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Improvement of Environmental Status of Underground Mines Using Recent Approach of Technology

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ABSTRACT
Many researchers are presently working for the National Institute for Occupational Safety and Health (NIOSH) at the Pittsburgh Research Laboratory are developing ways to protect the health of miners. In the mines, the environmental condition is not always identical due to presence of harmful gases, and Toxic agents based moisture. Hence, improving the air quality in underground stone mines by developing ventilation techniques that can be used in these types of operations. The air quality in these large opening non-metal mines can be significantly improved by using diesel particulate matter (DPM) controls along with sufficient ventilation quantities to remove contaminants. There are several methods are used in Practical sense to shor these issues, but we need some methods of ventilating these underground stone mines can be accomplished by using mine layouts that course and separate ventilation air through the use of stoppings.
Keywords:- Underground Mines, Toxic agents, Air pollution, Environmental condition.

I. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) conducts research into various mining health and safety issues to provide the basis for improvements to U.S. miners' health and safety [1]. It is the organization which develops a safety prerequisite guidelines and equipments for the miners for their safe mining. As we know, in the mines area, the air pollution is very high which reduces the life span of miners up to great extents. This paper describes concepts that can be incorporated into the overall ventilation design of these underground mines. The most common underground large opening mines are underground stone mines followed by underground rock salt mines. Surveillance data from the Mine Safety and Health Administration (MSHA) for the year 2000 shows that there were 162 active non-metal underground mines in the United States, of which, 117 were stone mines and 13 were rock salt mines.

Hence to make the tunnel in a safer manner, for the miners, we need to have the proper ventilation facility. The most common ventilation knowledge and techniques that are utilized in coal and some metal mines are not readily adaptable to large opening mines. The large openings in many mines offer little ventilation resistance to air flow [1]. However, this low resistance permits large air quantities to move through the large opening mines at extremely small mine (fan) pressures. From an engineering design prospective, this large air quantity, small pressure scenario should play an integral part in the overall mine ventilation design scheme.

II. FUNDAMENTALS OF IMPROVING VENTILATION IN LARGE OPENING MINES

In the mines, the harmful gases, non-metal particles are available in the air. So the ventilation is the essential process for releasing of these toxic agents. Previous literature (Head 2001; Grau 2002) has documented the necessity for the large air volumes that are required to effectively dilute DPM concentrations to meet the proposed regulatory standards established by MSHA. In addition to the large air requirements, effective planning for the placement of ventilation equipment and control devices, such as fans and stoppings are necessary to effectively ventilate the large opening mines.

Determining the required air quantity throughout the mine is the first and most important elements for planning effective underground mine ventilation [2].

To release the amount of toxic gases from the mines, we need to implement these factors.

Therefore, we believe, that for the foreseeable future, the eventual DPM regulatory exposure limits will be the dominant parameter driving ventilation requirements for these mines.

III. DESIGNING EFFICIENT VENTILATION SYSTEMS

The fundamental principle of mine ventilation is that air movement is caused by differences in air pressure.

The pressure difference results from either natural ventilation pressures or a mechanical fan(s) or a combination of both. There are currently large variations in the methods used by U.S. underground large opening mine operators to develop air movement. The methods vary from reliance on natural ventilation forces to the use of main mine fan(s) or combinations of both. In addition, auxiliary jet fans (free standing) are often used in most of these systems for local areas or to assist and direct the main mine currents. Since natural ventilation is a product of the differences in densities of air columns in and around mine openings, natural ventilation is largely variable and uncontrolled. The direction and magnitude of natural ventilation will change frequently, often several times in a day and certainly seasonally in temperate climates [1, 3]. Therefore, mines that rely solely on natural ventilation as the primary source of ventilation have a highly uncontrolled ventilation system. It should be noted that natural ventilation is better than no ventilation and natural ventilation may provide satisfactory air exchanges in some circumstances or in some parts of the mine. Natural ventilation has been helpful in some large opening drift stone mines with multiple entries and in parts of mines that have been extensively benched. Even with small differences in elevation, natural ventilation alone can promote large volume air movement and mine air exchanges, although in an uncontrolled manner. In areas that have become extensively benched, the large void created may actually create an “air reserve.”

V. DETERMINING SUFFICIENT AIR REQUIREMENTS

The first step to designing an effective ventilation system in underground stone mines is to determine the total air quantity that is needed for effective dilution of DPM and other contaminants. As previously noted, although many different mining activities emit noxious

Contaminants and require dilution, the result of the new DPM regulations will be that the overriding ventilation design parameter is for the dilution of DPM. In addition, the amount of gases to release is also an important factor so we need to calculate the ratio of ventilation hole with respect to the requirement. even though the total theoretical air quantity needed to dilute these contaminates can be estimated for adequate dilution, sufficient quantities of air must be distributed to areas where contaminates are being generated. Therefore, certain mining operations may require auxiliary fans to adequately dilute the DPM at the source.

