

# Study on goaf gas control technology of gob-side entry driving

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**Abstract.** The 1112 (1) track gate roadway of Gu Qiao coal mine of Huainan mining group adopt the method of gob-side entry driving, the gas emission is large during the driving of the roadway, the gas in the goaf seriously influences the safe driving of the roadway. Equalizing method, drilling drainage method, jet grouting method and other goaf gas controlling measures has been adopted. Finally, it effectively solves the safety threat of gas in goaf to roadway driving, it provides a good reference for the gas control of the gob-side entry.

## 1. Introduction

At present, to save gas control of the project and improve the driving speed of coal roadway, most stope gate roadway or system roadway are driving along the upper stage of the goaf, and small coal pillars are left behind (less than 10m). Now, the coal roadway is in the unloading zone of the upper stage, and there is no prominent danger in this area. Regional verification measures can be adopted during roadway driving, the replacement time of stope and the time of system roadway preparation are shortened.

The coal mining in our country extends to the deep at an annual rate of 20~40m, the risk of coal seam outburst increases and the gas emission gradually increases. Especially in the mining of outburst coal seam, a large amount of gas emission has become the difficult problem of restricting the safety production and mining. Deep coal rock under high stress, high temperature and high-pressure gas environment, and subjected to many strong disturbance, leading to roof deformation is intense and spalling and floor heave of gob-side entry are serious; At the same time, the speed of gob-side entry driving is fast, and the width of the coal pillar is small. With the influence of the ground air pressure in the goaf, the continuous influx of the gas in the gob leads to the threat of safety in production.

Under the condition of deep mining in Gu Qiao coal mine, aiming at the problem of gas emission in goaf during gob-side entry driving, two methods of equalizing method for changing flow field in goaf and draining gas from the goaf are adopted to test and apply.

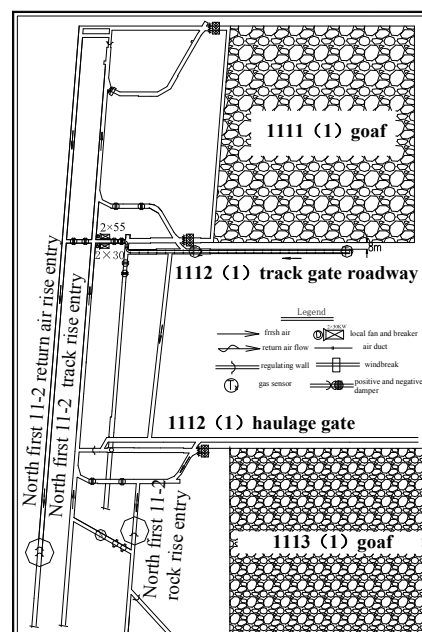


## 2. Mine survey

Guqiao Mine is in the territory of Fengtai County of Anhui Province, the area is about 106.7km<sup>2</sup>, the approved production capacity of the mine is 9.0Mt/a, the central, southern, Eastern District Development and layout. The mine is divided into districts of the central, southern, eastern. The first level elevation of central area is -780m, the first level elevation of south area is -796m, the ground elevation was +25m; At present, 11-2 and 13-1 coal seams are main seam, and the average distance between two seams is 75m, 11-2 coal seam is 13-1 coal seam protective layer. In order to alleviate the tension of mining replacement, the mining face of mine has adopted "skip mining" arrangement, which will inevitably form island stope; In order to improve the recovery rate of coal resources and alleviate the unfavorable situation, coal roadway driving is carried out by using small coal pillar less than 10m.

## 3. Gas emission in gob-side entry driving

The 1112 (1) track gate roadway adopt the method of gob-side entry driving, it is near the 1111 (1) goaf, the width of 8m isolation pillar is reserved in the center. During the excavation, a 30KW×2 and a 50KW×2 part-fan supply is used, the air flow rate is 1240m<sup>3</sup>/min, the T1 and T2 probes for monitoring the gas concentration in the return air are generally less than 0.1%, and the gas emission volume is generally less than 3m<sup>3</sup>/min, as shown in figure 1.



**Figure 1.** Layout of 1112 (1) stope

Around 11:50 February 13, 2013, an abnormal gas emission occurs at the C position of 1112 (1) track gate roadway in Figure 1, the maximum gas concentration monitored by T1 probe and T2 probe reached 0.19% and 0.41% respectively, the maximum absolute gas emission is 5.1m<sup>3</sup>/min.

Through the examination, at the distance from the head-on 2m position, there is a crack in the roof rock that extends from the lower roadway to the upper roadway about 10m, the gas concentration of crevice and anchor, anchorage cable hole in the crevice are all above 10%, the maximum gas concentration of the drilling hole near the fissure is 27% by 100% gas machine.

Through the construction of the measuring hole in the 1111 (1) goaf from the head-on 50m, the gas concentration of crevice and anchor, anchorage cable hole in the crevice are high, and it flows into the tunnel, and the maximum gas concentration is 58%; When the pressure gauge is negative, the gas concentration of crevice and anchor, anchorage cable hole in the crevice are only about 0.1%.

Therefore, it can be concluded that the roof crevice in 1112 (1) roadway communicate with 1111 (1) goaf, and the gas comes from 1111 (1) goaf.

