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Discussion on Dust Control Technology of Coal Mine Integrated Excavation Face

Youfan Deng

Chongqing Research Institute of China Coal Technology and Engineering Group Corp, Chongqing 400037, China

Abstract: Coal is an important energy source in our country, and coal mine dust seriously endangers production safety and occupational health and safety, so it is necessary to take effective technical measures to prevent and control the coal mine. According to the main technical ways of dust prevention and control, the technical measures such as improving dust-proof water, strengthening coal seam water injection, carrying out high-pressure external spray, dust control and dust extraction purification, air flow purification and individual protection are discussed respectively. Finally, the technical measures of dust prevention and control in the future are prospected, and several technologies and equipment should be emphasized to break through.

Keywords: Coal Mine Excavation Surface; Dust Control; Technical Measures; Dust Collector.

1. Introduction

China's coal reserves are relatively richer than other energy mineral resources, although the national policy has increased the investment in new energy in recent years, coal is still in the main position in the energy structure, the total coal consumption still accounts for about 60% of the total energy consumption, and in the future for a period of time, coal will continue to become the main energy in China. Provide factors of production for economic development [1].

With the continuous improvement of coal mine production output and mining technology level, dust hazards are also increasing, affecting mine production safety and miners' occupational health and safety. According to the field measurement, the mass concentration of dust can reach 3000mg/m3 in the case of no dust prevention measures on the excavation face [2]. Although China has paid more attention to occupational health in recent years, the work of dust control is still a long way to go. In the aspect of dust control in coal mine driving face, it is necessary to continue to carry out technical and technological research and take effective technical measures.

2. Technical Measures for Dust Prevention and Control of Working Face of Integrated Excavation in Coal Mine

At present, the main technical approaches for dust prevention and control of comprehensive excavation face are: improving the dust exposure characteristics of dust control water, coal seam water injection to reduce dust production, high pressure external spray to control dust diffusion, control dust removal and dust extraction purification, tunnel air flow purification, and individual protection to reduce dust exposure of workers, so as to realize effective protection of workers [3].

2.1. Optimize Water Quality

The Coal Mine Safety Regulations (2016 edition) put forward the requirements of suspended matter content and hardness index in the water quality for anti-dust reduction. If the dust-proof water is not up to the standard, the anti-dust reduction system (pipelines, control valves, nozzles, etc.) cannot be used normally, which seriously affects the anti-dust reduction effect. Automatic backwash filtration technology can be used to achieve automatic blockage prevention through intelligent hair flushing, and the filtration efficiency is high, which can effectively remove suspended particles in water. Using mobile water softening technology and resin as the intermediary, sodium ions and magnesium ions are replaced, thus reducing water hardness [4]. It is difficult for coal dust to be moistened and settled in ordinary water, so it is necessary to add special wetting agent to reduce the surface tension of water, so as to improve the condensation and combination effect of water mist and dust in the process of dedusting, and thus improve the efficiency of dedusting [5-6].

2.2. Coal seam Water Injection Technology Reduces Dust Production

With the development of technology, coal seam water injection has become one of the important measures to reduce the dust concentration from the source. Among them, the "three-pressure belt" segmented water injection and dust prevention technology is used to carry out high-pressure water injection and anti-reflection successively in the coal body stress reduction area, stress increase area and original rock stress area on the integrated excavation face. The crack of coal body is opened and the dust around the crack is wet, and then the water enters the micro-pores to further wet the coal body by means of static pressure seepage and capillary adsorption. At the same time, the intelligent water injection monitoring system can realize the automatic monitoring of water injection pressure, flow rate, water injection amount, water injection time and other parameters, as well as the automatic identification and control of leaking holes [7].

2.3. High-pressure External Spray Controls Dust Diffusion

Spray dust removal technology has high practicability, low cost, simple operation, and excellent dust control effect, and is also a more widely used way in coal mining face at present. The inner spray of the boring machine is easy to be blocked, and it is basically impossible to carry out normal dust removal work. In the actual production process, the TBM mainly uses high-pressure external spray dust removal technology, which

has become an important measure for dust-proof work of comprehensive excavation face at this stage [8]. The spray fog flow emitted by the high-pressure spray dust removal technology can effectively control the dust diffusion, control most of the dust in the driving surface, and has a strong dust control effect, which can reduce the pollution caused by the dust containing air to the working environment to a certain extent.

