



Analysis of Coal Mine Gas Control and Outburst Prevention Measures

Quan Ma

Henan Polytechnic University, Henan Jiaozuo, Jiaozuo, China
Email: 1265680072@qq.com

Abstract In the process of coal mining and excavation, the relevant staff should pay special attention to the problem of gas outburst, and control the gas content in practice to eliminate the potential safety hazards. Based on this, the relevant personnel need to know the gas content in real time, analyze the change of gas content, find out the influencing factors, and formulate the control plan, so as to effectively prevent gas outburst.

Keywords coal mine; gas control; Outburst Prevention Countermeasures

1. Introduction

Gas content is one of the main parameters of coal seam gas, and it is also an important basis for predicting mine gas emission and coal seam outburst risk [1]. From the point of view of gas geology, the original gas content in coal seam is the geological residual gas content in coal seam so far. At present, scholars at home and abroad have done a lot of research on the accurate determination of coal seam gas content. Kaiser et al [2] studied the control law of geological structure and hydrogeological conditions on coal seam gas generation. Based on the measured value of coal seam gas content in the mining area, the applicable prediction formula of coal seam gas content in the unmined area of the mine field is established [3]. Zhong Lingwen et al [4] established a prediction method of coal-bed gas content under the comprehensive influence of near-in-situ CBM reservoir conditions. The grey system theory was used to analyze the factors affecting the gas content in coal seam, and the main and secondary factors were obtained [5]. The influence factors of gas content in Panyidong Coal Mine are analyzed by grey correlation method. It is concluded that coal thickness, geological structure and roof lithology are the main influence factors [6]. Longwei et al [7] analyzed the influence of geological factors such as fault structure, roof and floor lithology and coal seam thickness on the occurrence of coal seam gas. High gas content will cause explosion and fire accidents. When gas outburst is serious, the staff on the scene are hard to escape. Therefore, gas control and prevention become an important issue of site safety management. In the process of mining, relevant personnel can control the change of geological structure or other aspects to reduce gas production. When the gas content and concentration increase gradually, the relevant personnel need to do a good job of gas extraction, so that the gas content can be reduced, and at the same time, it can be rationally applied. This paper mainly aims at the coal mine gas control and outburst prevention countermeasures analysis.

2. Influencing factors of gas content change in coal seam

With the increase of the scale of mining equipment and the change of mining intensity, the problem of gas outburst becomes more serious. Outburst prevention has become the most important task of safety management. Gas content is directly related to the thickness of coal seam. In the process of tunneling, the thickness of coal seam will only get bigger and bigger, so the safety precautions of tunneling engineering are also more and more [8]. The occurrence of gas accident is directly related to its flammable and explosive nature and geological structure. The change of fold or fault structure will increase the probability of increasing gas content, and the mining action will also cause the change of gas content. In the geological structure of fold, the uneven parts of



fold will hinder the gas flow, so these parts are easy to become gas gathering places. When the gas content is too high, explosion accidents occur. The direction of coal seam will affect the structure of coal seam. When the angle appears in the structure, gas will find a gathering place. In fault structure, it has the characteristics of sealing and permeability, which will promote gas accumulation and increase its content.

3. Gas control measures for roadway tunneling in high gas seam

There are mainly three kinds. One pair of tunneling faces is improved by setting air ducts on both sides of the roadway to increase the air supply. Although this can improve the gas flow rate, not to gather, but will occupy operating space, which is not conducive to the excavation work. When the air volume becomes larger, the worker will be in the space environment where gas or other gas flow rate is larger, and his body will be affected. In addition, the amount of gas released along the way will increase with the increase of time and air duct, which will also cause gas accumulation. The second side is to drain while digging, that is to say, in the process of digging, to implement extraction measures, so as to reduce the gas content, and make it get efficient application. This method can control the gas content in a short time, so that it will not be too high, but it will be affected by extraction technology and extraction time [9]. The process of gas extraction is difficult, the time of gas extraction will be limited, and the amount of gas extraction will be limited. If the relevant personnel can not extract gas efficiently in a limited time, when the gas gathering speed far exceeds the extraction speed, the final gas content will exceed the standard. The third roadway is sprayed. Gas mainly occurs in the cracks of roadways. By using filling materials and spraying roadways, the cracks on the surface of roadways can be filled completely, and the amount of gas emergence will be controlled. However, there are also defects in this way, such as contamination of filling materials, which will affect the health of the surrounding staff. Coating of roadway will be damaged in application, and new cracks will be added to the roadway itself, which provides a good opportunity for gas.

