By this time the quality of the water on Surface Mine One had degraded to the point of requiring treatment. Acidity levels were ranging from 10 to 30 mg/L as $CaCO_3$, with manganese levels approaching 30 mg/L depending on the

flow. So installation of treatment systems to maintain compliance for manganese on both sites was required.

In 1997, Fola began extensive testing to determine what caused the trend toward poor water quality when available information from acid-base accounting indicated that it should not occur. Field inspections were carried out on Surface Mine One and on North Ridge, which revealed one major similarity. In several areas where sandstone was exposed to weathering, a green tint was noticeable, both in sandstone rock used for riprap in flumes and spillways, and on exposed highwalls along the haulroad. A review of acid-base accounting data showed the sandstone strata in these highwall areas exhibited NP values of 0 to +15 tons/1000 tons, which should have been inert to slightly alkaline. This strata, located between the Upper and Middle Kittanning coal seams, is a very hard, white to gray, homogeneous unit that varies in thickness from 10 to 30 feet. Located high in the geologic column, it is easily accessible, making it a prime candidate for construction material.

Procedures in performing acid-base accounting for both Surface Mine One and Two indicated the use of distilled-ionized (DI) water in the process. Current literature such as "Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania" (Brady et al., 1998), and "the modified NP method" (Skousen et al., 1997) recommended using hydrogen peroxide as an oxidant in the ABA process. The modified NP method of Skousen et al. (1997) introduced a small amount of hydrogen peroxide to oxidize ferrous iron in rock samples. Upon dissolution in acid in the old NP laboratory technique (Sobek et al., 1978), siderite and other ferrous iron materials do not have enough time for complete oxidation from the ferrous form to the ferric form. As the modified NP method with hydrogen peroxide was used during acid-base accounting, it was clear that some of the acidity in the rocks was not accounted for by the old procedure.

To produce results that more closely resembled the effects of weathering on overburden strata, Fola made contact with several laboratories to discuss the potential of changing the sample analysis procedure to include an oxidizer. This method added 5ml of 30% hydrogen peroxide at the end of the analysis to allow for complete oxidation of iron.

Samples of the green sandstone were taken from the Middle Kittanning interburden and subjected to the modified NP procedure. The results were compared to acid-base accounts done on previous rock samples from coreholes containing the same strata using only DI water. The comparison revealed a distinctive difference in NP values. With the modified NP procedure, strata that before had values of 0 to 15 tons/1000 tons excess, now showed ranges of –5 to +1 tons/1000 tons. The majority of these newly analyzed samples would have been interpreted to be potentially toxic and require special handling. In addition, leachate produced from these sandstones produced manganese levels as high as 50 mg/L.

With these results in mind, Fola instituted a program to map the overburden on current operational areas to determine if any other strata showed such variations. Our mining methods play a major role in the design of the mapping program. With six spreads of equipment working on different strata, we sample the interburden of every seam of coal within the geologic column. Central Testing Inc., in Summersville, WV, provides the key function. By providing consistent,

reliable laboratory services and quick turnaround time, we can compare the acid-base accounting results using peroxide analysis to the acid-base accounting data in the original permit, allowing decisions about handling the various materials to be made before placement occurs.

Sampling is carried out in the following manner. Depending on the size of the bench, 3 to 5 drill-cutting samples are obtained from each shot and delivered to the lab the same day as drilling. These samples are analyzed using the hydrogen peroxide NP procedure as described above. Turnaround time for the results is around 36 hours. By sampling each shot, mine foremen are provided with up to date information on the quality of the overburden for each spread of equipment operating on their shift. The mobility of the equipment in conjunction with this data allows for better decision making when lining pits with clay or lime, constructing refuse cells, and the placement of materials during the reclamation process. We have been able to identify the "green sandstone" before it turns green and, more importantly, allows us to handle this material in an environmentally sound manner.

The results of this program are very promising. To date, two valley fills have been completed with good water quality at the toes, thereby not requiring treatment. Three large valley fills are in various stages of completion, with resultant water quality meeting in-stream limits at their respective discharges, also without treatment.

Placement of this sandstone in appropriate places is a continuous strategy to maintain good quality water. If proper placement is not conducted, we constantly see the result during active mining. Large rain events produce pit water with high manganese content, which must be treated before release.

References

Brady, K., M. Smith, and J. Schueck. 1998. Coal mine drainage prediction and pollution prevention in Pennsylvania. Report published by the Pennsylvania Department of Environmental Protection, Bureau of Mining & Reclamation, Harrisburg, PA.

