PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

BACK FILL OF ABANDONED HIGHWALLS USING FGD-DERIVED CEMENTS

PRIMARY PROJECT PARTNER

University of Kentucky
Lexington, KY

MAIN SITE

Center for Applied Energy Research
University of Kentuky
Lexington, KY
Ivy Creek Mine
Floyd County, KY

TOTAL ESTIMATED COST

$1,261,487

COST SHARING

DOE	$899,535
Non-DOE	$361,952

Description

Abandoned mine cuts, or highwalls, pose serious problems of slope stability and environmental quality, even while they contain billions of dollars of high quality coal. There are an estimated 5,000 miles of abandoned highwall in the Appalachian coal fields which were augur-mined prior to abandonment. Auger mining uses a large diameter drill-shaped bit to recover coal from up to 150 feet into an exposed seam. The highwall is weakened because there is not enough coal left up front to secure the roof of the mine, and the coal left behind the augured section is not accessible. This “stranded” or “sterile” coal represents billions of tons of America’s best coal. At the same time, the augered highwalls present a serious risk of landslides, slumps, and acid drainage.

This project tests the use of dry flue gas desulfurization (FGD) materials as a low cost grout to fill auger holes in abandoned highwalls, thereby strengthening the highwall face so that the residual coal web can be recovered. This application has important economic and environmental benefits for the Appalachian region.

Automated highwall mining technology, perfected in the early 1990’s, can now recover much of the coal left by earlier contour mining. Problems with rock instability prevent highwall mining of augured seams, however. Attempts to strengthen the highwalls by infilling or grouting the auger holes with conventional materials is too costly to be practical.

FGD materials are an attractive alternative for filling the auger holes. Most dry FGD materials form an expansive cement when mixed with water. Optimizing these cements creates a material that completely fills the highwall voids and becomes a self-stressing roof support. Geotechnical testing of the materials provides information on their strength development and stability. Chemical and mineralogical tests provide information on reactions contributing to strength development as a function of time and the degree of hydration of the FGD material.

Construction procedures for FGD materials are similar to those used for concrete. The FGD material is wetted to minimize dust and to meet EPA air quality standards. Additional mix water is added to bring the FGD-mix to its desired slump of 10 inches. Slump tests and sample specimens are tested according to ASTM standard applicable to testing fresh concrete. The FGD cement is transported from the load-out facility to the placement site in 10 CY continuous mixer trucks. Continued moisture loss associated with hydration reactions of the FGD material while in transit require that additional mix water be added at the site prior to emplacement to optimize the slump for pumping.

Back Fill of Abandoned Highwalls Using FGD-Derived Cements

The optimized FGD mixture is placed in the auger holes using a high capacity concrete pump. A sandbag bulkhead is constructed to keep the FGD material in the auger hole, and the pump discharge is extended approximately 40 feet into the hole so that the entire void is filled. These placement procedures have been documented with a low-light video camera mounted on a robot.

Goal

To ensure the most cost-efficient delivery of electrical power, the DOE is conducting research and development to improve coal combustion by-product (CCB) management. The research program emphasizes characterization and reuse of CCBs to help stimulate markets for new materials such as those produced under the DOE's Clean Coal Technology program. Over the next 5 to 10 years, the program's goals are to develop processes leading to a 100% increase in the current FGD by-product utilization rate, a 10 % increase in the national rate of overall CCB utilization, and a 25% increase in the number of CCB applications considered "allowable" under state regulations.

Benefits

- Cost advantage and environmental benefits from use of by-product material.
- Increased coal recovery and highwall stabilization.
- Expansive FGD cement forms a self-stressing roof support upon curing.
- Density of the FGD-derived cement increases as it cures, while the porosity and permeability decrease with time, providing a durable roof support and preventing leachate migration.

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