4. Gas Control Countermeasures in coal mining face

In view of the gas control of coal face, the improvement of ventilation system should be taken into account, the reasonable optimization of gas drainage design scheme of coal face can be done, and the gas control in goaf of coal face can be achieved in coordination with the gas control during the mining period, so as to meet the requirements of gas control of coal face.

4.1. Improvement of ventilation system

The most direct and effective way to control gas in coal mining face is to use ventilation and extraction methods. Specifically, in actual operation: first, improve the ventilation system. The traditional mine ventilation system still has some shortcomings. It can not convey air to the inside of the mine in ventilation, and can not offset the pressure brought by gas. Aiming at the existing problems of traditional ventilation, we should improve the ventilation system and choose dual U-type ventilation in operation, so as to meet the requirements of fast and convenient ventilation, increase the ventilation volume, and also maintain the air persistent transmission in the underground. Second, increase the intensity of extraction. In coal mining, because there are more gas in the coal seam itself, gas gushing often occurs. Based on this situation, if we only choose simple ventilation and exhaust, it can not meet the requirements, so we need to use the way of extraction to deal with gas. With the continuous development of science and technology, underground gas extraction technology is also being reformed. At present, some mines have changed the original passive mode, made positive prediction for the gas in the mine, and carried out targeted pre-drainage in advance, thereby reducing the risk existing in mining.

4.2. Optimizing Design Scheme of Gas Drainage in Coal Mining Face

To do a good job of gas control in mining face, this paper analyses the specific design scheme of gas drainage, which can meet the requirements of gas control. For the design scheme of gas drainage, it mainly carries out concrete design from two aspects: pre-drainage of coal seam gas by drilling along seam and pre-drainage of pressure relief gas by drilling through seam in adjacent seam of coal face.



4.2.1. Coal seam gas pre-drainage by drilling along the seam mainly concentrates on the working face, so regional outburst prevention measures should be taken to eliminate outburst before mining. Therefore, drilling holes should be drained along the inclination of coal in the transportation (track) trough, and the pressure difference between drilling holes is 10-15 m to ensure that no blank zone is left in the working face.

4.2.2. In order to prevent a large amount of pressure-relief gas from pouring into the working face in the process of mining, a group of boreholes should be constructed in advance to extract gas from the adjacent seam at intervals of 10 m in the bottom drainage roadway or the tunnel chamber. All pre-drainage boreholes must be evenly distributed. No blank belt.

4.3. Gas Control in Goaf of Working Face in Mining Period

4.3.1. Top corner buried pipe drainage design Closed intubation drainage in goaf. Install a low negative pressure drainage pipe to the top corner along the roof of the air return trough in the front of goaf. Install a three-way pipe every 12-18 m and adopt step-by-step alternate extraction.

4.3.2. Before extraction of pressure relief gas face in goaf, a high-level drilling ground is constructed every 70 m from the return air chute. The high-level drilling ground is arranged at a position of 1 m from the chamber to the roof plate. The drilling horizon is located at 15 and 25 m from the roof plate of the coal seam, covering the fracture zone of 20-30 m in the direction of the working face and the depth of the hole is about 100 m.