Skousen, J., J. Renton, H. Brown, P. Evans, B. Leavitt, K. Brady, L. Cohen, and P. Ziemkiewicz. 1997. Neutralization potential of overburden samples containing siderite. J. Environ. Qual. 26: 673-681.

Sobek, A., W. Schuller, J. Freeman, and R. Smith. 1978. Field and laboratory methods applicable to overburdens and minesoils. EPA-600/2-78-054. U.S. Environmental Protection Agency, Cincinnati, OH.

REIC Laboratory

Acid-Base Account

Company: Fola Coal Company
Site: CORE F-128-98
Date: September 21, 1998
REIC Job#: 0998-64640

**** Third Run- No Peroxide****

Calcium Carbonate Equivalent in Tons/1000 Tons of Material

									Net Neutralizers		
Sample Number	Sample Interval	Thickness	Rock Type	Color	Reaction wtih HCL	% Sulfur *=Pyritic	Potential Acidity	Neutralization Potential	Deficiency	Excess	Paste pH
1	8.00-12.30	4.30	SS	2.5YR7/3	0	0.01	0.31	0.23	0.08		5.8
2	12.30-14.40	2.10	SS	10YR7/2	0	0.01	0.31	0.08	0.23		6.5
3	14.40-15.00	0.60	MS	10YR5/1	0	0.09	2.81	-1.03	3.85		3.8
	15.00-17.10	2.10	COAL								
4	17.10-17.25	0.15	MS/CARB	10YR6/1	0	0.04	1.25	-0.02	1.27		4.2
5	17.25-18.10	0.85	MS	10YR7/1	0	0.01	0.31	0.57		0.26	5.0
6	18.10-20.10	2.00	MS	10YR6/1	0	0.04	1.25	0.43	0.82		4.6
	20.10-24.00	3.90	COAL		0						
7	24.00-24.70	.70	MS	10YR6/1	0	0.07	2.19	1.37	0.82		5.0
8	24.70-26.00	1.30	SS	10YR6/1	0	0.05	1.56	1.27	.30		5.0
9	26.00-28.00	2.00	SS	2.5YR6/2	0	0.22	6.88	1.37	5.51		4.5
10	28.00-30.00	2.00	SS	10YR7/1	0	0.06	1.88	0.65	1.23		4.9
11	30.00-34.00	4.00	SS	10YR6/1	0	0.14	4.38	-0.02	4.39		4.7
12	34.00-39.00	5.00	SS	10YR7/1	0	0.12	3.75	-0.71	4.46		6.2
13	39.00-44.00	5.00	SS	10YR7/1	0	0.09	2.81	4.44		1.62	6.1
14	44.00-47.65	3.65	SS	10YR7/1	0	0.11	3.44	2.78	0.66		6.3
15	47.65-49.10	1.45	SS/CARB	10YR/4/2	0	0.33	10.31	6.88	3.43		5.0
16	49.10-51.65	2.55	SS	10YR7/1	0	0.06	1.88	11.09		9.22	5.7
17	51.65-52.45	.80	SS/CARB	10YR4/1	0	0.31	9.69	2.93	6.76		4.4
18	52.45-53.35	.90	SS	10YR5/1	0	0.11	3.44	2.03	1.40		4.7
19	53.35-58.00	4.65	SS	10YR7/1	0	0.10	3.13	0.25	2.87		5.5
20	58.00-63.00	5.00	SS	10YR7/1	0	0.08	2.50	0.33	2.17		5.8
21	63.00-68.00	5.00	SS	10YR7/1	0	0.12	3.75	1.17	2.58		6.2
22	68.00-69.50	1.50	SS	10YR7/1	0	0.11	3.44	0.90	2.54		6.6
23	69.50-73.00	3.50	SS	10YR6/1	0	0.18	5.63	3.59	2.03		6.0
24	73.00-78.00	5.00	SS	10YR7/1	0	0.07	2.19	0.48	1.71		6.3
25	78.00-81.20	3.20	SS	10YR7/1	0	0.06	1.88	0.85	1.03		6.3
26	81.20-85.90	4.70	SS	10YR7/1	0	0.06	1.88	2.38		0.51	6.7
27	85.90-90.30	4.40	SS	10YR7/1	0	0.02	0.63	1.17		0.54	6.9

As Reference in EPA manual: EPA-600/2-78-054; Field and Laboratory Methods Applicable to Overburden and Minesoils

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Fola Coal Company, LLC
ABA Analysis Sheet

