

# Research on Technology of Multi Crosscuts United Coal Uncovering for Highly Outburst Seam of Deep

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**Keywords:** deep; highly outburst seam; rock cross-cut coal uncovering; regional measures; closed loop floor roadways

**Abstract.** Analyzing the main factors effecting prevention of coal and gas outburst of multi crosscuts united coal uncovering for highly outburst seam of deep, the thesis proposes comprehensive outburst prevention measures based on regional governance measures and supplemented by local governance measures to realize seam outburst elimination in essence. According to the site engineering geological characteristics, closed loop floor roadways were formed and regional measures using widely layer-through boreholes for gas extraction were successfully implemented, this technology becomes success model for rock cross-cut coal uncovering on similar conditions and provides an effective method for realization of regional predrainage outburst measure for rock cross-cut coal uncovering.

## Introduction

Coal and gas outburst is complex mine dynamic phenomena controlled by a variety of factors<sup>[1-3]</sup>. Coal and gas outburst is one of the serious natural disasters in the process of mining, because it can eject a lot of gas and pulverized coal and form special hollows with certain dynamic effects in short time<sup>[4]</sup>. China is one of the most serious countries occurring coal and gas outburst in the world, the cumulative number of outburst accounts for more than 40% of the world<sup>[5]</sup>. In 415 pairs national mine enterprises by mainly monitored, there are 234 pairs high gas and coal and gas outburst mines accounting for 56.4%, 142 pairs coal and gas outburst mine, accounting for 34.2%, 33 pairs oversize coal and gas outburst mine, accounting for 8%<sup>[6]</sup>. Statistics show that there are 68% gas explosion accidents of national mine occurring in underground heading face in 10 years<sup>[7]</sup>. As for the heading face, coal tunnel is the most frequent, accounting for about 45% of the total number, but outburst strength when rock cross-cut coal uncovering is maximum, the average strength is 586.1t, which is 6.55 times than the total average strength, and there are more than 80% oversize occurring in rock cross-cut coal uncovering<sup>[4]</sup>. Therefore, safe and efficiently uncovering outburst dangerous seam is the foundation and guarantee to avoid serious accidents for coal and gas outburst mine, and multi crosscuts united coal uncovering for highly outburst seam of deep is a problem of strong technology, complex process and high danger. This thesis is based on multi crosscuts united coal uncovering for highly outburst seam of deep in Wangfenggang well of Xieyi Mine of Huainan Mining, further discusses and summarizes the implement of two-level “quaternity” of rock cross-cut coal uncovering especially for the regional outburst prevention measures, in order to form success model for rock cross-cut coal uncovering on similar conditions

## Project Overview

Xieyi Mine of Huainan Mining went to operation in 1952 and its design production capacity was

0.3Mt/. In 2005, after combined with Wangfenggang Mine, the design production capacity of Xieyi Mine grew to 5.0Mt/a because of resource depletion and mine aging. In 1979, Xieyi Mine was stipulated to coal and gas outburst mine, and the C15, C13, B11b, B9b, B4b coal seam were outburst seams, among which the C15, C13 coal seam were highly outburst seams. Over the years, coal and gas outburst accident has occurred 58 times including the maximal coal and gas outburst during subvertical coal uncovering in recorded history when Wangfenggang well was building, which causing the great economic losses and casualties. With the increase of mining depth, mining pressure is larger and larger, gas emission quantity rises rapidly, the risk of coal and gas outburst continuously enhances, which is seriously hindering the extension of the mine development.

