

Beneficial Use of Short Paper Fiber (paper mill sludge) for Pollution Prevention in the Mining Industry

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ABSTRACT

One of the major environmental issues facing the mining industry is water quality and treatment of large volumes of contaminated water. The treatment and handling of these massive volumes of water is not only very costly, but at times, the reason for not receiving new state and federal permits for expanding operations or opening new mining sites. One area of concern is surface water, not only water shedding off mine refuse piles, but rainwater percolating through them.

Short Paper Fiber (SPF) has proven to be beneficial in reducing and in some cases eliminating the generation of contaminated water due to mining operations. SPF is a co-product that is manufactured in the papermaking process. It is a co-product, produced at any mill which utilizes a water treatment system for removing solids and further purification of process water after the papermaking process. The marketing program developed and implemented for selling the SPF product is called BioMix Technology. With proper permitting (in some states) the BioMix Technology has been able to de-classify the SPF material as a solid waste and recognize it as a product based on its' intrinsic properties.

INTRODUCTION

Many paper mills still struggle as to what they can do with their paper residuals. Being that the industry has recently spent billion of dollars in pollution prevention technologies it only goes to reason that mills take advantage of that investment. They need to start exploring markets which can beneficially use co-products developed from these environmental investments. Organizations such as EPA, through their sponsorship of "The Industrial By-Products Beneficial Use Summits", along with the years of work by NCASI, the state regulatory agencies are giving a friendlier ear to beneficial use permitting. We still have work ahead of us, but certainly the environment between paper companies and the regulatory agencies has improved over the past years.

SPF is a co-product having many market outlets but it is still perceived as a waste by the end-users. Having this perception the end-users feel they should receive a tip fee to take the material from the generator. For this reason the generators must develop strong market plans including MSDS sheets, marketing literature explaining the properties and benefits for using the product, scheduling delivery times that meet the needs of the customer, properly completed "Bill of Ladings", and followed lastly with proper billing invoices. One must develop a marketing plan just as you do for the paper products you manufacture.

The mining industry has been around for centuries and is a very active industry today both in the USA and globally. Man has used the minerals in the earth to improve his quality of life for years. For a long time this industry was not regulated under water quality standards. The consensus believed that the spoil left from mining operations was not harmful to the environment. As water impairment became greater and greater around these spoil piles regulations began evolving making the mining companies accountable to the environment. In 1977 a federal law was passed in Congress called the Surface Mining Control and Reclamation Act (SMCRA). The law was promulgated to hold mining companies responsible for returning water bodies affected by mining operations to their pre-mining water quality.

One area of the country suffering severe water impairment was the coal mining areas in the Appalachian region. These coal areas included parts of Kentucky, Ohio, Virginia, West Virginia and Pennsylvania. As one travels through this part of the country you can't help to notice the enormous refuse piles coming from the mining of coal. These refuse piles are referred to as "gob piles" within this region. Today the coal

companies must adhere to strict guidelines for permitting and operating these gob piles. This has created additional costs to the mining industry but the industry stepped forward and took responsibility for operating in an environmental friendly manner.

ACID MINE DRAINAGE (AMD) FROM MINING COAL

AMD is generated when sulfide minerals in rocks that are exposed to oxidizing conditions. The sulfide minerals that commonly occur in coal are iron sulfides, being pyrite and marcasite (FeS_2). When the iron sulfides are exposed to water and oxygen a chemical process occurs resulting in the formation of ferrous iron, sulfate, and acidity. The resulting water has an extremely low pH (3.0 to 2.5) with dissolved forms of iron, sulfates, and at times manganese. In the heavily coal areas within the Appalachian region miles of streams and rivers have been impaired by AMD.

AMD is somewhat like a three leg stool. To generate AMD one must have minerals containing sulfides and the material must be exposed to water and oxygen. The three components making up the legs of the stool are sulfide minerals, water and oxygen. Take away any one of the legs and the stool falls down. The same holds true for AMD, take away any one parameter, sulfide minerals, water, or oxygen and AMD is not generated.

This is where SPF from the paper making process has successfully stopped the generation of AMD. When properly qualified and used SPF can remove two of the three parameters, water and oxygen. With the removal of both oxygen and water AMD cannot be produced.

