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Using In-Place Stone Stoppings To Direct Air in Underground Stone Mines

Objective

To improve the ventilation of large-opening underground stone mines by using stoppings made from stone left in place.

Background

Underground stone mines typically use large room-and-pillar openings with little ventilation control. Stone miners may be exposed to contaminants that include silica dust, diesel particulate matter (DPM), exhaust gases, nuisance dust, and face shot (blasting) fume gases. The health risks from breathing these fine particles and toxic organic materials are well documented. Although contaminants such as dust or diesel exhaust can be somewhat controlled at the source, the escaping contaminants are often diluted and removed from work areas using ventilation with minimal controls. In many cases, current mine ventilation practices use trial-and-error techniques to improve ventilation. The growing realization of the importance of a healthy work environment along with increased regulations will require many stone mines to implement new ways to improve ventilation. In-place stone stoppings are one option.

Mine air flows from one point to another because of a pressure differential between those points. This pressure differential is established using a mechanical fan in conjunction with separations (stoppings) between high-pressure (intake) and low-pressure (return) airways. The separation of intakes and returns is an important concept that is used in most other types of mines. Normally, air moves through underground stone mines with minimal control technology. Fans are placed in locations where they are thought to be most beneficial, and intakes are not separated from returns. In a few smaller underground stone mines, proper ventilation can be achieved with a few strategically placed fans. However, as these mines increase in size, moving adequate quantities of air throughout the mine becomes harder, and separation of intakes and returns becomes a problem. Building traditional mine stoppings to separate the intake and return airways in entries with a cross-section area often exceeding 800 ft^2 is difficult. The stoppings must be able to withstand both the dynamic pressure from face shots and the static pressures created by the fans. Construction and maintenance difficulties, as well as high costs, are the main factors preventing these traditional mine stoppings from gaining wide acceptance by the stone mining industry.

In-Place Stone Stopping Concept

In-place stone stoppings eliminate many of the drawbacks associated with traditional constructed mine stoppings. Stone stoppings that connect pillars create a large air wall that is strategically orientated to direct the air to the working face. The stone stoppings are created by eliminating the last face shot that would normally break through two adjoining pillars. To direct the air, the stone stoppings are oriented parallel to the ventilation airflow. Several types of in-place stone stoppings are shown in figure 1.

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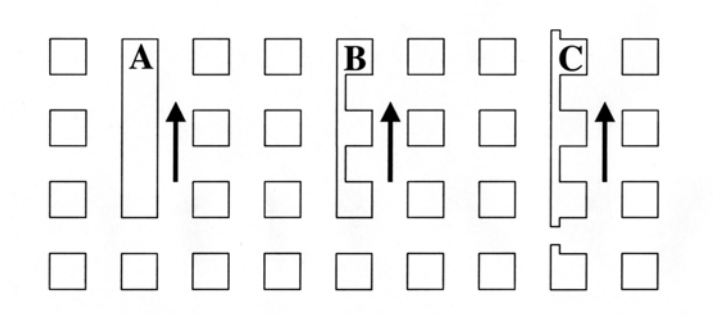

Figure 1.—Various types of in-place stone stoppings. A, Solid stopping; B, notched stopping; C, notched stopping with opening wide enough for truck travel.

Depending on the layout of the underground mine, in-place stone stoppings can be temporary or permanent. Three mine ventilation methods have been previously described by NIOSH researchers: perimeter, split-mine, and unit-ventilation. The perimeter ventilation system is designed to keep the active faces, or the outside perimeter of the mine, always under intake air using air walls. Under this method, the in-place walls are created perpendicular to the development direction and are used until a second air wall is developed several crosscuts ahead of the original wall. Mine development can be adversely affected because of the decrease in the number of working faces when developing around the in-place stoppings. Alternate faces must be used to reduce adverse stone production associated with creating the in-place stone stoppings. Upon completion of the second air wall, the original stone stoppings can be mined through for optimum stone recovery, and bench mining may take place if desired.

Split-mine ventilation is designed to split the mine into two parcels, intake and return, separated by an air wall. Under the split-ventilation method, the in-place walls are created parallel to the development direction and are permanent. The unit-ventilation method is used when a series of units or sections are created that are the active mining areas. In the latter method, in-place pillars help in building the mining units. Mining can be both parallel and perpendicular to the working face. In both split ventilation and unit ventilation, development is not adversely affected because face availability is constant. However, the stone must be left in place until the end of the mine's life.

As part of this research, two cooperating mines are using in-place stone stoppings in their mine design for further evaluation of this technique to control and separate stone mine ventilation.

For More Information

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