Core Hole#: **F-128-98**
No Peroxide

		Input					Input			
	OG Elev.		1330 feet			Length	3			
	Percent Of Slope		%							
Sample#	Horizon Elevation	Depth	% Slope	Horizon Width (FT)	Volume (Ft^3) Triangle	Volume (Ft^3) Block	Total Volume (Ft^3)	Total Volume (C.Y.)	NP Neutralization Potential	PA Potential Acidity
		Input	Input						Input	Input
1	1330.00	**4.30**	**65.00**	6.615	14.223	----	42.67	1.580	**0.23**	**0.31**
2	1325.70	**2.10**	**65.00**	9.846	3.392	13.892	51.85	1.921	**0.08**	**0.31**
3	1323.60	**0.60**	**65.00**	10.769	0.277	5.908	18.55	0.687	**-1.03**	**2.81**
4	1323.00	**2.10**	**65.00**	14.000	3.392	22.615	78.02	2.890	**0.00**	**0.00**
5	1320.90	**0.15**	**65.00**	14.231	0.017	2.100	6.35	0.235	**-0.02**	**1.25**
6	1320.75	**0.85**	**65.00**	15.538	0.556	12.096	37.96	1.406	**0.57**	**0.31**
7	1319.90	**2.00**	**65.00**	18.615	3.077	31.077	102.46	3.795	**0.43**	**1.25**
8	1317.90	**3.90**	**65.00**	24.615	11.700	72.600	252.90	9.367	**0.00**	**0.00**
9	1314.00	**0.70**	**65.00**	25.692	0.377	17.231	52.82	1.956	**1.37**	**2.19**
10	1313.30	**1.30**	**65.00**	27.692	1.300	33.400	104.10	3.856	**1.27**	**1.56**
11	1312.00	**2.00**	**65.00**	30.769	3.077	55.385	175.38	6.496	**1.37**	**6.88**
12	1310.00	**2.00**	**65.00**	33.846	3.077	61.538	193.85	7.179	**0.65**	**1.88**
13	1308.00	**4.00**	**65.00**	40.000	12.308	135.385	443.08	16.410	**-0.02**	**4.38**
14	1304.00	**5.00**	**65.00**	47.692	19.231	200.000	657.69	24.359	**-0.71**	**3.75**
15	1299.00	**5.00**	**65.00**	55.385	19.231	238.462	773.08	28.632	**4.44**	**2.81**
16	1294.00	**3.65**	**65.00**	61.000	10.248	202.154	637.21	23.600	**2.78**	**3.44**
17	1290.35	**1.45**	**65.00**	63.231	1.617	88.450	270.20	10.007	**6.88**	**10.31**
18	1288.90	**2.55**	**65.00**	67.154	5.002	161.238	498.72	18.471	**11.09**	**1.88**
19	1286.35	**0.80**	**65.00**	68.385	0.492	53.723	162.65	6.024	**2.93**	**9.69**
20	1285.55	**0.90**	**65.00**	27.077	0.623	23.123	71.24	2.638	**2.03**	**3.44**
21	1284.65	**4.65**	**65.00**	34.231	16.633	125.908	427.62	15.838	**0.25**	**3.13**
22	1280.00	**5.00**	**65.00**	41.923	19.231	171.154	571.15	21.154	**0.33**	**2.50**
23	1275.00	**5.00**	**65.00**	49.615	19.231	209.615	686.54	25.427	**1.17**	**3.75**
24	1270.00	**1.50**	**65.00**	51.923	1.731	74.423	228.46	8.462	**0.90**	**3.44**
25	1268.50	**3.50**	**65.00**	57.308	9.423	181.731	573.46	21.239	**3.59**	**5.63**
26	1265.00	**5.00**	**65.00**	65.000	19.231	286.538	917.31	33.974	**0.48**	**2.19**
27	1260.00	**3.20**	**65.00**	69.923	7.877	208.000	647.63	23.986	**0.85**	**1.88**
28	1256.80	**4.70**	**65.00**	77.154	16.992	328.638	1036.89	38.403	**2.38**	**1.88**
29	1252.10	**4.40**	**65.00**	83.923	14.892	339.477	1063.11	39.374	**1.17**	**0.63**
						Totals	**10782.96**		**45.46**	**83.48**

Weighted NP Avg. 2.06

Weighted PA Avg. 0.00

Net Weighted Potential: **2.06**

REIC Laboratory

Acid-Base Account

Company: **Fola Coal Company**
Site: **CORE F-128-98**
Date: **September 21, 1998**
REIC Job#: **0998-64640**

