CDC NIOSH Workplace Safety and Health

Technology News

No. 518 Milestones in Mining Safety and Health Technology May 2006

Super Stopping:
A Permanent Solid Stopping for Directing Ventilation Airflows in Large-opening Metal/Nonmetal Mines

Objective

To identify and evaluate a permanent stopping to direct ventilation airflows in large-opening metal/nonmetal mines.

Background

Significant air quantities are necessary in underground mines to dilute airborne contaminants to statutory concentrations. These contaminants include diesel particulate matter, diesel and blasting fumes, and silica dust. Diluting airborne contaminants is fundamental to safeguarding the health of underground workers. Typically, underground mine ventilation air quantities are produced by fans, while stoppings direct the required ventilation airflow to the active working areas. Stoppings are subjected to air pressures that are generated by the mine ventilation fans or stone production blasts. Maximum ventilation effectiveness is achieved by using a stopping that will withstand the pressure dynamics occurring at the stopping location in the mine and endure the timespan for which the stopping is to be used. Other important stopping design considerations include ease of installation and resistance to damage from repetitive motion caused by air movement against the stopping.

Description

The Super Stopping (Figure 1) is designed for use as a permanent, long-term ventilation control in large-opening metal/nonmetal mines. The stopping is composed of low-density, composite cement and fly ash blocks 48 inches long by 48 inches high by 32 inches wide and weighing approximately 1,200 lb. The Super Stopping is a massive, high-strength structure designed to last for the life of the mine. It is constructed by using an extended-reach forklift to lift and set each block. Factory-installed holes are cast into the blocks to readily receive the forklift tines. The Super Stopping is constructed in three phases: (1) site preparation and foundation, (2) block stacking and adhesion, and (3) top capping and sealing.

Phase 1 – Site Preparation and Foundation

The stopping construction site should be reasonably uniform on the walls (ribs) of the mine, level on the floor, and of relatively equal distance from roof to floor across the opening. The footing for the stopping should consist of standard 3,000-psi concrete embedded with standard 6-inch by 6-inch steel wire mesh reinforcement. It should be 44 inches wide to provide an extra 6 inches on each side of the stopping block, at least 6 inches thick, and span the mine entry.

Phase 2 – Block Stacking and Adhesion

The first course of blocks is aligned along a chalk line struck on the concrete footing. Since it is critical to maintain a stable structure as the construction progresses, careful articulation of the blocks with the forklift is necessary for proper vertical alignment of the stopping. Each block is secured in place

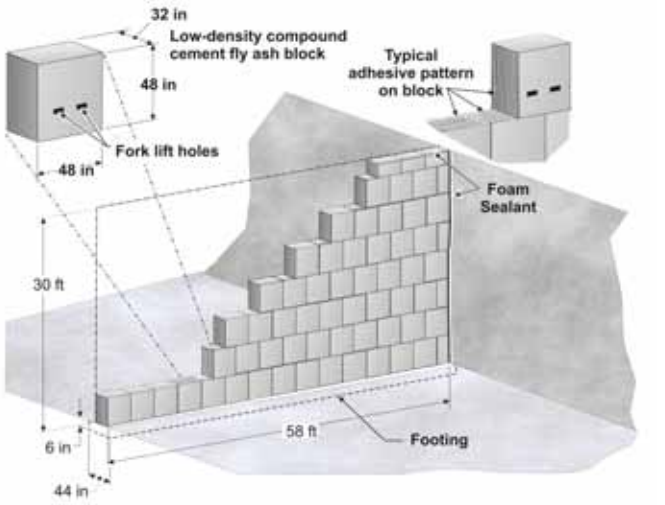

Figure 1.—Schematic of the Super Stopping for use in large-opening mines.

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with a high-grade polyurethane construction adhesive. The adhesive is applied in a Z-shaped pattern with an approximately 2-inch spacing on all contacting sides (non-free-face) of the blocks. The blocks must be laid tightly to ensure adequate adhesive contact for proper bonding and minimal leakage. The blocks are stacked using the standard wall-building method of a half-block staggering pattern laid in successive layers (Figure 2). The fly ash blocks can be scribed and readily cut to fit the rib with a simple handheld saw or ax. Layers of blocks are laid until the remaining gap between the top of the last block and the roof is smaller than the height of the 48-inch block.

Phase 3 – Top Capping and Sealing

To complete construction, smaller or standard-size fly ash blocks, 24 inches by 16 inches by 8 or 6 inches, are used to top cap the stopping structure. Consistent with phase 2, the smaller blocks are half-block staggered and cut to conform to the mine roof and sides and secured with construction adhesive. The blocks should be cut to fit within approximately 3 inches of the mine opening surfaces.

Figure 2.—Partially constructed Super Stopping.

The gaps at the top and sides of the stopping are sealed using an expansion foam product. The foam is applied to approximately one-half the depth (16 inches) of the blocks until the foam completely fills the void. The expansion foam conforms to the shape of both the cut blocks and mine opening surfaces, thus increasing structural stability and minimizing air leakage.

Test Results

Stoppings in an underground mine must withstand air blasts associated with mine development and stone production blasting. The structural integrity of stoppings can be tested by subjecting them to known blast loads. Blast pressure tests using unconfined explosive charges were conducted on the Super Stopping in the large underground entries at NIOSH's Lake Lynn Laboratory. The tests confirmed the integrity of the stopping, which included the strength of the adhesive between blocks, the effectiveness of the perimeter foam, and the overall stability of the stopping. As a benchmark for evaluating the Super Stopping, in-mine blast pressures at an operating underground stone mine were measured at approximately 1 psig. The Super Stopping was subjected up to 3 psig blast pressure from an unconfined explosive charge during the Lake Lynn evaluations. The Super Stopping readily withstood these blast test evaluations without damage to its structural integrity.

For More Information

For more information on the Super Stopping, contact Roy H. Grau III, NIOSH Pittsburgh Research Laboratory, Cochrans Mill Rd., P.O. Box 18070, Pittsburgh, PA 15236–0070; phone: (412) 386–6562; fax: (412) 386–6891; e-mail: **RGrau@cdc.gov**.

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DHHS (NIOSH) Publication No. 2006–134