Gas control technology for high gassy sandstone direct overlying working face during initial mining period

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Abstract. During the initial mining period of the high gassy and sandstone direct overburden face, the working face is faced with not only the large area roof suspension, but also the problem of gas transfinite caused by the sudden roof caving. Deep hole pre-splitting blasting technology is adopted to blast the roof. the practice shows that the main roof collapses completely when the working face advancing 37m, and large area roof suspension is eliminated during the initial mining period. Gas control roadway is constructed at the rear of open-off cut, perforating drilling, bedding drilling and roof drilling are respectively arranged in the roadway, and the pressure relief gas is pumped from the coal seam and its adjacent seam. This technology has increased the daily output of the working face by 33%, and good results have been achieved in the field practice.

1. Geological survey of mine and test area

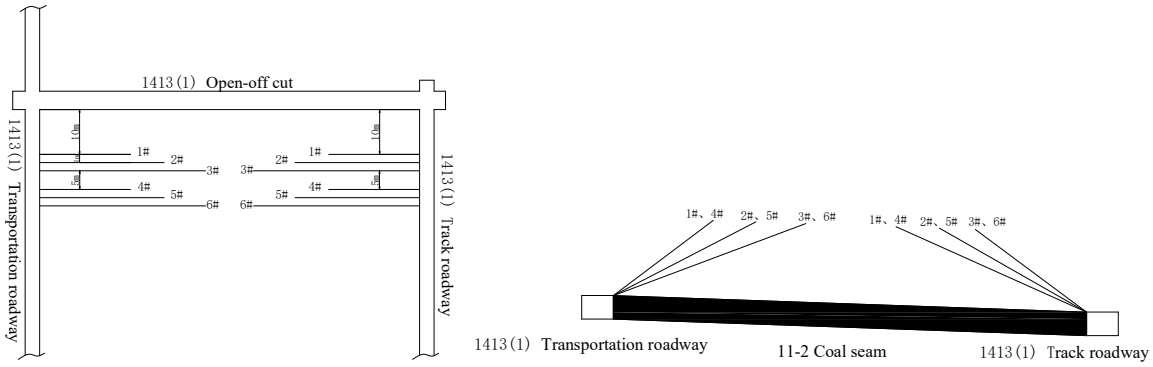
At present, Guqiao Coal Mine currently main mining 13-1 coal seam and 11-2 coal seam, of which 11-2 coal seam gas content is less than 13-1 coal seam, and as a 13-1 coal seam protective layer first mining; The average thickness of 11-2 coal seam is 2.9 m, the inclination angle is 3~4°, the gas content is 5.6 m3/t, and there is a thick sandstone hard roof overlying the 11-2 coal seam, in the process of 11-2 coal seam mining, there is danger of large area roof suspension and gas transfinite.

During the mining period of 1412 (1) working face in 11-2 coal Seam of Nansan mining area, the maximum gas emission of working face reached 80 m3/min. Before the first weight of the main roof, the scope from the open-off cut to the top line of the working face is goaf, which has a large scope and accumulates more gas, resulting in the greater gas emission from the goaf. During the mining period, the problem of hanging roof with hard roof are faced with the working face. The problem of gas transfinite caused by the sudden collapse of hard roof seriously restricts the safe and efficient mining.

The 1413 (1) working face of Nansan mining area is about 2290m long and tends to be 240m long; The direct roof of working face is composed of mudstone, sandy mudstone, fine sandstone and siltstone. The average thickness of sandstone is about 20m. 1413 (1) working face is adjacent to 1412 (1) working face, during the initial mining period, it will also face the problems of large area roof suspension with hard roof and difficult gas control. Therefore, taking 1413 (1) working face of Nansan mining area as the research object, the gas control technology for high gassy sandstone direct overlying working face during initial mining period is studied.

2. Roof deep hole pre-splitting blasting technology

Based on the analysis of surface drilling and underground drilling data, it is known that the roof of 1413 (1) face is fine sandstone with 9~28m lithology, lithology is dense and complete., joints and fractures do not develop, and large area suspended roof is easy to occur in the initial mining process of the working face. Design in front of 1413 (1) open-off cut 10m, a group of blasting hole are respectively constructed on track roadway and transportation roadway. A total of 12 blasting hole are installed. The charge section is 10-26m on the roof of 11-2 coal seam. The charge of track roadway blasting hole is 510kg, and that of transportation roadway blasting hole is 480kg. Design plan and section for deep hole pre-splitting blasting is shown in Figure 1.