During the gob-side entry driving, the gas emission changes regularly. The surface temperature of 17:00~10:00 period of time at low atmospheric pressure, the air pressure and the static pressure of underground roadway are all increased, at this time, the heading face static pressure is higher than the goaf pressure, which can effectively suppress the goaf gas flowing into the roadway, so the gas emission is small; the surface temperature is higher in period 10:00~17:00, the air pressure and the static pressure of underground roadway are all decreased, the pressure in 1111 (1) goaf is higher than the ventilation pressure at the heading face, the gas in the goaf is in an expansive state, and the high concentration gas flows through the crevice to the 1112 (1) track gate roadway.

#### **4. Measures and effects of gas emission control in gob-side entry driving**

During the gob-side entry driving of 1112 (1) track gate roadways, in view of the phenomenon of large amount of gas flowing from the goaf to the roadway, the method of equalizing method, reinforcing roadway and arranging drilling can be adopted to solve it.

##### *4.1. Equalizing method*

Equalizing method is to adjust the ventilation system by building ventilation facilities or change facilities position, to change the gas pressure distribution and flow field in the goaf; Considering the complexity and importance of gob spontaneous combustion prevention work, equalizing method is the preferred method of goaf gas emission; However, when the ventilation system is more complex, it is difficult to achieve the goal of controlling gas by equalizing method.

According to 1112 (1) track gate roadway and nearby roadway engineering plan analysis, when equalizing method is adopted, the ventilation system of north first 11-2 coal seam rise entry should be adjusted first, balance the pressure difference between 1112 (1) track gate roadway and 1111 (1) goaf, open the two doors at the bottom exit of the north first 11-2 coal seam return air rise entry, at the position of B in Figure 1, to reduce the pressure energy in front of the closure wall of the 1111 (1) track gate roadway, so that the 1111 (1) track gate roadway of the original negative pressure condition turns into a positive pressure state. Then, a regulating facility is added to the 11-2 rock return air rise entry, that is, the position of A in Figure 1, increasing the pressure of the airflow in 1112 (1) track gate roadways.

Through the adjustment of the system, the goaf spontaneous combustion observation hole construction in 1112 (1) track gate roadways has been in a state of negative pressure, to ensure that the air pressure of 1112 (1) track gate roadway is higher than 1111 (1) goaf, to prevent the 1111 (1) goaf gas flowing into the roadway due to the change of atmospheric pressure.

##### *4.2. Drilling drainage method*

When equalizing method is adopted, it has better application effect during the 1000m range of 1112 (1) track gate roadway driving. Since the length of the 1112 (1) track gate roadway is 2750m, with the increase of gob-side entry driving distance and the increase of the crevice along the goaf, the method has not reached the effect of controlling gas emission after regulating pressure. Gu Qiao mine promptly arranged for the construction team to use anchor rope machine to construct a deep 3m drilling near the crevice zone, and put in 4 "steel pipe" with the length of 1m, and the steel pipe exposed about 200mm. And use the nitrogen injection pipeline in the roadway to drainage gas synthetically.

The gas in the crevice used a 1-inch hose to incorporate the nitrogen injection pipe and draining drilling nearby crevice into the extraction system to carry out draining. The gas concentration in the hose also increased from 11% to 25%. The gas flowing from the goaf to gob-side entry is effectively controlled by draining.

In addition, most of the gas flows into gob-side entry through crevice in the process of roadway driving. Grouting is applied to the roadways with crevice, faults, abnormal areas, coal bodies and coal

thickness change zones, the fractures are blocked and the gas emission passages are cut off to prevent the gas emission from the goaf.

#### *4.3. Control effect of gas emission in gob-side entry*

After adopting comprehensive treatment measures of equalizing method, pumping method and jet grouting method, gas emission and gas concentration in return air during the 1112 (1) gob-side entry driving are decreased, the gas concentration quickly dropped to below 0.1%, it guarantees the normal construction of roadway.

The gas emission problems in the upper and lower gate roadway driving of 1112 (3), 1114 (3) and 1116 (3) and other island stope in Gu Qiao mine are adopted by the method, these methods not only ensure the gas not exceeding the limit, but also ensure the quick driving of the coal roadway, which provides the guarantee for the successful production replacement of the mine.

By using the equalizing method, goaf drainage should pay attention to the following questions: ① The ventilation system is stable and reliable in gob-side entry driving, not only conducive to gas management but also conducive to the spontaneous combustion protection management; ② The gob-side entry driving must be provided with an observation hole passing through the goaf at intervals of 500m, it is easy to check the gas content and CO content in the goaf and relative to the pressure difference in the roadway; ③ When adopting goaf drainage method, it is necessary to strengthen spontaneous combustion prevention inspection and air leak location investigation, as far as possible to reduce air leakage, to avoid spontaneous combustion accidents, the relationship between gas drainage and spontaneous combustion prevention should be well dealt with; ④ When the tunnel encounters a small chamber or a fault, the auxiliary measures of jet grouting should be taken, it not only plays a blocking role, slows down the release rate of gas, but also acts as an isolating air leakage passage to prevent spontaneous combustion; ⑤ The opening position of drilling through the goaf shall be arranged in the rock layer as much as possible, which is easy to seal the hole and will not cause the leakage of the goaf; ⑥ When the goaf is closed, the closure wall pre buried drainage pipes for drainage at the late, and the diameter is not less than 325mm.

### **Conclusion**

Equalizing method, drilling drainage method, jet grouting method and other goaf gas controlling measures has been adopted in 1112 (1) track gate roadway of Gu Qiao coal mine, it solves the problem of goaf gas emission problems, the normal construction of gob-side entry is guaranteed, it is beneficial to relieve the tight of stope replacement. It can be used for reference in gas control of gob-side entry under similar conditions.

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