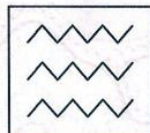




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National University of Water
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CONFERENCE

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TECHNOLOGIES AND SUSTAINABLE USE OF NATURAL
RESOURCES”**

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№3, additional volumes of ore and rock extraction were also determined. With an average density of magnetite quartzites of $3,5 \text{ t/m}^3$, the additional volume of ore is 22,1 million tons, overburden rocks - 2,1 million m^3 , and total mining rock mass - about 9 million m^3 . The additional overburden ratio is $0,1 \text{ m}^3/\text{t}$.

Thus, the investments of PJSC "ArcelorMittal Kryvyi Rih" in the research of safe parameters of prospective contours of open-pits № 2-bis and № 3 will ensure a decrease in the average overburden ratio and a corresponding improvement in the technical and economic indicators of the development of deposits while ensuring a high level of mining safety works.

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SOLUTIONS TO IMPROVE MINING EFFICIENCY FOR THE LONGWALL IN THICK, SLOPING SEAMS OF MAO KHE COAL MINE, VIETNAM

Improving mining efficiency in the longwall is extremely important in directing the operation and actual production of the mine. There are many factors affecting the efficiency of longwall exploitation, including the group of factors on geological conditions and technology. When choosing a mining solution to apply, it is necessary to analyze and evaluate those factors fully and clearly. However, due to the characteristics of mining, during the mining process, it is necessary to make flexible and timely adjustments to match the actual conditions of the longwall to ensure the best efficiency.

The longwall in Seam 6 at East Side of Mao Khe Coal Mine belongs to the thick, sloping seams. The fact shows that the output and labor productivity, as well as the top-coal caving rate have not met the requirements. Through assessment, analysis, combined with methods of comparison and synthesis of data collected at the mine, the author has selected a solution that can improve the efficiency of this longwall. Accordingly, the chosen solution is to preliminarily weaken the top-coal by drilling and blasting. After calculating the technical and economic indicators of the longwall, the output, productivity and recovery rate of top-coal have all been improved.

The research these results can serve as a basis for Mao Khe Coal Mine to apply in actual production in order to improve the efficiency of exploitation of the longwall in Seam 6 at East Side, contributing to improving the mining efficiency for the whole mine. This research result is also the basis to apply to other longwalls with similar conditions at Mao Khe Coal Mine.

For longwall mining technology with horizontal-inclined layers and stratified roadway, the actual annual mining output is about 0,45 million tons, accounting for $\frac{1}{3}$ of the overall mining output of the entire Mao Khe mine [1,2]. However, because the geological conditions in the sloping seam areas of Mao Khe deposit are very complex.

Coal seams have many fluctuations in thickness and slope angle, coal in the seam changes from soft to hard, roof and floor of coal seam change complicatedly [3]. Therefore, some economic and technical indicators of mining technology are not as expected, such as: low coal recovery rate, which leads to high cost indicators, increasing mining costs and affecting the mining efficiency of Mao Khe Coal Mine [4,5].

Factors such as geological conditions, technical and technological factors all affect the efficiency of stratified roadway mining technology for thick and sloping seams [6-9]. In the world and in the country, there have been studies to increase mining efficiency for stratified roadway mining technology.

In the Quang Ninh coalfield, there have been specific directions such as research to increase the top-coal rate to reduce coal loss by preliminary weakening of the top-coal [10,11].

*** Proposing solutions to improve exploitation efficiency for the longwall in Seam 6 of Mao Khe Coal Mine**

When exploiting thick, sloping seams using stratified roadway mining technology, countries around the world and Vietnam have had a number of technical and technological solutions to increase efficiency in the longwall mining process. Specifically, the following two groups of solutions include:

+ *Solution 1: Group of solutions to preliminary weaken the top-coal*

The essence of this group of solutions is preliminarily weaken the top-coal of the mining stratifications, making it easy for the coal to collapse when caving. Depending on each specific condition, the group of solutions for preliminary weakening of the top-coal has three main solutions as follows:

- *Preliminarily weaken the top-coal by pumping water*

The essence of this solution is to drill long boreholes into the top-coal in front of the longwall face and then use pumps and high-pressure pipeline systems to pump water into the coal block from the above boreholes to breaking the pristine state and reducing the durability of the coal block to a convenient limit for top-coal caving.

- *Preliminarily weaken the top-coal with a vibrator and a polarized wave generator*

Essence of the solution: Use a vibrator installed in the tunnel dug in the top-coal in the pressure zone, 15÷20m from the mining mirror to create horizontal waves, causing distortion and destruction of the coal mass. The advantage of this solution is safety in mine conditions with explosive gas and dust; the high level of mechanization allows for increased output and labor productivity. The disadvantage of the solution is that the size of the coal block at the top-coal is uneven; In soft coal seam conditions, the effectiveness of the solution is low.

