

Laboratory and Pilot-Scale Field Testing of CCB Flowable Grout for Mining of Coal

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ABSTRACT

The goal of this research was to develop a flowable grout mix consisting of FGD gypsum and fly ash that can be economically placed in mine voids and possibly re-mined along with coal in abandoned and active coal mines to enhance coal recovery. The grout mix is intended to have properties similar to the regional coal. The grout has to be strong enough to stabilize the voids, but weak enough to be re-mined without damaging mining equipment. Beneficially used FGD gypsum and fly ash will no longer need to be landfilled at an expense to the generator and the environment, but can be used to benefit the environment, the coal mining company, and the generator. The grout is not intended to be a permanent fixture in the void spaces; it can be poured, set, and then may be partially excavated along with the surrounding coal.

The main laboratory properties of the grout investigated in this study were the flowability, unconfined compressive strength, and shrinkage potential. Additional properties investigated included the hydraulic conductivity, solubility, consolidation, and swell potential of the grout. The testing program shows that FGD gypsum and Class F fly ash flowable grouts amended with small amounts of cement perform satisfactorily in laboratory testing. The grout mixes with higher concentrations of FGD gypsum took longer to develop strength, but continued to gain strength during the 90 day curing period. The strengths at 90 days of curing were not significantly affected by the proportion of FGD gypsum and fly ash, but largely dependent on the cement content. The strength development with curing time was mainly based on the proportions of FGD gypsum and fly ash.

In September 2012, a pilot-scale field implementation of the grout injection was carried out to demonstrate that the grout can be mixed and pumped in the field and the delivery method can progress through a simulated roof fall that may be present in an auger hole. A 60-foot long 24-inch diameter pipe with a simulated roof fall in the middle was successfully grouted using typical field grouting equipment. The grout was easily able to make its way through and past the simulated roof fall using a 3 inch diameter steel grouting pipe. Samples of the grout were collected in the field during placement and cored from the pipe. The samples were tested for unconfined compressive strength and show more than adequate strength at 28 days of curing.