4.3.3. Borehole Drainage in Tail Roadway of Goaf

When there are bottom drainage roadways in coal mining face, 3-5 large diameter boreholes are constructed from bottom drainage roadways to vegetable goaf. The drilling layers are about 10-20 m in the top plate of coal mining seam, and the boreholes are evenly arranged in the fissure zone more than 20 m away from the return air roadway. In the process of gas control in coal face of gas mine, while paying attention to practice, safety issues and technology are also needed. These are the basic conditions for gas control. Specifically, in the actual operation, the relevant staff also need to do: first, establish a reasonable prediction system, pay attention to technological innovation. The most difficult point of gas control lies in the coal mining, and it is difficult to predict the actual content and location of gas. Coal mine enterprises also need to formulate corresponding safety management system and put forward effective measures to ensure the safety of underground construction.

5. Coal Mine Gas Outburst Prevention Measures

5.1. Regional Gas Outburst Prevention Measures

In gas outburst prevention, the relevant personnel should first instill this awareness into the staff, so that all personnel on the site can attach importance to gas outburst prevention work, so that they can standardize their own behavior, rigorously treat extraction or other treatment work, so that gas extraction effect is remarkable. In the process of outburst prevention, the relevant personnel should increase the extraction content to reduce the gas accumulation. In the production area, the relevant personnel should also monitor the gas content and pressure in the air in real time. When the content is too high or the pressure is too high, the relevant personnel should pay attention to this phenomenon and take timely preventive measures to prevent gas outburst in coal seam [10]. In regional outburst prevention, relevant personnel should determine the location of gas drainage holes, and design the size of boreholes reasonably so as to reduce gas reserves. Before extraction, the relevant personnel should also check the coal seam, determine its safety and gas content, and then drill the hole to extract according to the actual requirements. Water injection measures can also reduce the regional gas content, in the implementation of this measure, the relevant personnel should do a good job of control. Firstly, the water content of coal seam injected with water should be suitable to reach the wetting degree. When injecting water, the wetting degree should be the same everywhere. In the process of water injection, reasonable boreholes should be drilled so that parallel boreholes can flow water evenly into the coal seam. Coal seam has a certain degree of water permeability, which will certainly affect the wettability of coal seam, so the relevant personnel also need to control the injection time and water volume. Water injection pressure should also be controlled, so that the coal seam will not be overpressured. Pumping hole and water injection hole are different in size and scale, and relevant personnel should do a good job of inspection.



5.2. Local Gas Outburst Prevention Measures

Local coal seams also have the problem of excessive gas content. In view of this outburst event, relevant personnel should also formulate local outburst prevention countermeasures to minimize the gas reserves in local areas. Relevant countermeasures mainly include two kinds. One is to eliminate gas outburst from the root, so that the factors affecting gas production or increase can be controlled and eliminated, so that gas accumulation will be reduced, and it will not constitute a potential safety hazard. Relevant personnel need to loosen the coal seam so that it will not produce gas. Measures such as blasting vibration, blasting loosening, water injection loosening and pressure loosening can achieve the goal, so as to reduce the gas reserves [11]. Secondly, when the gas can not be completely eliminated, the relevant personnel should improve the efficiency of gas utilization, drilling and other measures are widely used. Despite the drawbacks of the extraction technology, the ultimate gas extraction amount can be guaranteed by solving the limitation of extraction time and improving its extraction effect. When the gas extraction amount increases, the remaining gas amount in the coal seam will be reduced, the gas pressure in the coal seam will be reduced, and the gas outburst condition will be eliminated eventually. In addition, advance drilling measures are mainly to reduce the gas pressure in the coal seam, gas will dissipate along the pore, so the amount of locally accumulated gas will be greatly reduced. In this process, the relevant personnel should also pay attention to controlling the size and quantity of the aperture, which will affect the gas dissipation speed and efficiency.

6. Conclusion

In the process of gas outburst prevention, the best scheme is to extract gas efficiently, so that it can be reasonably applied in other areas. However, the requirement of extraction technology is higher and the difficulty is greater. In the process of extraction, there may be other potential safety hazards. Relevant personnel should be fully prepared to effectively prevent and control gas outburst. In gas control, attention should also be paid to avoid causing other safety problems, but also to ensure the safety of the control site. In addition, coal mine enterprises should introduce advanced talents and equipment technology to ensure gas outburst prevention.

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