# An Ounce of Prevention Is Worth a Pound of Water Treatment!


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## Introduction

CoalTrain Corporation was formed in 1975 when Bill Larew, President of Larew Coal Company, retired. Bill Larew (Glenn Larew's father) began mining coal in the early 1940's. Through the 1950's and 60's, he operated small I deep and strip mines. After the organization of CoalTrain in 1975, the company has mined coal from the Upper Freeport, Bakerstown, and Pittsburgh coal seams in Taylor and Preston Counties. It is a small, non-union, family-run operation employing between 12 to 18 men depending on the number of jobs active and working. CoalTrain operations over the years have been at two locations concurrently. The first has gene-rally been a Bakerstown job while the other was either a Pittsburgh or Freeport remining operation. Because of the alkaline nature of Bakerstown coal overburden, this overburden has been used to "sweeten" the acid soils/overburdens of Pittsburgh and Freeport jobs.

## Site Descriptions and Mining Technique

### Bakerstown Job

In 1986, CoalTrain received a permit to mine 70 acres of land underlain by the Bakerstown coal seam on Snake Hill Road, approximately 1 mile northwest of Masontown, West Virginia. Contour haulback mining methods were used on the site. The premining land use was pasture and the surrounding land use was predominately pasture for dairy and/or cow-calf operations. Soil on the site was 3 to 6 feet deep and of good quality. The overburden was characterized by about 35 feet of gray shale, 20 feet of alkaline red shale and limestone, and 15 feet of fractured sandstone. There has been no history of acid mine drainage problems with mining in this area due to the presence of the red shale and limestone in the upper 20 feet of overburden (Table 1). In fact, disturbance of this overburden material has often raised the pH of surrounding streams.

The overburden required blasting and due to the high water content of the overburden, an emulsion explosive was used. A Clark 475C loader (12 yd bucket) was employed for overburden removal into two International 350 Pay Haulers which carried approximately 50 tons of rock. The highwall averaged 45 feet to a maximum of 70 feet. A Fiat Allis HD 31 bulldozer was also used for regrading and backfilling the site. No water quality problems have been experienced during the mining of this site. Approximately one-fourth of the alkaline red shale material in the overburden was separately loaded and hauled to a nearby Upper Freeport job.

The Bakerstown coal seam was mined using one 7-yd loader and hauled to Reedsville to a coal stockpile facility where it was mixed with other seams of coal. Annual production at the site between 1988 and 1991 averaged 60,000 tons per year -

### Upper Freeport Job

The Upper Free-port job was located about 1 mile northwest of the Bakerstown site. The site was contour mined and daylighted some deep mines which were mined in the 1950's. Little topsoil was available on the site but that small amount was saved and stockpiled. The overburden was characteristic of the Upper Freeport coal seam with respect to rock type; approximately 60 feet of massive and some fractured sandstones, and 10 feet of gray shale were present (Table 2). According to the Acid-Base Account, the overburden on this site had much more NP than most other Upper Freeport overburdens. Acid mine drainage from the old deep mines had degraded Mountain Run for many years and attests to the potential for generating acid mine drainage upon mining the site. Knowing of the extreme alkaline material nearby on the Bakerstown job, it was decided to remove the old stumps of Upper Freeport coal and prevent the acid from being formed by importing alkaline material to this site.

Selective handling and placement of acid-producing materials along with importation and placement of alkaline material on the pavement was deemed as a essential element to the mining and reclamation plan. By compacting the acid-producing material thereby reducing water infiltration and oxygen diffusion, and also covering the acid material with alkaline material, the resulting water pH should be high and the dissolved oxygen content low. Under these conditions, the production of acid mine drainage should be reduced or eliminated. With proper identification, handling and placement, it was felt that acid mine drainage would not be a problem on the active part of the job and the old deep mine discharges could be eliminated.

The permit was received in March 1990. One cut averaging 150 feet back into the deep mine was taken. Slope at the site was steep (40%) and therefore only one out was taken before the overburden became more than 70 feet thick. The overburden was blasted on 16 to 18 foot centers with Anfo. Blasting was conducted to fracture the rock and shale to facilitate removal with dozers and loaders. However, blasting was controlled so that the potentially-acid material was not pulverized. This process was important because large chunks of acid material expose less surface area for weathering and acid generation. The large chunks of acid material also required less alkaline material for neutralization. The alkaline material was a friable shale material that weathers very rapidly and, as such, reacts quickly utilizing nearly all of its neutralizing potential.