- *Preliminarily weaken the top-coal by drilling and blasting*

The solution of drilling and blasting to weaken the top-coal is the most commonly applied solution in underground mines around the world and in the country to improve top-coal caving rate when mining sloping seams.

Preliminary weakening of the top-coal by drilling and blasting can be done directly in the longwall face or from tunnels excavated in the top-coal in front of the longwall face. Five commonly applied solutions are as follows:

- Drilling and blasting weakens the top-coal at the longwall face;
- Drilling and blasting in large diameter boreholes;
- Simultaneous drilling and blasting into the roof and floor of the roadway;
- Drilling and blasting in long boreholes;
- Drilling and blasting in short boreholes.

+ *Solution 2: Innovate support technology*

Reality shows that one of the factors that directly affects mining efficiency using stratified roadway mining technology is the support technology in the stratified roadway. In many longwalls exploited using stratified roadway mining technology in countries around the world such as China and Russia, mechanized shields have been used to improve support efficiency and increase top-coal caving rates, as well as improving safety during longwall mining [12].

In Vietnam, the stratified roadway mining technology with mechanized supports has been applied experimentally at Ha Long and Vang Danh Coal Mines. Although the application results have not been successful due to many different reasons, it is still the basis and has created good conditions for the domestic mining industry to access the technology of supporting by shield for applying short longwall face to exploit thick, sloping seams [13].

*** *Selection a reasonable solution for the current conditions of longwall in Seam 6 of Mao Khe Coal Mine***

Two groups of solutions to improve mining efficiency for the longwall in Seam 6 have been mentioned above. In particular, solution group 2 applies support technology using the shields tested at Ha Long and Vang Danh Coal Mines.

Through evaluation and analysis, when applied in the Quang Ninh coalfield, there are still some disadvantages as follows [14].

(1) the shield has a large size and weight, not suitable for the limited space conditions of the stratified roadway, and is often misaligned;

(2) synchronization of equipment imported from abroad, so during the exploitation process, some parts of the shield were damaged and could not be replaced promptly, causing a loss of continuity and affecting the production process;

(3) the seam thickness changes strongly, fluctuating in large directions, the shields are linked together, thus limiting the ability to cut the longwall, leading to the longwall not changing direction in time, so the roof and floor must be cut, that affect the efficiency of longwall mining;

(4) Due to the characteristics of sloping seam mining, the upper mining stratification has ended, so the longwall has water flowing in from the terrain and the shield is sunk, and it is difficult to recover coal at the rear scraper conveyor;

(5) The process of moving the shields is affected by the impact of pressure on both sides of the roadway. At the same time, the shields are pushed into the inside of the roadway, leading to obstacles to the top-coal caving, or even impossible to cave.

The longwall in Seam 6 of the Mao Khe Coal Mine is already being exploited, the excavation of the stratified roadways has been completed, so to apply solution 2 to change the support technology, it is necessary to renovate the entire tunnel system, which requires cost and time, leading to production interruption for the mine.

Therefore, to improve mining efficiency, it is necessary to choose solution group 1, which is to preliminarily weaken the top-coal. In this group of solutions, there are solutions that can be applied. Through evaluation and based on actual conditions for a longwall in Seam 6, this study has selected a preliminary weakening solution.

This study has chosen the solution of preliminary weakening of the top-coal by drilling and blasting at the the stratified roadway in short boreholes. This solution is selected based on the mine's existing conditions in terms of current status, equipment and technology.

*** Conclusions**

- To improve mining efficiency in the mining technology diagram for longwall conditions of Seam 6. Based on experience in weakening the top-coal in domestic and foreign underground mines and to suit the geological and technical conditions of the mine, as well as the current state of technology and equipment available at Mao Khe Coal Mine, the author has researched, analyzed and selected the solution to preliminary weaken the top-coal by blasting in short boreholes from the stratified roadway to improve the top-coal caving rate and reduce coal loss in the stratified mining longwall.

- Based on the selected solution to improve the efficiency of the mining technology diagram for the longwall in Seam 6, in order to apply the research results to actual production, the author has conducted a design to apply the solution in specific conditions is a longwall in Seam 6. The results of calculating economic and technical indicators all show that it is more effective than the diagram that has not applied the solution of preliminary weakening of the top-coal.

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IMPROVING THE SAFETY OF KRYVBAS MINERS BY IMPROVING THE EQUIPMENT OF THE MINING RESCUE SERVICE

The mining industry of Ukraine is focused on the fulfillment of two main tasks: increasing the volume of mineral extraction while simultaneously increasing the level of safety of mining operations.