The goal for many mine operators in the near

Future will be to have their mine be in compliance with the DPM regulations. We expect that, over time, this will be a process of implementing both DPM control measures and ventilation techniques. Operators are looking at different scenarios in both areas to determine where the most DPM reduction can be achieved in the best practical way.

IV. FAN SELECTION

To make the ventilation process effective we need a highly effective fan system. Many underground limestone mines are drift mines developed from previous quarry operations. Typically, these room and pillar mines have entries that are 6.1 m (20 feet) or higher and at least 12.2 m (40 feet) wide [4].

These large dimensions lead to a very small pressure loss, even when significant air quantities move through the mine. This is especially true of the drift mine operations where our observations found that pressure differences of less than a 24.9 Pa ((0.1 in of water gauge, (w.g.)) are not uncommon, no matter whether these mine are ventilated by natural ventilation, a mechanical fan(s) or combinations of both. Our observations also indicate that the underground stone mines with slope/decline and shaft operations that are less than 70 m (200 ft) in depth, have small mine pressure differences, usually less than 746 Pa (3 in w.g) [3,4]. These differences are or could be much lower if the proper consideration was given to the contribution that the slope/decline and shaft provide to the overall mine resistance. The low pressure loss present in these large opening mines is actually an advantage compared to other type mines and should be treated as such. The ventilation principles, concepts and techniques used to ventilate these mines are different from the techniques used in mines with larger pressure losses. Propeller fans can be used as either main mine fans or as free standing auxiliary (jet) fans. Freestanding fans are commonly used to promote air movement as shown in Figure 1.

Figure-1 Jet Fan

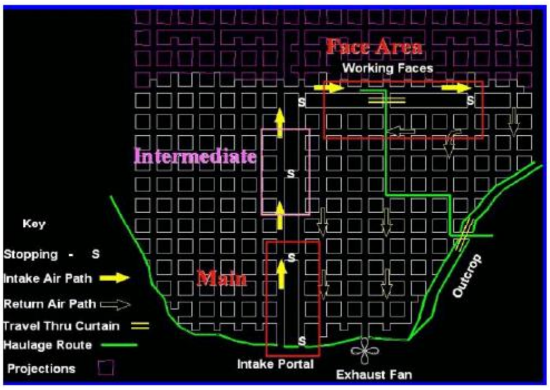

Figure 2. Stopping locations in a typical room and pillar stone mine.

Other important results from these tests showed that the performance of these fans was enhanced by adding a nozzle to the fan.

Results were also significantly improved by angling the fan upward and located against a rib when ventilating a dead-ended opening.

VI. VENTILATION CONTROLS (STOPPINGS)

In order to adequately deliver proper air flows to the face areas, good air controls in the form of stoppings are necessary. Stoppings are physical barriers that separate the intake air from the return air. Since air flows through a mine due to differential pressure between travel points, a pressure difference always exits between the intake and return airways. The stoppings act as a barrier allowing for this pressure differential to exist and circumvent short circuiting of intake air to return air. This single split concept currently eliminates the need for other control measures such as overcasts, regulators and air doors. In many underground mines with large openings, the auxiliary fans are the only control devices used to distribute the air to the face working area.

Stoppings have not been widely used in large opening stone mines. Unfortunately, capital expense, construction, and maintenance problems have impeded this segment of the mining industry from building stopping's [4]. This is particularly problematic in the larger, more established mines. In those mines, stoppings were never incorporated into the mining plan. Retrofitting the mines with stoppings to course the air requires building many stoppings with a corresponding investment in time and construction cost.

Pressures from face production blasts far exceed the ventilation pressure. Tests performed by NIOSH, (Mucho, 2001) found pressures from two different.

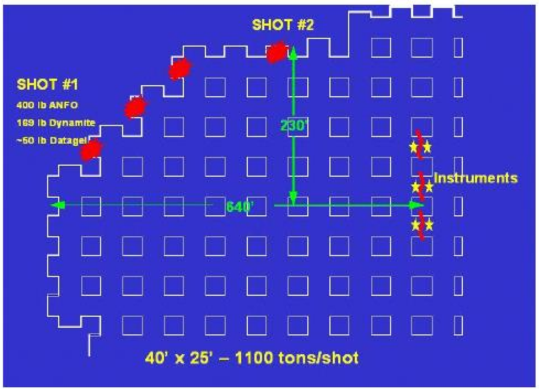

Figure 3. Schematics of tests for measure pressure from face production shots.