Several pieces of equipment were used for overburden removal and include one International 400 loader and two International trucks (50 ton). This site was located at the top of a narrow hollow limiting the space for equipment movement. The distance of rock haulage was 500 feet or less on this job. The acid material was compacted and covered within a day or two of its excavation to prevent oxidation and leaching.

The coal was mined by a 7-yd loader into trucks which hauled the coal to the coal stockpile in Reedsville. A binder of 3 to 4 inches of black shale occurred in the seam and was removed and handled separately. Once the bottom coal was loaded from the Freeport job, about 2 to 4 feet of the alkaline red shale from the Bakerstown job was placed on the Upper Freeport pavement and covered. As trucks hauled out coal, they backhauled alkaline shale. The pit floor was covered with alkaline shale the same day coal was removed. As a result, any water that accumulated in the pit had a pH of 6.5 to 7.0, thereby further reducing the possibility of acid production. The black shale binder between the breast and bottom coal in the Upper Freeport seam was placed about 20 feet up from the pavement and compacted into one layer about 1 foot thick. This material was also covered with a I foot layer of alkaline red shale from the Bakerstown job. These layers were then compacted by bulldozers and trucks and covered. About 6 inches of the alkaline shale were also spread on the surface and mixed with the topsoil.

## Volumes and Costs of Moving Overburden from Bakerstown to Freeport Jobs

Volumes of alkaline material imported to the Upper Freeport job from the Bakerstown job amounted to about 6600 tons per acre. This represented about 3 feet of alkaline material if that amount of material was spread evenly over one acre of mined area. Using the numbers from the Acid-Base Account, the alkaline, material, from the Bakerstown job had excess CaCO of about 300 tons per 1000 tons (Table 1). The shale binder in the coal seam at the Upper Freeport job showed a deficiency of about 60 tons per 1000 tons (Max Needed) to neutralize the acidity calculated from %S (Table 2). So, theoretically one foot of Bakerstown alkaline material should neutralize or balance the acidity generated from 5 feet of Upper Freeport toxic material if the particle size of the two materials were the same. Based on the location of the overburden analysis hole, the Upper Freeport overburden analysis in Table 1 contained a 6-inch binder of toxic material (60 tons/1000 tons deficiency), 5 feet of 6 tons/1000 tons deficiency material (layer 8), and 15 feet of potentially acid-producing material (layers 10, 11, and 13). The overburden analysis from this Upper Freeport hole was used as a reference but changes were common especially in this area of Upper Freeport overburden. Therefore, adjustments were made based on observation during mining. The actual zone of toxic material in this area where the alkaline material was used was about 6 feet. Based on the blasting technique, the particle size of the materials favored the alkaline material. In other words, a large safety factor was built in by importing 3 to 4 feet of alkaline material from the Bakerstown job.

The quantity of alkaline material transported to the Freeport job represented a cost of about $.50 per ton of coal removed. An average of about 8,000 tons/ac of coal was removed making the cost of hauling the alkaline material to the site about $4000/ac. This cost only included hauling the material from the Bakerstown job to the Freeport job. Handling and compacting costs were integrated into the method of mining and done in concurrence with normal mining. Therefore, with a little advance planning and coordination, these costs were minimal.

Based on water samples from the Calvin deep mine, the deep mine discharged approximately 5 to 25 gpm of 3.7 pH water with 60 mg/l acidity. Using an average of 15 gpm with 60 mg/l acidity, the chemical cost for treating this water was estimated from $200 per year for ammonia to $800 per year with caustic. This estimate does not account for any additional AM that may be potentially created through mining the site without alkaline addition. Without eliminating the potential for acid mine drainage production, the annual cost of treatment (along with any other additional water, acidity, and maintenance costs; increases in chemical costs, inflation, etc.) could be higher and multiplied across 20 to 30 years.

## Conclusion

While the conditions and scale of this Upper Freeport job were not as severe as normally encountered on a Preston County Upper Freeport surface mine, the methods used should be applicable to other situations. Since there were many variables to consider, each site must be carefully evaluated and a site specific prevention plan formulated. The careful execution of the mining and reclamation plan was about as important as the plan itself .

In this day with so much controversy concerning mining, reclamation, and acid mine drainage, it was essential, prudent, and wise to consider the up-front costs of pre-venting AM during the mining and reclamation process. Water quality was addressed before mining, and during mining and reclamation so that it was not a problem. For the well-being of a mining company and in order to obtain future mining permits, AM must be prevented.

