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Using Propeller Fans To Improve Ventilation in Large-Entry Stone Mines

Objective

To improve the air quality in large-opening stone mines by developing better ventilation techniques, including appropriate fan selection in conjunction with air-coursing methods.

Background

Stone mines are the most common underground large-entry mines in the United States. Data from the Mine Safety and Health Administration (MSHA) for the year 2000 indicate that there were 162 active nonmetal underground mines in the United States, of which 117 were stone mines. Many underground stone mines are drift mines developed from previous quarry operations. Typically, these room-and-pillar mines have entries that are 20 ft or higher and at least 40 ft wide. These large dimensions lead to a very small ventilating pressure loss, even when significant air quantities move through the mine. This is especially true of drift mine operations where ventilating pressure losses of <0.25 in w.g. are common. Underground stone mines with shafts that are <200 ft deep typically have ventilating pressure losses that are <2 in w.g. The pressure losses through these mines are much lower than those of a typical coal mine or deep metal/nonmetal mine. Therefore, the ventilation techniques and principles are quite different. In addition, because of new MSHA regulations that limit the concentration of diesel particulate matter, these mines may need to greatly increase their ventilation airflow.

Therefore, large-opening mines need a fan that can move large air quantities and operate at low static pressures.

There are three fan types for mine ventilation: centrifugal, axial vane, and propeller. Centrifugal fans are uncommon in underground stone mines as they are often associated with mines requiring the highest of ventilation pressures. Axial vane fans are widely used in all types of mining operations. They are the most common fan type currently found in underground large-opening stone mines. However, they typically do not operate at low static pressures with high efficiency. Propeller fans are currently uncommon in underground stone mines. They are designed for low static pressures and large air quantities at higher efficiency. This fan type best suits the ventilation needs in large-opening stone mines—they produce large air quantities at low pressure losses. Mines with air shafts <100 ft long and at least 12 ft in diameter have fairly low mine static pressures and may also benefit from propeller fans.

Results

Research on propeller fans in underground drift stone mines has shown that significant ventilation improvements can be achieved. In large-entry mines that do not have any high resistance-sections (shafts >100 ft long or shaft diameters <12 ft), propeller fans can greatly increase the total system airflow. Propeller fans can be used as either main mine fans or as freestanding auxiliary (jet) fans. NIOSH researchers have documented the



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Figure 1.—Two propeller fans installed in an underground stone mine.

performance of two recently installed propeller fans in a working limestone mine (figure 1). Together the fans exhausted 750,000 cfm at a rated hp of 200. These fans replaced an axial vane main mine fan that produced 300,000 cfm at a rated hp of 250. The use of the propeller fans more than doubled the air quantity while operating at 50 hp less than the original main mine fan system. In addition, the new fans, when used with effective air-coursing methods such as stoppings, reduced

or eliminated recirculation near the face areas. This is because propeller fans are more efficient at lower pressures and can produce large air quantities at lower horsepower requirements than axial vane fans.

For More Information

For more information on the use of propeller fans, contact Roy H. Grau III or Susan B. Robertson, NIOSH Pittsburgh Research Laboratory, Cochrans Mill Rd., P.O. Box 18070, Pittsburgh, PA15236-0070, phone: (412) 386-6562 or (412) 386-6720, respectively; e-mail: RGrau@cdc.gov or SBRobertson@cdc.gov, respectively.

To receive additional information about occupational safety and health problems, call **1-800-35-NIOSH (1-800-356-4674)**, or visit the NIOSH Web site at www.cdc.gov/niosh

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