



Coal Combustion Products Extension Program

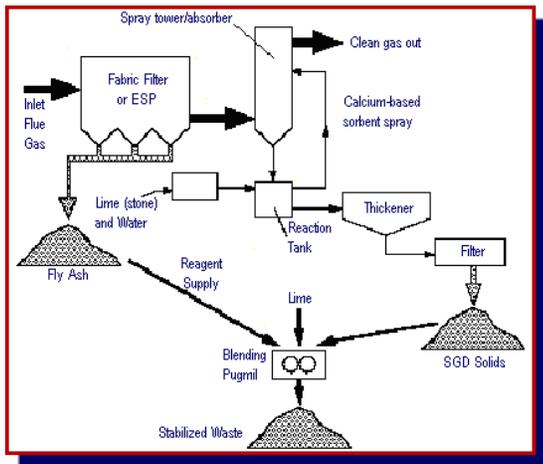
Fact Sheet

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FGD By-Product Utilization at Ohio Coal Mine Sites

Where does FGD By-Product come from?

Approximately 90 % of the electricity produced in Ohio is generated from coal fired electric utilities. Ohio coal mine operators produce over 20 million tons of coal annually, 90% of which is used for production of electricity. In 1990 the Clean Air Act Amendments mandated a reduction in sulfur dioxide (SO_2) gas emissions from power plants. Wet scrubber technology also known as flue gas desulphurization (FGD) is the process that has been implemented in some coal-fired power plants with more coming on line in the next 5 years. In this process, the flue gas enters a spray tower or an absorber where the gas is sprayed with water slurry containing about lime or limestone. The calcium in the water slurry reacts with the SO_2 to form calcium sulfate (13%) and calcium sulfite (70%). This mixture called "filter cake" is then pumped into a thickener where the solids settle. The solids from the thickener go through a dewatering filter that reduces the water content significantly. The filter cake is then mixed with fly ash and lime for stabilization. This material is commonly referred to as stabilized FGD material. Below is a schematic of a typical FGD system:



In the near future several more coal fired power plants will be adding new scrubbers that will produce a different material using a forced oxidation technology resulting in an FGD by-product called synthetic gypsum or calcium sulfate. This material will have engineering and chemical properties that are different from the sulfite rich stabilized FGD by-product.

Will production of FGD in Ohio be increasing?

In 2008 Ohio's coal fired power plants in the coal mining region of Ohio generated 4.2 million tons. Phase 2 of the Clean Air Act Amendments went into effect in 2000, and the amount of FGD material to be produced in eastern Ohio by the year 2012 will be about 10 million tons per year. In Ohio's coal mining region, AEP

operates five coal fired power plants, three of which currently produce FGD material (FGD gypsum at Cardinal in Jefferson County, stabilized FGD at Conesville in Coshocton County, and stabilized FGD at Gavin as well as Kyger Creek in Gallia County). AEP will be adding forced oxidation scrubber units to its Muskingum River (Muskingum County), Conesville, and Kyger Creek power plants beginning in 2009 and will continue installation through 2012. First Energy's Sammis coal fired power plant in Jefferson County will be adding a forced oxidation scrubber system in the next three years.

What is done with the FGD material today?

In the past, FGD material has generally been treated as a waste product and landfilled. However, the desirable properties of FGD and the increasing costs of landfilling as well as the scarcity of landfill space have led utility companies look into the beneficial use of this by-product. FGD material has successfully been demonstrated and is currently available for use as a road base, coal mined land reclamation, livestock feedlot and hay storage pads, wallboard, and landfill liner, or cap system. Ongoing research for other uses of the material include flowable fill, synthetic aggregate, wetland liner, concrete block, soil conditioner, and treatment of sewage sludge.

Can FGD material be used in mine reclamation?

Yes, in Ohio about 5% of the FGD material is used in mine reclamation at both active and abandoned mined lands. In the early 1990's the Ohio Coal Development Office supported and provided cost share funding to several entities that researched and constructed seven demonstration projects at mine reclamation sites. This applied research work resulted in several uses for the FGD material at mine reclamation that includes:

- intermediate and final cover for active coal waste disposal areas
- caps for unreclaimed abandoned coal refuse piles
- pond liners
- grout mix and engineered barriers to abate acid mine drainage from abandoned underground mines, auger mining
- structural fills for abandoned highwalls to eliminate dangerous unreclaimed coal mined highwalls and pit conditions.