Three main crosscuts at the elevation of -817m of Wangfenggang well of Xieyi Mine are the main roadway and the key pioneering system of the first level(-820m) at Northern mining area. Among them, the railway crosscut and transport crosscut both go through C13 seam. The C13 seam is highly outburst seam, thickness is 6m and dip is  $20^\circ$ . Gas content of C13 seam in -817m is  $17\text{m}^3/\text{t}$  and gas pressure measured at railway crosscut is 4.6MPa,  $\Delta p$  is 12 and  $f$  is 0.28; in addition, jet orifice phenomenon is serious when layer-through borehole is constructed at -780m floor roadway of the C13 seam and -790m transport crosscut

### **The Main Factors Effecting Rock Cross-cut Coal Uncovering**

#### **(1) The large coal seam outburst hazard**

The C13 seam is highly outburst seam and gas pressure is 4.6MPa, gas content is  $17\text{m}^3/\text{t}$ ,  $\Delta p$  is 12 and  $f$  is 0.28.

#### **(2) The wide working range for coal uncovering.**

Thickness of the C13 seam is 6m and dip is  $20^\circ$ . Working range for coal uncovering is from 5m to the roof of coal seam to seam into the base plate down through 2m which the theoretical values are almost more than 60m.

#### **(3) The high influence degree of united coal uncovering**

Design sections of -817m railway crosscut and transport crosscut are  $20\text{m}^2$  and  $23\text{m}^2$ , dynamic pressure is heavy during roadway excavation and mine pressure behavior is severe after excavation, effective spacing between the two crosscuts is small and the working range for coal uncovering is wide. With frequent circulating footage, it makes two crosscuts influence each other severely during coal uncovering at last.

#### **(4) Complicated stress state in coal uncovering area**

The place of the C13 coal uncovering is apart from 850m of the surface and located at a severe fold change area, where has developmental Secondary fault、fold and joints. Within 50m of the area there are FY-001、F13-4 faults, the distribution of crustal stress and tectonic stress are complex.

### **The Closed Loop Floor Roadway Regional Predrainage Outburst Measure**

#### **Prevention Strategies.**

Because of large coal seam outburst hazard、wide working range for coal uncovering、high influence degree of united coal uncovering and complicated stress state in coal uncovering area, The traditional rock cross-cut coal uncovering for outburst elimination is difficult to fundamentally realize safe coal uncovering.

According to related requirements of 《Coal and gas outburst prevention provisions》 and field engineering experience, aim at multi crosscuts united coal uncovering for highly outburst seam of deep, this thesis proposes comprehensive outburst prevention measures of two-level “quaternity” which is regional outburst prevention measures advancing and local outburst prevention measures completing to realize seam outburst elimination in essence.

For this coal uncovering, layer-through boreholes are constructed widely for gas extraction as main regional measures without the condition of the protective layer mining. Then, using multi

crosscuts united coal uncovering has wide working range and control range of measuring drillings at roadway head is limited, moreover, it is difficult to construct drillings to penetrate the C13 seam with highly outburst hazard downwards and jet orifice phenomenon is serious. So highly outburst seam closed loop floor roadway area predrainage elimination method is proposed to realize regional outburst prevention measures

### Regional Control Range.

According to related requirements of 《Coal and gas outburst prevention provisions》, for regional outburst prevention measures with layer-through boreholes gas extraction to gently inclined coal seam, regional control coal range is outside the 12m of the tunnel contour. At the same time, Considering that the actual gas geological and engineering conditions, regional control coal range is apart from walls of crosscut 30m and roof and floor 15m(vertical distance). Control range of regional outburst prevention measures is shown in Fig.1