(a) Plan (b) Section

Figure 1. Design plan and section for deep hole pre-splitting blasting

3. Gas extraction technology

According to the layout of the roadway, a coal roadway is constructed along the 11-2 Coal Seam behind the open-off cut in 1413 (1) working face, which is specially used for gas control. The horizontal distance between the gas control roadway and the lower open-off cut is 40m, the horizontal distance between the roadway and the open-off cut is 30m, the angle between the roadway and the open-off cut is 9°, and the length of the roadway is 90m. The roadway is supported by anchor and cable net, and the section size is 3.4m × 3.4m. In the gas control roadway, there are 22 drilling have been constructed, including perforating drilling, roof drilling and bedding drilling, which are used to control the gas in the working face. Layout of gas control roadway of 1413 (1) working face is shown in Figure 2.

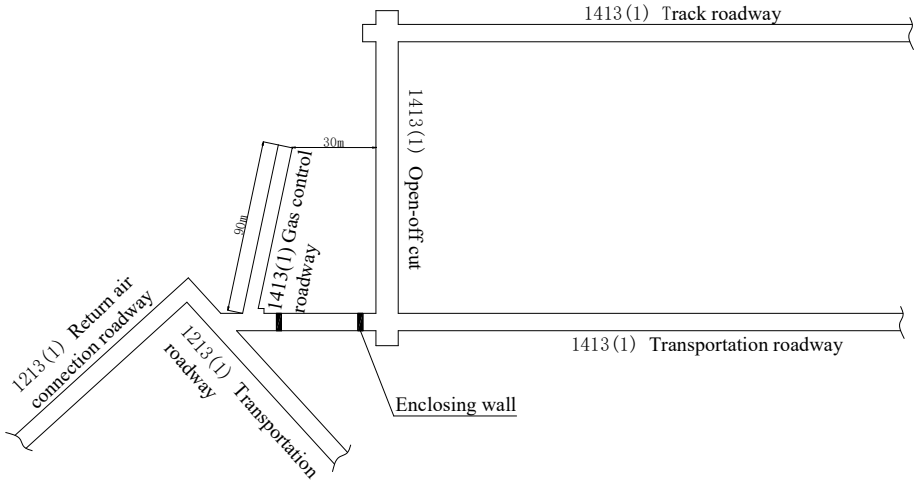


Figure 2. Layout of gas control roadway of 1413 (1) working face

3.1. Design of perforating drilling

Two rows of cross-seam drilling were constructed in 1413 (1) working face to the overlying 13-1 coal seam. A total of 12 holes were drilled to pump pressure relief gas in the 13-1 coal seam. The first row is 80m away from the track roadway, 60m apart from the two rows, 10m apart from each row of the final drilling, the final hole point in 13-1 coal seam, 40m inside the working face and 10m outside the working face.

