

**Grant Number:** ACFRFP20-123

**Title:** Time Dependent Pumpable Roof Support Assessment

**Organization:** University of Arizona

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**Partnerships:** GMS Mine Repair and Maintenance

**Focus Area:** Health & Safety Interventions: Ground Control

### Synopsis

**Project Goal:** Pumpable roof supports are increasingly used in underground mines to prevent ground falls because of their advantages in terms of installation, particularly in difficult to access areas. A major constituent of pumpable supports is the cementitious material. Two basic types of pumpable support cementitious materials are currently used in practice: calcium-sulfo-aluminate (CSA) based grout and Portland cement/fly ash (PC/FA) based grout. The PC/FA based grout is less expensive and more commonly used than the CSA based grout. However, when exposed to air, the PC/FA based grout severely deteriorates, rendering the support much weaker and adversely affecting the overall safety. To ensure good performance of pumpable supports using PC/FA based grout, it is critically important to minimize or alleviate the air degradation problem. Therefore, the **major goal** of this project is to determine the scope and severity of the air degradation problem, understand the mechanism for deterioration due to air exposure, and develop guidelines and recommendations for minimizing or alleviating the air degradation problem for PC/FA based pumpable supports.

**Research Approach:** To achieve the overall goal, the research will perform systematically designed tasks in three phases:

- (1) *Assessment of Scale of Problem:* The scope and severity of the air degradation problem for PC/FA based pumpable supports will be assessed by collecting the information and data about the prevalence of PC/FA based supports, the functional service life of pumpable supports, the percentage and severity of bags with rips or tears, and the reported premature support failures or signs of support deterioration. This will be achieved by reviewing publications, reports and related documents, conducting a survey, interviewing pumpable support installers and mine operators, and visiting mines and inspecting pumpable support installations.
- (2) *Laboratory Experimental Testing:* The air degradation problem of PC/FA based pumpable supports will be investigated systematically in the laboratory. Specifically, the air and water permeability of canvas materials currently used in support construction and similar surrogate materials will be measured. Small-scale samples of PC/FA based supports wrapped in currently used crib bag canvas materials and similar surrogate materials at various conditions will be produced and tested to determine the zone of influence and depth of penetration of the air damages as a function of time. Potential supplemental additives to the PC/FA grout for minimizing or alleviating the air degradation problem will also be studied.
- (3) *Large (Full) Scale Testing:* Based on the results from Phase 2, a plan will be developed to further evaluate the effect of air degradation on the loading behavior and capacity of aged full-scale PC/FA based supports. To do that, 8 pumpable supports (2 ft diameter and 5 ft height) will be

produced under various conditions and tested first using the non-destructive ultrasonic equipment and then with the NIOSH Mine Roof Simulator. Several curing times will be considered based on the results in Phase 2 in order to evaluate the time effect. The tested supports will be carefully inspected regarding the air damages. Small samples will also be taken during support production and after support tests for laboratory studies.

**Expected Outcome:** The expected outcome of the project will be 1) enhanced understanding of the scope/severity and mechanism for the deterioration of PC/FA based supports due to air exposure, and 2) developed guidelines and recommendations for minimizing or alleviating the air degradation problem, promoting the safety of PC/FA based pumpable supports.