# Cementation and Stability of CCP Grouts for Environmental Remediation Projects in Maryland

By Raymond T. Hemmings* and Paul Petzrick**

**Abstract**

This paper is part of a series describing the scientific and engineering basis for the development of CCP based grouts for large scale environmental remediation projects in Maryland. Among these projects is the remediation of acid mine drainage (AMD) issuing from the abandoned Kempton Mine Complex, an area covering about 12 square miles in western Maryland from which AMD is discharged at a rate of millions of gallons per day into Laurel Run, a tributary of the North Branch Potomac River.

Design criteria for the CCP grouts for these projects have been established to ensure ease of handling and injection as well as efficacy underground to reduce acid formation and control subsidence. Among these criteria are rheological properties ensuring sufficient fluidity for optimum fissure and/or mine shaft penetration; adequate strength for ground support; and *in situ* characteristics to reduce acid formation in the abandoned mine workings. At the same time, the CCP grouts must be stable and compatible with the mine water present in the flooded underground mine workings to ensure they retain strength for void filling and subsidence control, and retain chemical integrity against its potential dissolution and release of metals into either ground water or surface water.

The CCPs selected for the grouts were pulverized coal fly ash (PFA) and fluidized bed combustion (FBC) ash from the Mount Storm and North Branch power plants, respectively, both located close to the Kempton Mine Complex. Optimized CCP grout formulations meeting the design criteria were highly cohesive in nature with Bingham or pseudoplastic flow characteristics, and 28-day compressive strengths that could be targeted in the range 500-3000 psi to meet the needs of the different exposure conditions underground. The mechanistic aspects of cementation, stability and efficacy of these CCP grouts is presented in this paper.

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