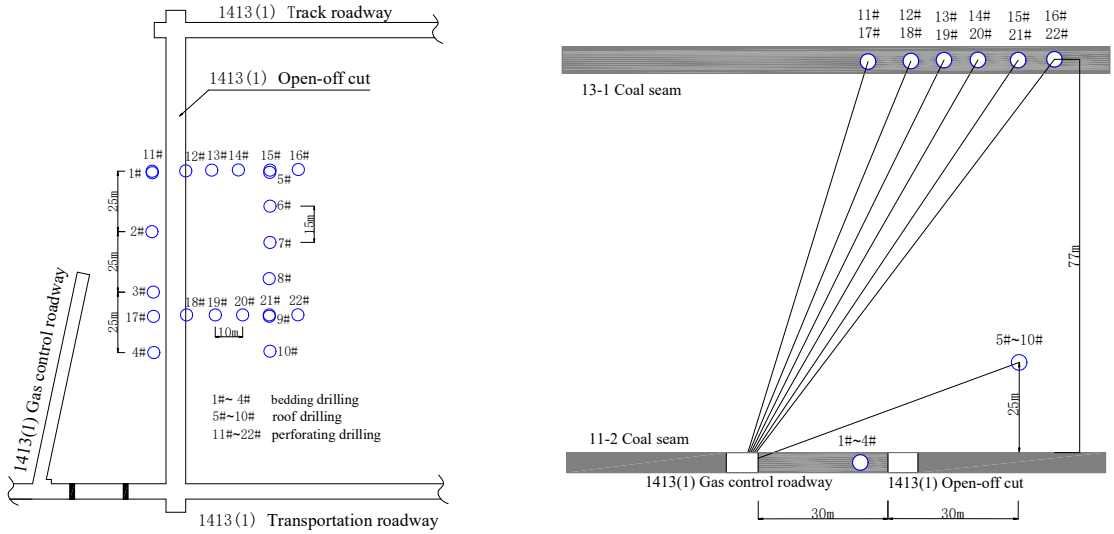
3.2. Design of roof drilling

A row of roof drilling was constructed above the goaf of 1413 (1) working face. A total of 6 drilling were constructed to intercept and extract pressure relief gas from working face and goaf of 13-1 coal seam. The distance between 11 # hole and track roadway was 80m, the distance between the end drilling was 10m, the distance between the end drilling was 25m from the roof of 11-2 coal seam, and 30m inside the working face.

3.3. Design of bedding drilling

A total of 4 drilling were arranged along the 11-2 seam, and gas in 1412 (1) goaf and gas in the 1413 (1) working face were pumped. The distance between the 1# drilling is 80m from the track roadway, and the distance between the final drilling is 25m, and the distance between drilling and the open-off cut is 10m.

Layout of drilling in gas control roadway is shown in Figure 3.



(a) Plan (b) Section

Figure 3. Layout of drilling in gas control roadway

4. Effect Survey

4.1. Gas pump effect in working face

Through laying 325mm diameter gas pump pipe in 1413 (1) gas control roadway, adopting ground permanent drainage system station to pump gas, and installing matching orifice plate and automatic metering device to inspect the effect.

Mining began on January 16, 2016, and the main roof of the face caved on January 27, 2016 (working face advancing 37m). On January 25, 2016, 1413 (1) gas control roadway began to pump gas; On June 16, 2017, the end of mining, as of October 31, 2016, a total of 3150160 m3 of gas was pumped. On June 16, 2017, the 1413 (1) working face was completed. According to the observation of the ground pressure,

the displacement of the roof, floor and two sides of the roadway was very small, which effectively guaranteed the pore-forming effect of the sealing section.

On January 27, 2016 (main roof caving) the extraction purity increased obviously. When the working face was advancing 40 m, the extraction concentration reached 47%, and the extraction purity reached 42.5 m3/min. During the initial mining period, the gas emission of the working face is 54.2 m3/min, and the total extraction capacity is 47.2 m3/min. The gas extraction capacity of the gas control roadway accounts for 90% of the total extraction capacity of the working face. The problem of gas control during the initial mining period is well solved.

4.2. Roof deep hole pre-splitting blasting effect

After weakening treatment by roof pre-splitting blasting, the direct roof began to cave on January 20, 2016 (working face advancing 16m), the goaf was filled with caved coal and rock mass on January 24, 2016 (working face advancing 30m), and all the main roof caved on January 27, 2016 (working face advancing 37m). The maximum return air gas of the working face is 0.36% from the beginning of the mining to the full caving of the main roof, which prevents the huge impact failure of the roof and the gas overrun accident.

The combined action of blasting stress wave and explosive gas pressure weakens the roof strength. At the same time, deep-hole pre-splitting blasting makes the cracks develop in the roof drilling section of 11-2 coal seam, and improves the pump efficiency of 1413 (1) gas control roadway.

5. Conclusion

The design section of gas control roadway is small, the construction progress is fast, the amount of drilling is small, the cost is low, and the management is simple. Pump effect is more effective than buried pipe in upper corner and roof strike drilling, which can be used as the main means to control gas during initial mining. The daily output of the working face has increased by 33%, achieving the safety, high yield and high efficiency of the working face.

The deep hole pre-splitting blasting effect of thick hard roof is good. When the working face is pushed forward for 37m, the main roof collapses completely, which greatly reduces the appearance intensity of pressure in the working face. The roof collapse does not affect the equipment and personnel of the working face, and the roof pre-splitting effect is good.

Acknowledgments

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