2.4. Dust Extraction and Purification Technology of Dust Collector

After carrying out the above-mentioned measures, the integrated excavation surface can still achieve the dust quality concentration standard, so on this basis, it is necessary to match the dust extraction and purification technical measures of the dust collector. At present, the dust extraction and purification technology of precipitator is widely used in China's coal mining face, which is mainly divided into two parts: dust control and dust extraction. The dust control link makes the working face air supply form a clean air curtain through the vortex air duct or the wall attached air duct, effectively isolating the dust from the head and controlling the dust diffusion. The dust extraction link is pumped through the negative pressure of the dust collector, which will be controlled in the head-up dust inhalation dust removal system, which is mainly equipped with the dust collector, negative pressure dust extraction duct, dust suction hood, etc. At present, the dust collector is mainly wet filter dust collector, wet cyclone dust collector, washing dust collector, etc. These dust collectors have the advantages of high dust removal efficiency, high dehydration efficiency, small volume and low noise. Dust precipitators can be installed by airborne, random mobile or monorail crane. Research shows that in recent years, the technology of wet dust precipitators in China's coal industry has made rapid development, and a variety of different types and specifications of dust precipitators have been developed and their use supporting technologies have been applied and promoted in the dust control of coal mining faces [9-11].

2.5. Air Flow Purification Technology of Roadway

An automatic spraying system is set up at the entrance of the integrated excavation roadway. Through the real-time monitoring of the dust mass concentration sensor, when the dust mass concentration in the roadway exceeds the specified or preset value, the system automatically starts the whole-section spraying of the roadway to purify the roadway air flow and achieve the dust reduction effect. When the monitored dust concentration in the roadway is normal, the spray will stop automatically [12]. with the support of high-precision real-time dust concentration monitoring technology, the air flow purification technology can realize intelligent air flow purification in the roadway, which is convenient and practical and has high acceptance.

2.6. Individual Protective Measures

Personal protective technical measures, that is, by wearing dust masks to prevent dust from entering the miners' respiratory tract, are the most effective occupational disease protection measures and the last line of defense. However, conventional dustproof masks, because they need to achieve efficient dustproof effect, have respiratory resistance, and there will be a feeling of choking after wearing, so in the heavy physical labor intensity, miners have to wear resistance or do not wear. With the continuous progress of technology, the latest positive pressure air supply mask solves this problem by adopting efficient filtration and active air supply technology to provide positive pressure air supply and realize breathing freedom [13].

3. Management Measures for Dust Control

With the development of China's economic market, the level of science and technology has been continuously improved, at this stage, all aspects of coal mining have a variety of ways corresponding dust prevention technical measures and equipment, but due to the diversity of dust generation, the need for a number of technologies and equipment with each other, in order to achieve efficient dust prevention effect. Therefore, safety and occupational health must be put in the first place, the use of more advanced dust control equipment and multi-type integrated dust prevention system, the use of more efficient dust prevention technology; It is necessary to strengthen management, establish a sound supervision and management system, rely on the system, fully mobilize the enthusiasm and initiative of workers through the reward and punishment system, and ensure the continuous and effective operation of dust control equipment to provide a safer working environment.

4. Looking Forward

At present, dust hazards are still one of the main disasters in the coal mine production process, and there is still a long way to go in the development and research of dust control technology and equipment, especially in the following aspects:

(1) Develop and promote the application of remote real-time monitoring and monitoring system for coal mine dust treatment concentration and dust prevention equipment to improve the management ability of the management department for underground equipment;

(2) Research on intelligent and integrated high-efficiency wetting additive formulation and matching process, automatic addition, water quality assurance technology and equipment to improve the dust removal efficiency of respirable dust;

(3) Continue to promote the research of key technology and equipment for dust control and dust removal of integrated excavation face, and further improve the technical level of dust prevention equipment of excavation face.

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