**** Second Run- Peroxide****

Calcium Carbonate Equivalent in Tons/1000 Tons of Material

									Net Neutralizers		
Sample Number	**Sample Interval**	**Thickness**	**Rock Type**	**Color**	**Reaction wtih HCL**	**% Sulfur *=Pyritic**	**Potential Acidity**	**Neutralization Potential**	**Deficiency**	**Excess**	**Paste pH**
1	8.00-12.30	4.30	SS	2.5YR7/3	0	0.01	0.31	0.51			5.8
2	12.30-14.40	2.10	SS	10YR7/2	0	0.01	0.31	0.78		.20	6.5
3	14.40-15.00	0.60	MS	10YR5/1	0	0.09	2.81	-1.13		0.47	3.8
	15.00-17.10	2.10	COAL		0				3.94		
4	17.10-17.25	0.15	MS/CARB	10YR6/1	0	0.04	1.25	-0.25			4.2
5	17.25-18.10	0.85	MS	10YR7/1	0	0.01	0.31	1.02	1.50		5.0
6	18.10-20.10	2.00	MS	10YR6/1	0	0.04	1.25	0.17		0.71	4.6
	20.10-24.00	3.90	COAL		0				1.08		
7	24.00-24.70	.70	MS	10YR6/1	0	0.07	2.19	1.96			5.0
8	24.70-26.00	1.30	SS	10YR6/1	0	0.05	1.56	-0.74	0.23		5.0
9	26.00-28.00	2.00	SS	2.5YR6/2	0	0.22	6.88	-4.02	2.30		4.5
10	28.00-30.00	2.00	SS	10YR7/1	0	0.06	1.88	-3.43	10.90		4.9
11	30.00-34.00	4.00	SS	10YR6/1	0	0.14	4.38	-7.80	5.31		4.7
12	34.00-39.00	5.00	SS	10YR7/1	0	0.12	3.75	2.35	12.71		6.2
13	39.00-44.00	5.00	SS	10YR7/1	0	0.09	2.81	1.37	1.40		6.1
14	44.00-47.65	3.65	SS	10YR7/1	0	0.11	3.44	3.33	1.44		6.3
15	47.65-49.10	1.45	SS/CARB	10YR/4/2	0	0.33	10.31	6.88	0.11		5.0
16	49.10-51.65	2.55	SS	10YR7/1	0	0.06	1.88	1.34	3.43		5.7
17	51.65-52.45	.80	SS/CARB	10YR4/1	0	0.31	9.69	-6.89	0.53		4.4
18	52.45-53.35	.90	SS	10YR5/1	0	0.11	3.44	-4.59	16.58		4.7
19	53.35-58.00	4.65	SS	10YR7/1	0	0.10	3.13	-0.35	8.02		5.5
20	58.00-63.00	5.00	SS	10YR7/1	0	0.08	2.50	0.39	3.47		5.8
21	63.00-68.00	5.00	SS	10YR7/1	0	0.12	3.75	1.59	2.11		6.2
22	68.00-69.50	1.50	SS	10YR7/1	0	0.11	3.44	1.59	2.16		6.6
23	69.50-73.00	3.50	SS	10YR6/1	0	0.18	5.63	4.41	1.85		6.0
24	73.00-78.00	5.00	SS	10YR7/1	0	0.07	2.19	1.44	1.22		6.3
25	78.00-81.20	3.20	SS	10YR7/1	0	0.06	1.88	1.83	0.75		6.3
26	81.20-85.90	4.70	SS	10YR7/1	0	0.06	1.88	2.25	0.04	0.37	6.7
27	85.90-90.30	4.40	SS	10YR7/1	0	0.02	0.63	1.78		11.16	6.9

As Reference in EPA manual: EPA-600/2-78-054; Field and Laboratory Methods Applicable to Overburden and Minesoils

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Fola Coal Company, LLC
ABA Analysis Sheet

