Study on the Protective Effect of Upper and Lower Coal Seams in the Protection Layer Mining of Middle Distance Coal Seam Group

Ying-jiang ZHOU¹ and Yong-jiang ZHANG²,³

¹Investment Xinji Energy Co., LTD Huainan 232001
²National Key Laboratory of Gas Disaster Detecting, Preventing and Emergency Controlling, Chongqing 400037, China
³Chongqing Research Institute of China Coal Technology & Engineering Group, Chongqing 400039, China

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Abstract. Gas treatment of high gas outburst coal seam group with protection layer mining, based on the engineering geological conditions of the mine, combined with the field engineering test, study on the effect of B10 coal seam mining on the upper cover B11b and down to B8 under the protective layer in the protection layer 22108. The results showed that the protective layer mining combined with drilling pre pumping protected layer gas, the coal and gas outburst danger of the middle and lower coal seams were reduced, the coal seam gas occurrence law was changed, the permeability of coal seam was increased, and the effect of extraction was improved, which provided the technical basis and support for the regional gas control in the protective layer of the mine.

Introduction

Coal and gas outburst is one of the most serious natural disasters often encountered in the production of coal mine, the practice at home and abroad showed that by selecting the outburst danger of small or non prominent seam as a protective layer, so the outburst coal seam becomes non outburst coal seam, high gas coal seam into low gas coal [1-5].

The multi coal seam group in Anhui mining area is characterized by high coal seam, high gas content, low permeability, and serious disaster of coal and gas outburst. Experimental mine is a typical coal seam group, B11b, B8 coal seam are outburst coal seam, selecting B10 coal with less outburst danger as the protective layer which is located in the middle of the two outburst coal seams. In the protective layer mining process, the effective protection range and gas parameters of protected layer were studied, and the effect of pressure relief in protective layer was analyzed.

General Situation of Test Area

The 22108 working face of B10 coal seam is located at the second level, elevation of working face is -620m~710m, the advancing distance is 500m, the stope length is 270m, the dip angle of coal seam is 26 degrees on average, Y type ventilation mode is adopted in the working face. The average interval distance of B10 coal seam with overlying B11b coal seam and underlying B8 coal seam is 35m and 45m. The average thickness of B10 coal is 1.8m, gas pressure is 0.5MPa, gas content is 6.0m³/t; B11b coal seam is a stable coal seam, the average thickness is 2.4m, the gas pressure is 1.6MPa, the gas content is 13m³/t; B8 coal seam is a medium thick coal seam with simple structure, the average thickness is 2.0m, the gas pressure is 3.4MPa, the gas content is 10m³/t. There are coal and gas outburst dangerous in B11b and B8 coal seam, the above 3 coal seams are typical middle distance coal seam group, which provides the condition for the protective layer mining.
**Protection Scope Investigation**

According to the specific engineering geological conditions of the working surface of the protective layer, determination of the upper and lower protective layer in the theoretical maximum protection of the vertical distance of 174m, 68m and minimum mining under the protection of the layer spacing of 16m, according to the measured data, the protection layer mining was feasible. According to "Coal and gas outburst prevention regulations"[6.7.8], determining the scope of design specification protection in accordance with the protective layer protection range, combined with mine specific engineering geological conditions and the field engineering test determining the strike pressure relief angle of overlying B11b coal seam was $\delta_3 = \delta_4 = 58^\circ$, upper and lower pressure relief angle respectively as $\delta_1 = 73^\circ$, $\delta_2 = 87^\circ$, determining strike pressure relief angle of underlying B8 coal seam was $\delta_3 = \delta_4 = 57^\circ$, and inclined pressure relief angle was $\delta_3 = \delta_4 = 75^\circ$. Along the strike direction of protected seam of B11b coal seam working face, opening cut and stopping line staggered for 21.9m, corresponding along the incline direction of B10 coal seam 22108 working face, return airway and haulage roadway staggered for 10.7m, 1.8m. Along the strike direction of protected seam of B8 coal seam, opening cut and stopping line staggered for 29.2m, corresponding along the incline direction of B10 coal seam, return airway and haulage roadway staggered for 12m. The protection range along strike and incline direction of the working face was shown in Figure 1, 2.

![Figure 1. Protection range along strike direction of working face.](image1)

![Figure 2. Protection range along incline direction of working face.](image2)
Protected Seam Extraction Method

The protective layer mining method makes the upper and lower coal seams of the protected seam rupture, loosen, fracture opening and proliferation, in a certain range, the permeability of coal and gas emission intensity were increased, through drilling pre pumping to get the gas from the surrounding coal to be discharged, decreasing gas pressure and gas content, gas potential was released, with the gas continuous discharge, shrinkage deformation occurred in coal, permeability has been greatly improved. At the same time, the range of gas pumping was enlarged and effect of gas pumping was increased.

