**REPORT**
FEBRUARY 2001


1. **PROJECT SPONSOR:**
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2. **PROJECT MANAGER:**
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3. **OCDO GRANT NO:** CDO/D-89-35B

4. **PROJECT UPDATE ___ OR FINAL REPORT__X__:**

5. **PROJECT TITLE:** ENVIRONMENTAL MONITORING OF ABANDONED MINE LAND REVEGETATED USING DRY FGD BY-PRODUCTS

6. **PROJECT TERM:** FROM DECEMBER, 1995 TO DECEMBER, 1998

7. **PROJECT CO-SPONSORS**:

| NAME | COST-SHARE |
|---|---|
| OCDO | $ 377,845 |
| DOE-METC | $ 50,000 |
| EPRI | $ 36,000 |
| USGS | $ 157,600 |
| Ohio State University | $ 134,245 |
| TOTAL PROJECT COST | $ 755,690 |

## 1. ABSTRACT

8. **OBJECTIVES**:


The utility industry currently generates about 25 million tons of flue gas desulfurization (FGD) by-products annually in the United States. Utilities expect this quantity to increase as they apply new controls to comply with Clean Air Act Amendments. This report presents the results of a field-scale study of beneficial land-use applications of these by-products in surface mine reclamation.

The Clean Air Act Amendments of 1990 spurred the development of FGD processes that plant managers can retrofit onto existing coal-burning systems. While these processes are proving to be successful at bringing utility operators into regulatory compliance, they also generate byproducts. Landfill disposal of the by-products as solid waste is one management alternative, but a number of beneficial applications in surface mine reclamation exist. Many areas drastically disturbed by surface coal mining prior to the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) are still in need of reclamation. Where conventional reclamation is expensive, or borrow soil is not available, the use of non-hazardous, alkaline flue gas desulfurization by-products as an amendment may be an effective method of reclaiming these lands.

Objectives of this project were:

¥ To improve the understanding of FGD by-products as an alkaline soil amendment alternative, both with and without the addition of compost for reclamation of acid surface minefields.
¥ To evaluate the long-term beneficial effects of the use of FGD by-products on acid mine drainage abatement, plant growth, hydrology, and water quality.

## 9. WORK DONE AND CONCLUSIONS

In autumn 1994, six 0.4 ha watersheds were constructed at an abandoned surface coal mine site in Ohio. The project team completed three treatments including the incorporation of 280 Mg/ha FGD by-product into the spoil; incorporation of 280 Mg/ha FGD by-product and 112 Mg/ha compost into the spoil; and conventional reclamation. Conventional reclamation included the incorporation of 112 Mg/ha agricultural lime into the spoil which was then covered by a 20 cm layer of borrow soil treated with 45 Mg/ha additional agricultural lime. The project team reclaimed areas outside the six small watersheds either by conventional methods or by using FGD plus compost. U.S. Geological Survey scientists used the additional FGD plus compost reclaimed areas to study the potential effects of FGD on interstitial and groundwater quality. They seeded all of the treated areas with a grass-legume seed mixture.

The results of the study indicate that aboveground biomass yields were significantly greater for the conventional reclamation treatment than for the other treatments in 1995 and 1997, but the differences among treatments were not significant in 1996 and 1998. Erosion control was excellent and comparative soil losses decreased for all treatments from < 5.3 Mg/ha in 1995, to < 2.0 Mg/ha in 1996, and then to < 0.7 Mg/ha in 1997 and 1998. In comparison to the conventional reclamation method, researchers found FGD, with and without addition of compost, equally effective in ameliorating chemical conditions that were initially extremely acidic and phytotoxic.

The researchers also monitored interstitial, ground, and spring water quality for four years following reclamation. This report presents data collected from June 1996 through June 1998, and includes some additional data to examine longer-term trends. The beneficial influence of FGD by-product on water quality was evident from lower concentrations of iron, nickel, and zinc in the application-area interstitial waters as compared to interstitial waters from an area reclaimed with conventional methods. Other trace elements derived from the FGD by-product that could adversely affect water quality were well below Maximum Contaminant Levels (MCLs) set by the USEPA. Furthermore, concentrations of these trace elements rarely exceeded instrumental detection limits. Successful reclamation of acidic and toxic mine spoil using FGD is possible, and monitoring of various environmental parameters did not indicate any potential long-term negative impacts of such FGD use.

## 10. PLANS FOR COMING YEAR

Not applicable because this is a final report

## II. HIGHLIGHTS AND ACCOMPLISHMENTS

**11.** This study provides detailed technical information on the beneficial uses of FGD by-products in surface mine reclamation. The results showed successful reclamation of acid and toxic mine spoil using FGD is possible. Monitoring of various plant, soil and water parameters did not indicate any potential long-term negative impacts of such FGD use.

## III. ARTICLES AND PRESENTATIONS

**12**. Papers published or presented this past year are listed below.

Hao, Y. and W. A. Dick. 2000. Potential inhibition of acid formation in pyritic environments using calcium sulfite Byproduct. Environmental Science and Technology 34:2288-2292.

Power, J.M. and W.A. Dick (editors). 2000. Land Applications of Agricultural, Industrial and Municipal By-Products SSSA Book Series no. 6, Soil Science Society of America, Madison, WI, USA.

Dick, W.A., R.C.Stehouwer, J.M. Bigham, W.E. Wolfe, Y.L. Hao, D. Adriano, J. Beeghly and R.J. Haefner. 2000. Beneficial uses of flue gas desulfurization by-products: Examples and case studies of land application. *In* J.M. Power and W.A. Dick (Eds.), Land Applications of Agricultural, Industrial and Municipal By-Products SSSA Book Series no. 6, Soil Science Society of America, Madison, WI, USA.

Dick, W.A., R. Lal, T. Houser, T. Stehouwer, J. Bigham and R. Haefner. 2000. Environmental Monitoring of Abandoned Mined Land Revegetated Using Dry FGD By-Products and Yard Waste Compost. EPRI Report 1000721, Electric Power Research Institute, Palo Alto, CA.

Houser, T.A. 1999. Surface Mineland Reclamation Using Clean Coal Combustion By-Products. M.S. Thesis, Ohio State University, Columbus, OH.