Core Hole#: **F-128-98**
Peroxide

		Input		Input									
	OG Elev.		1330 feet		Length		3						
	Percent Of Slope		%										
Sample#	Horizon Elevation	Depth	% Slope	Horizon Width (FT)	Volume (Ft^3) Triangle	Volume (Ft^3) Block	Total Volume (Ft^3)	Total Volume (C.Y.)	NP Neutralization Potential	PA Potential Acidity		NP_W_AVG	PA _W_AVG
		Input	Input						Input	Input			
1	1330.00	**4.30**	**65.00**	6.615	14.223	----	42.67	1.580	**0.51**	**0.31**		0.51	0.31
2	1325.70	**2.10**	**65.00**	9.846	3.392	13.892	51.85	1.921	**0.78**	**0.31**		0.66	0.31
3	1323.60	**0.60**	**65.00**	10.769	0.277	5.908	18.55	0.687	**-1.13**	**2.81**		0.36	0.72
4	1323.00	**2.10**	**65.00**	14.000	3.392	22.615	78.02	2.890	**0.00**	**0.00**		0.22	0.43
5	1320.90	**0.15**	**65.00**	14.231	0.017	2.100	6.35	0.235	**-0.25**	**1.25**		0.20	0.45
6	1320.75	**0.85**	**65.00**	15.538	0.556	12.096	37.96	1.406	**1.02**	**0.31**		0.33	0.43
7	1319.90	**2.00**	**65.00**	18.615	3.077	31.077	102.46	3.795	**0.17**	**1.25**		0.28	0.68
8	1317.90	**3.90**	**65.00**	24.615	11.700	72.600	252.90	9.367	**0.00**	**0.00**		0.16	0.39
9	1314.00	**0.70**	**65.00**	25.692	0.377	17.231	52.82	1.956	**1.96**	**2.19**		0.31	0.54
10	1313.30	**1.30**	**65.00**	27.692	1.300	33.400	104.10	3.856	**-0.74**	**1.56**		0.16	0.68
11	1312.00	**2.00**	**65.00**	30.769	3.077	55.385	175.38	6.496	**-4.02**	**6.88**		-0.63	1.86
12	1310.00	**2.00**	**65.00**	33.846	3.077	61.538	193.85	7.179	**-3.43**	**1.88**		-1.12	1.86
13	1308.00	**4.00**	**65.00**	40.000	12.308	135.385	443.08	16.410	**-7.80**	**4.38**		-3.02	2.58
14	1304.00	**5.00**	**65.00**	47.692	19.231	200.000	657.69	24.359	**2.35**	**3.75**		-1.42	2.92
15	1299.00	**5.00**	**65.00**	55.385	19.231	238.462	773.08	28.632	**1.37**	**2.81**		-0.70	2.89
16	1294.00	**3.65**	**65.00**	61.000	10.248	202.154	637.21	23.600	**3.33**	**3.44**		0.01	2.99
17	1290.35	**1.45**	**65.00**	63.231	1.617	88.450	270.20	10.007	**6.88**	**10.31**		0.48	3.50
18	1288.90	**2.55**	**65.00**	67.154	5.002	161.238	498.72	18.471	**1.34**	**1.88**		0.58	3.31
19	1286.35	**0.80**	**65.00**	68.385	0.492	53.723	162.65	6.024	**-6.89**	**9.69**		0.31	3.54
20	1285.55	**0.90**	**65.00**	27.077	0.623	23.123	71.24	2.638	**-4.59**	**3.44**		0.24	3.54
21	1284.65	**4.65**	**65.00**	34.231	16.633	125.908	427.62	15.838	**-0.35**	**3.13**		0.19	3.51
22	1280.00	**5.00**	**65.00**	41.923	19.231	171.154	571.15	21.154	**0.39**	**2.50**		0.21	3.40
23	1275.00	**5.00**	**65.00**	49.615	19.231	209.615	686.54	25.427	**1.59**	**3.75**		0.36	3.44
24	1270.00	**1.50**	**65.00**	51.923	1.731	74.423	228.46	8.462	**1.59**	**3.44**		0.40	3.44
25	1268.50	**3.50**	**65.00**	57.308	9.423	181.731	573.46	21.239	**4.41**	**5.63**		0.72	3.62
26	1265.00	**5.00**	**65.00**	65.000	19.231	286.538	917.31	33.974	**1.44**	**2.19**		0.81	3.45
27	1260.00	**3.20**	**65.00**	69.923	7.877	208.000	647.63	23.986	**1.83**	**1.88**		0.88	3.34
28	1256.80	**4.70**	**65.00**	77.154	16.992	328.638	1036.89	38.403	**2.25**	**1.88**		1.03	3.18
29	1252.10	**4.40**	**65.00**	83.923	14.892	339.477	1063.11	39.374	**1.78**	**0.63**		1.10	2.93
						Totals	**10782.96**		**5.79**	**83.48**		**-4.92**	**0.00**

Weighted NP Avg. -4.92

Weighted PA Avg. 0.00

Net Weighted Potential: **-4.92**