According to the existing conditions of coal seam and roadway layout, during the mining of B10 coal seam 22108 working face adopted comprehensive treatment method of pumping and gas pressure relief by constructing roof inclined drilling of roadway (15m construction of a set of drilling, the drilling diameter was greater than 110mm, each group of 3 holes), buried pipe along (buried pipe pumping gas in goaf along gob-side entry retaining), crossheading layer-through drilling (two roadway in the B10 coal seam construction B11b, B8 layer-through drilling, 15m construction of a set of drilling, the drilling diameter was not less than 110mm, each group of 4, 5 drilling) and haulage roadway drilling (construction B8 layer-through drilling in haulage roadway, 20m construction of a set of drilling, the drilling diameter was not less than 110mm, each group of 12 drilling), pumping the gas in the pressure relief range of the protected seam in time, and finally, the protected seam was first pumped, after mining, and the gas drainage rate was improved, and the gas content was reduced.

Analysis on the Effect of Protection Layer Mining

According to 51 article of "Coal and gas outburst prevention regulations", protection effect test of protective layer mining mainly uses the residual gas pressure, residual gas content, deformation of roof and floor and other experience confirmed the effective index and method, permeability can also be combined with the coal seam of coefficient of variation and other auxiliary indicators. In the process of protection layer working face mining, the data of gas pressure, gas content, drilling gas pumping volume and the deformation of the roof and floor of the coal seam were collected, comprehensive analysis of these test results, as the evaluation of protective layer mining gas control effect. Delineation of the protection scope in accordance with the above study that the pressure relief angle, arrangement of 3 measuring points, 6 drilling test residual gas pressure of B8 coal seam protected regional, arranged 2 measuring points, 4 drilling test residual gas pressure of B11b coal seam protected area. The maximum residual gas pressure of B8 and B11b coal seams are 0.2MPa and 0.1MPa respectively, Residual gas pressure determination of protected coal seam curve as shown in figure 3. During the test of outburst prevention measures effect, the gas dynamic phenomena such as the jet orifice, crown drilling, drilling tool jamming and so on were not appearing in the period of the drilling construction. To sum up the protective layer mining effect was obvious.

![Figure 3. Protected area residual gas pressure curve.](image-url)
Mining Verification of Protected Seam

Underlying the protected layer 22108 working face after protection layer mining and effect of regional outburst prevention measures test was valid, in the mining process without excessive index prediction and gas emission abnormal phenomenon. During working face excavation maximum gas emission quantity was only 1.6m$^3$/min. 22108 working face achieved the goal of safe and efficient mining, the protected layer working face mining and to verify the protected layer protection and drilling drainage effect is obvious. By protected layer working face mining, the protective effect of the protective layer and drilling drainage effect were verified.

Comprehensive treatment method of pumping and gas pressure relief by using protective layer mining and roof inclined drilling of roadway, buried pipe along gob-side entry retaining, crossheading layer-through drilling and floor layer-through drilling. During the mining process, gas emission in protective layer and protected seam was small, there was no abnormal emission phenomenon, improve the level of the mining face per unit area, production efficiency of working face was improved.

Main Conclusion

[1] 22108 face B10 as a protective layer of overlying B11b coal mining of coal seam, the trend of its tended to, above and below the discharge voltage protection Angle of 58 °, 87 ° and 87 ° respectively; As the underlying the covering layer of B8 coal seam mining, the direction and tendency, tend to be at the bottom of the discharge voltage protection Angle above the 57 °, 75 °, 75 ° respectively.

[2] Under the condition of coal seam dip angle was 26°, and its distance from the upper protective and lower protective layer was 35m and 45m. Based on the field investigation, the variation law of the correlation parameters of the protective layer and the gas drainage was obtained. B11 coal seam gas pressure from 1.6MPa down to 0.1MPa, B8 coal seam gas pressure from 3.4MPa down to 0.2MPa.

[3] Comprehensive treatment method of pumping and gas pressure relief by using protective layer mining and roof inclined drilling of roadway, buried pipe along gob-side entry retaining, crossheading layer-through drilling and floor layer-through drilling, it proved the B10 seam protection layer mining combined with pressure relief gas drainage technology successfully reached the target of regional elimination of B11, B8 coal seam of coal and gas outburst, reducing the gas content, the protection layer was provided with the conditions for safe and efficient mining, coal and gas safety were realized.

[4] Comprehensive regional prevention and control measures for coal seam gas pre pumping combined with protection layer mining, it has achieved good results and economic benefits.

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References