Table 1. Partial Acid-Base Account of the Bakerstown overburden.

## ACID-BASE ACCOUNT

| Sample Number | Depth (Feet) | Strata Thick. (Feet) | Rock Type | Fiz | Color | % S | Calcium Carbonate Equivalent Tons/1000 Tons of Material | | | | Paste pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Max. From % S | N.P. $CaCO_3$ Equiv. | Max. Needed (pH-7) | Excess $CaCO_3$ | |
| 1 | 0 - 5.0 | 5.0 | SH | 5 | 2.5Y 7/2 | .001 | .03 | 149.98 | | 149.95 | 7.9 |
| 2 | 5.0 - 10.0 | 5.0 | SH | 5 | 2.5Y 7/4 | .002 | .06 | 213.11 | | 213.05 | 8.1 |
| 3 | 10.0 - 15.0 | 5.0 | LS | 5 | 10YR 7/1 | <.001 | .03 | 569.23 | | 569.20 | 8.3 |
| 4 | 15.0 - 20.0 | 5.0 | LS | 5 | 10YR 8/1 | <.001 | .03 | 335.96 | | 335.93 | 8.3 |
| 5 | 20.0 - 25.0 | 5.0 | SH | 5 | 10YR 7/1 | .010 | .31 | 119.80 | | 119.49 | 8.2 |

Table 2. Acid-Base Account of the Upper Freeport overburden.

# ACID-BASE ACCOUNT

| Sample Number | Depth (Feet) | Strata Thick. (Feet) | Rock Type | Fiz | Color | % S | Max. From % S | N.P. $CaCO_3$ Equiv. | Max. Needed (pH-7) | Excess $CaCO_3$ | Paste pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Calcium Carbonate Equivalent Tons/1000 Tons of Material | | | | |
| 1 | 0 - 5 | 5.0 | SOIL | 0 | 10YR 7/6 | .007 | .22 | 1.62 | | 1.40 | 4.4 |
| 2 | 5 - 10 | 5.0 | SS | 0 | 10YR 7/6 | .013 | .41 | 1.90 | | 1.49 | 4.9 |
| 3 | 10 - 15 | 5.0 | SS | 0 | 10YR 8/4 | .008 | .25 | 2.06 | | 1.81 | 5.7 |
| 4 | 15 - 20 | 5.0 | SS | 0 | 10YR 8/3 | <.001 | .03 | 2.58 | | 2.55 | 6.4 |
| 5 | 20 - 25 | 5.0 | SS | 2 | 10YR 7/4 | <.001 | .03 | 10.59 | | 10.56 | 8.0 |
| 6 | 25 - 30 | 5.0 | SS | 0 | 10YR 7/4 | <.001 | .03 | 3.81 | | 3.78 | 7.2 |
| 7 | 30 - 35 | 5.0 | SS | 0 | 10YR 7/3 | .042 | 1.31 | 2.97 | | 1.66 | 6.8 |
| 8 | 35 - 40 | 5.0 | SS | 0 | 10YR 8/1 | .280 | 8.75 | 2.63 | 6.12 | | 6.6 |
| 9 | 40 - 45 | 5.0 | SH | 3 | 2.5Y 7/2 | .001 | .03 | 63.33 | | 63.30 | 7.7 |
| 10 | 45 - 50 | 5.0 | SS-SH | 0 | 10YR 7/2 | .393 | 12.28 | 21.38 | | 9.10 | 7.3 |
| 11 | 50 - 55 | 5.0 | SH | 0 | 10YR 7/1 | .277 | 8.66 | 9.68 | | 1.02 | 7.7 |
| 12 | 55 - 60 | 5.0 | SH-SS | 0 | 10YR 6/1 | .103 | 3.22 | 27.59 | | 24.37 | 7.7 |
| 13 | 60 - 65 | 5.0 | SH-SS | 0 | 10YR 5/1 | 1.05 | 32.81 | 30.32 | 2.49 | | 7.2 |
| 14 | 65 - 72 | 7.0 | COAL | 0 | 10YR 2/1 | 2.16 | 67.50 | 1.59 | 65.91 | | 4.6 |
| 15 | 72 - 77 | 5.0 | SH | 0 | 10YR 7/1 | .173 | 5.41 | 6.29 | | .88 | 7.0 |