BENEFICIAL FEATURES OF SPF IN STOPPING AMD GENERATION

SPF is a co-product produced in the manufacturing of paper. The material is produced at nearly all paper mills no matter what technology is utilized in the paper making process. The components of SPF are short fibers, clay, calcium carbonate, mineral fillers and biomass organisms. All SPF products are not the same and can contain any of the components mentioned at different percentages making the SPF. Most of the time the SPF produced at a given mill is very consistent, having variances as low as 1% to 3%. Such consistency is produced by implementing very tight quality control and quality assurance programs. Using such a consistent product like SPF, once the process for placing the material and manufacturing quality topsoil is developed the process runs smoothly.

As mentioned above, all SPF products are not the same. The paper making process for producing the best SPF product for curing AMD comes from deinking operations. These SPF products achieve the highest impermeability values resulting in no oxygen penetrating into the gob coal piles when placed properly. This does not mean that kraft, ground wood, OCC recycle mills and other paper making processes do not produce SPF that can be utilized in the BioMix Technology. The SPF impermeable layer is placed with a dozer directly on the coal refuse making up the gob pile. With three to four passes with the tracks of the dozer the SPF becomes stable even on steeply sloped areas and reaches impermeability values of 10^{-7} or greater. By mixing the SPF product in a 75% SPF with 25% coal refuse along with the proper nutrients one can create a topsoil of superior quality. These SPF topsoils have been proven to achieve moisture holding capacity exceeding 300% over a high quality virgin topsoil. Another added feature of SPF topsoil is 90% to 95% of the water held is available to the growing cover as compared to only 60% to 65% using native soils. On poor quality topsoils, like those used in the mine reclamation business, these values can be as low as 20% to 25% based on what soils are available on-site.

GOP PILES WHICH HAVE BEEN RECLAIMED USING SPF

The Tygart River Coal mining site, owned by Peabody Coal Company, had a gob refuse pile covering approximately 121.5 hectares (300 acres). The site resides on the Tygart River in West Virginia. Prior to installing a \$12 million water treatment facility, this site was a major contributor of AMD into the Tygart River. With the installation of the treatment plant the annual operating costs for chemicals, power, and labor had a major financial impact on Peabody. In 1995 Peabody looked into using SPF to place a final cap on the gob pile to eliminate the generation of AMD. Permits were issued by the state of West Virginia DEP and placement of the SPF product began in the fall of that year. The cap consists of a 45.7 cm layer of SPF product as an impermeable layer followed with a 45.7 cm layer of SPF manufactured topsoil over the impermeable layer. Our utilization rate of SPF was 3,240 cubic meters per hectare. Part of the site was previously covered with on-site soils which did not receive SPF. In comparison of the areas capped with SPF as to those covered with native soils there was a drastic differential in the amount of AMD generated. We not only experienced a major reduction in the AMD from the SPF covered areas, but also a major improvement in water quality. Being that we were well into the project before we fully realized the benefits from the SPF we were not able to generate any meaningful data on water quantity and quality for we had no baseline data to compare the results to. The site manager for Peabody did share with us that he experienced an 80% reduction in the treatment costs for the AMD coming from a major reduction of the generation rate along with the improved water quality.

The next gob pile we reclaimed was a 28 acre site known as the Stacks Run refuse pile located in Gladesville, West Virginia. This site was owned by The Anker Energy Group in Morgantown, West Virginia. Being that the site had no previous reclamation work done and all the AMD was captured in two on-site ponds for treatment we were able to test the AMD to give us baseline data before any SPF arrived at the site. The baseline data showed AMD generation having a pH of 3.0 to 2.8, acidity levels approaching 1,100 mg/l, iron levels peaking at 200 mg/l, total aluminum at 58 mg/l, with manganese just slightly below 28 mg/l. At these levels this AMD was not considered to be a very hot AMD but still required chemical treatment before being discharged into a receiving stream. The first loads of SPF were placed at the site on April 22, 2002. Being such a small gob pile and receiving 550 tons of the SPF product seven (7) days per week in a very short order (60 days) we recorded an improvement in water quality. By the fall of 2002, recorded pH was up to 9.0, acidity levels at 0, iron, total aluminum, and manganese all at < 1mg/l. All water treatment was halted in the fall of 2002 with direct discharge into the stream.

CONCLUSION

With water quality improvements documented like those from Stacks Run how could one not come to the conclusion that SPF is a product. Today the material is marketed under a product marketing campaign as a water treatment matrix. The material currently goes to a permitted decanting lagoon for coal fines where it is used in 244 cm (8 feet) engineered lifts for sealing off the lagoon from water and oxygen to stop AMD generation. This site is permitted for 1.2 million tons of product which will serve the mill for six (6) years.