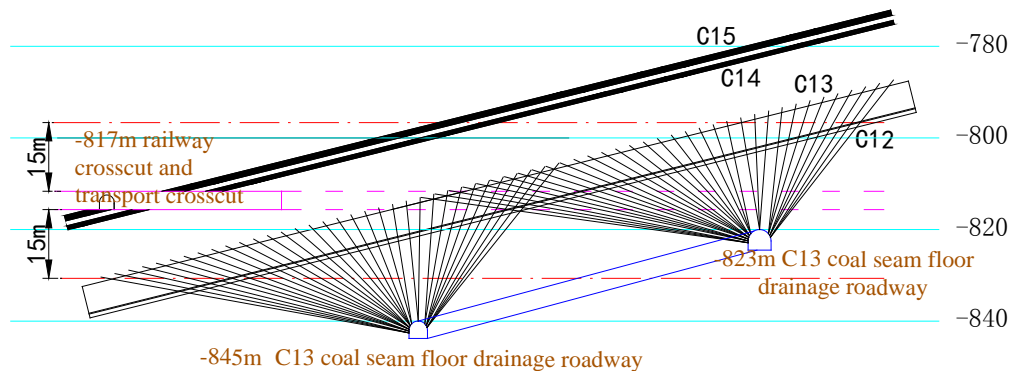


Fig.1 Layout profile of predrainage boreholes for regional outburst elimination measure

### The Closed Loop Roadway Layout.

As shown in Figure 1, Two C13 seam floor drainage roadways were constructed in -823m C13 coal seam floor which is 16~17m from C13 seam and at the elevation of -823m and -845m to build -817~-823m and -823~-845m return roadways, it can form closed loop floor roadways at C13 uncovering coal seam zone with -804~-960m C13 floor return entry. The main advantage is:

- (1) A full negative pressure ventilation system is formed and constructing layer-through boreholes at single roadway in highly outburst seam is avoided, so that construction can be more safety.
- (2) Multi-level floor drainage roadways combined drainage outburst elimination can expand the scope of measures to control the region effectively.-817m return crosscut
- (3) It is avoided to construct downward boreholes and nearly horizontal boreholes for reducing construction difficulty and ensuring the boreholes and construction quality control results.
- (4) Closed loop floor roadways is built to increase boreholes construction space、 achieve a multi-rig parallel operations、 reducing boreholes construction time and improve coal uncovering efficiency

### Predrainage Boreholes Design.

In the ease of construction and ensuring the effect of pressure relief, it is avoid to arrange downward boreholes and nearly horizontal boreholes, hole spacing is 0.4m×0.4m and the final hole spacing is 3m×3m. At the same time, in the key areas of rock cross-cut coal uncovering, through the upper and lower two floor roadway, layer-through boreholes are layout superposed and form three-dimensional grid intersection to reduce coal seam gas content and degree of stress in a maximum extent

Predrainage boreholes layout is shown in Fig.2. A total amount is 2277 and the total number of boreholes of length is 71,600 m

## The Main Conclusions and Suggestions

### The Main Conclusions.

Rock cross-cut coal uncovering is the emphasis and difficulty of mine outburst prevention, coal

uncovering is not a single technical measures, but a set of comprehensive prevention and treatment of complete outburst system engineering. Among them, as the main outburst prevention measures, regional outburst prevention measure is the basis of coal uncovering and all the outburst prevention and control work. Promoting the implementation of the regional outburst prevention measures effectively is the premise and the most effective protection of to promote the outburst mine safety in production.

Against multi crosscuts united coal uncovering for C13 highly outburst seam, Xieyi Mine of Huainan Mining forms closed loop floor roadways, successfully implements regional measures using widely layer-through boreholes for gas extraction, realizes outburst prevention strategy based on regional governance measures and supplemented by local governance measures during rock cross-cut coal uncovering, becomes the model of implementing regional outburst prevention measures in multi crosscuts united coal uncovering for highly outburst seam of deep

### **Suggestions.**

In Xieyi Mine multi crosscuts united coal uncovering for highly outburst seam of deep, it is necessary to consider the gas outburst of the coal seam, but also consider the factors of operation uncovered a long distance, exposing the hidden trouble of safety coal large. Therefore, it should follow the principle of "multiple punch, tight sealing, integrated pumping", strictly implement two-level "quaternity" comprehensive outburst prevention measures including outburst hazard prediction、outburst prevention measures、effect inspection 、area authentication(security measures), progressive gradually approach and ensure the safety of rock cross-cut coal uncovering.

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