Ohio has over 1,364 acres of unreclaimed dangerous highwalls and associated pits within a 15 mile radius of the six major coal fired power plants in the coal mining region. It is estimated that over 500 miles of streams in the state are choked with sediments from unreclaimed abandoned strip mined lands. Over 1,500 miles of streams in the State have impacted by acid mine drainage. There also exist over 4,500 abandoned underground mines with 348,361 underlying acres are known to exist within a 15 mile radius of these power plants in the coal mining region. In many instances, FGD

material can be used to reclaim these mined areas and improve significantly the environment and safety problems caused by these unreclaimed sites. This material could also be used in active mine reclamation where the FGD by-product could be brought back to the mine site via a haul back arrangement.

In 2008 there are two active FGD coal mine reclamation projects ongoing. One involves the backfilling of a dangerous unreclaimed highwall using stabilized FGD as a structural fill, and the second is using the same material as an intermediate layer and impervious cap for an active coal waste disposal area. Both of these sites are located nearby the Conesville Power Plant. Below is an example of an abandoned mined land project (Rock Run AML site, beneficial use of an impermeable FGD cap, 14 acres of coal refuse with 2 feet thick FGD cap covered with 8 inches of reseed material).



Rock Run – pre reclamation



Rock Run – during reclamation



Rock Run – post reclamation (2008)

Who regulates the disposal & beneficial uses of FGD by-product?

FGD material is considered to be an air pollution control waste and is regulated as a residual solid waste by the OEPA (Ohio Administrative Code, 3745-30-B-1). OEPA also administers the beneficial use of coal combustion by products used outside of the coal mining environment. In a mining environment the ODNr's Division of Mineral Resources has authority under O.R.C. 1513. It allows for the beneficial use of FGD material in mine reclamation applications under their policies and guidelines.

What is the chemical makeup of FGD and how does it react in the environment?

The chemical makeup of FGD material depends on the type of scrubber technology and whether the filter cake is mixed with fly ash. The filter cake from older scrubbing technologies consists largely of calcium sulfite, while new forced oxidation scrubbers produce calcium sulfate. Major constituents contributed from fly ash include

Si, Al, and Fe, as well as a number of other minor and trace elements, such as As, Se and B. When fly ash is mixed with filter cake and lime it reacts to gain strength over time. Typical minerals present in FGD include hannebachite, quartz, mullite, hematite, magnetite, and sometimes ettringite. The low permeability of the resulting product acts to minimize contact with water. Research has shown the release of chemical elements to water is generally very low in comparison to the levels observed in acid mine drainage. The lime in FGD acts to buffer the acidity of acid mine drainage waters and raise pH.

OSU is currently studying the chemical composition and leachate characteristics of FGD gypsum.

Who has been studying the potential uses of this material and any potential environmental impact ?

Several entities have been studying this material over the last couple of decades. The OSU has just been recognized by the UEEPA in July of 2008 for their research accomplishments and expertise on the beneficial use of Coal Combustion Products. These studies include: "Re-use of Clean Coal Technology By-Products in the Construction of Low Permeability Liners", "Market Opportunities for Utilization of Ohio FGD and Other CCPs", "Effect of Flue Gas Desulphurization (FGD) By-Product on Water Quality at an Underground Coal Mine", "FGD Product as a Soil Amendment for Mine Reclamation", and the current study entitled "FGD By-Product utilization at Coal Mine Sites; Past, Present, and Future". The National Academy of Sciences issued a study in 2006 entitled, "Managing Coal Combustion Residues in Mines".

What are other states doing with the material in mine reclamation?

Most states have developed their own regulatory approach for the use of coal combustion by products in mine reclamation. For example, The Commonwealth of Pennsylvania has implemented a general permit (WMGR052) for the beneficial use of FGD materials for construction, mine sealing, mine fire and subsidence control, and for reclamation of mine sites. This program is administered by the PA Department of Environmental Protection. The recent study by the National Academy of Science had called for the implementation of federal regulations for mine filling of coal combustion by-products. In cooperation with the USEPA, the Office of Surface of Mining is currently scheduled to release draft federal regulations in 2008, which will be available for public comment.

Benefits

If these FGD materials are treated and applied correctly, these materials have versatile properties that make them suitable raw materials for many uses such as mine reclamation. The recycling of these by product as raw materials in applications that are environmentally sound, technically safe, and commercially competitive should lead to a reduction in the practice of landfilling these raw materials. Their continued utilization will lead to: 1) a decrease in the need for landfill space, 2) conservation of the natural resources of the state, 3) reduction in the cost of producing electricity, 4) lower electricity cost for consumers, and 5) substantial savings for end –users of the by product.

More Information

More details on the uses of coal combustion products, especially FGD materials, can be obtained from the Internet web site <http://ccpohio.eng.ohio-state.edu> or by contacting the CCP Extension Program Coordinator:

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