Figure 4. Used mine belt used pressure relief.

VII. TYPES OF LARGE OPENING STOPPINGS

Stoppings are built from a variety of construction materials. The construction materials are chosen based upon the desired performance, construction time and ease, and material cost. Construction materials that have typically been used in these mines for stoppings include steel sheeting, cementious-covered fiber matting, mine brattice cloth, used mine belting and piled waste stone.

Used conveyor belting that is no longer useful for material transport can be used to make stoppings. The combination of used belting and brattice have been used effectively in stoppings for both sealing, production face shot relief, and flyrock or other physical damage protection. It has been successfully used as blast relief in a main mine fan bulkhead. Prior to utilizing the mine belt as shown in Figure 4, the mine had several stoppings blown over during production face shots. The mine belt weight and strength allow it to be strong enough to withstand the pressure wave from the face shot but flexible enough to give and act as a pressure relief. Belting hung in this manner should be hung in an overlapping concave pattern to promote interlocking of belting. This technique will minimize air leakage. Figure 5 shows used mine conveyor belt supplementing conventional mine brattice in a stopping.

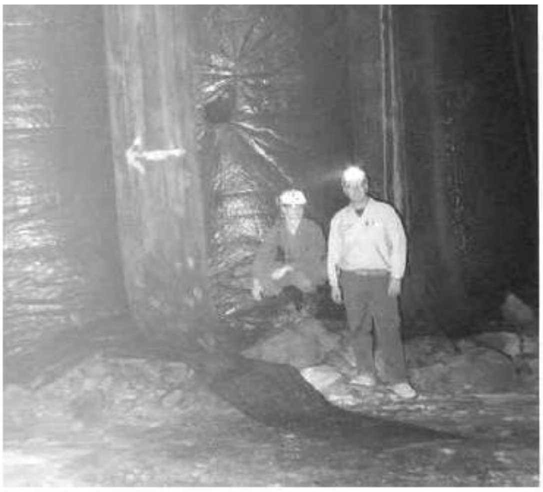

Figure 5. Used mine conveyor belt supplementing conventional mine brattice in a stopping.

Figure 6. Fly rock damage in brattice cloth.

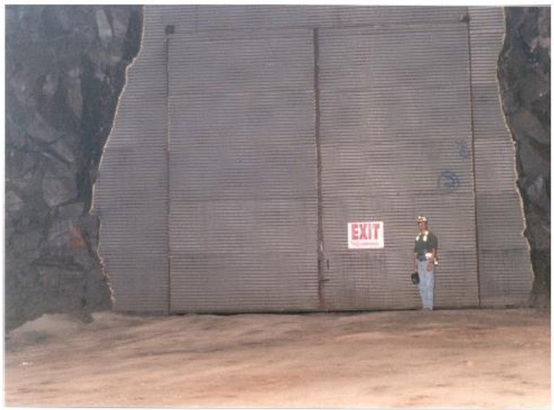

Figure 7. Stopping made for corrugated steel panels reinforced with a steel frame.

Figure 8. Fabric-grid material sprayed with cementious material.

VIII. NATURAL ROCK STOPPINGS

Leaving rock in place to form natural rock stoppings has several advantages. By using the natural rock stopping, leakage, construction, and maintenance costs are eliminated. The rock stoppings are created by leaving at least the last face shot that would normally break through two adjoining openings. This keeps a natural rock integrity between the two adjoining pillars. Similar to constructed stoppings, natural rock stoppings between future independent pillars can be strategically oriented to direct the ventilation air. In order to direct the air, the rock stoppings are oriented
parallel to the ventilation flow. Stone production may be temporarily compromised because the stone in the rock stopping is not immediately mined. However, the rock stoppings can be pre-drilled and mined through at a later time for stone recovery, or for other reasons when the particular stopping line is no longer required to course the air.

IX. CONCLUSIONS

At the conclusion end, we know that the NIOSH is researching various ways to improve ventilation in large opening mines in an effort to assist with methods and techniques to improve the air quality in these mines and therefore the health of miners. NIOSH is currently focusing on fan applications, air coursing, intake and return airway separation using stoppings, and implementing mine ventilation techniques and concepts into the mine planning to accomplish this goal.

Many underground mines are large opening mines that generally feature small ventilation head losses compared to other types of underground mining. Propeller fans are generally well suited to efficiently produce large air quantities under low pressure requirements. Stopping's are necessary to direct and control the mine air. A variety of stopping choices exist for these types of applications and depend upon the quality of the stopping needed.

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