

## **Determination of Gas Pressure in Coal Seam by Upward Method in No. 3**

### **Coal of Pingshan Mine**

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*Abstract: In order to determine the coalbed gas pressure in No. 3 coal of Pingshan Mine, and explore the law of coalbed gas pressure distribution in Pingshan mine, the upward method was applied to this article. Besides, this article combined the actual conditions of the underground and related standards. The measurement was carried out in the head-on of the windward lane, the head-on of the track and the 5 #windward contact lane of the windward lane. The observed results were drawn on the coordinates with time as the transverse coordinate and gas pressure as the longitudinal coordinate, and the coordinates of gas pressure was drawn. A gas pressure function curved rising over time was drawn. The laws of observed time after sealing the hole and coalbed gas pressure in No. 3 coal of Pingshan mine were obtained. According to the law of gas pressure and observed time, it provides theoretical basis for predicting the risk of coal and gas outburst.*

*Keywords: Upward method; Coalbed gas; Determination of gas pressure; Initial gas pressure.*

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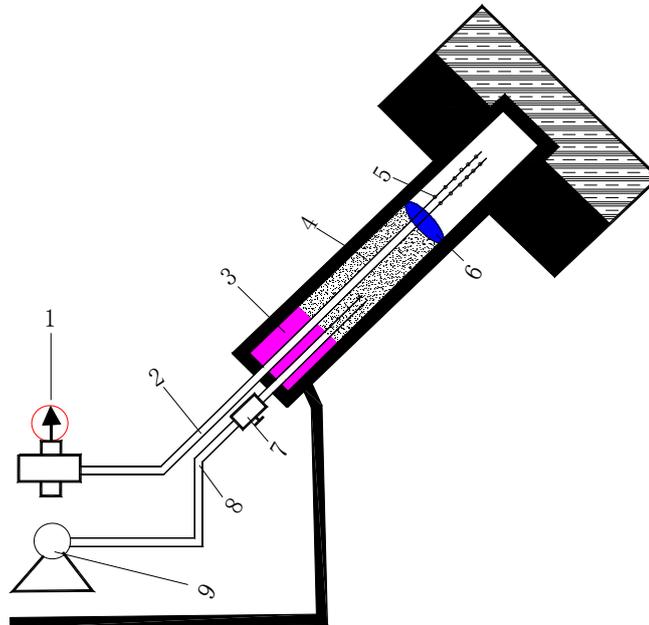
## **1. INTRODUCTION**

Coalbed gas pressure refers to the pressure of free gas contained in the pores of coal seams, that is, the pressure of gas acts on the pore wall. Coalbed gas pressure is one of the main factors that determine the content of coalbed gas. Whether it is the amount of free gas in coal or the amount of adsorption gas, it is closely related to gas pressure. When predicting the content of coalbed gas by indirect method, the pressure of coalbed gas must be known. Gas pressure plays an important role in the occurrence and development of coal and gas outburst mine, and it is one of the main indicators of gas pressure prediction.

## **2. RINCIPLE AND METHOD OF GAS PRESSURE DETERMINATION**

The principle of coalbed gas pressure measurement is to drill a hole in the coal seam, drill a gas tube in the coal hole, connect the gas pressure gauge, and connect of closed boreholes to the outside world. At this moment, the gas in the coal hole has been dispersed and the pressure is low, then coalbed gas around the coal hole moves into the coal hole, and the pressure gradually

increases. After a period of gas seepage, the gas pressure in the coal hole gradually approaches the original gas pressure of the coal seam, and the gas pressure value can be read from the external pressure gauge. The measurement is based on the standard "AQ/T1047-2007 direct measurement method for coal seam gas pressure in coal mines", using passive pressure measurement method [6-8]. The device for measuring gas pressure [6-10] and sealing process [11] as shown in Figure 1.



1-pressure gage; 2-Pressure tube; 3-polyurethane; 4-Cement mortar;  
5-Sieve; 6-baffle; 7-valve; 8-grouting tube; 9-grouting pump

Fig 1. The picture of pressure sealing process for upper coal seam

### 3. THE DESIGN OF PRESSURE HOLE'S PRAMETERS

Determining the coalbed gas pressure accurately, so that the original gas pressure of the coal seam can be represented by the measured pressure. The pressure measurement sites should be selected in areas that are not affected by faults and small cracks. In order to measure the gas pressure of the No. 3 coal seam, according to the actual conditions in the underground of the relevant standards, the measurement was carried out in the head-on of the windward lane, the head-on of the track and the 5# windward contact lane of the windward lane. The Coalbed gas No. 3 is measured by two upward boreholes at each construction site, and the measurement point is shown in Figure 2.

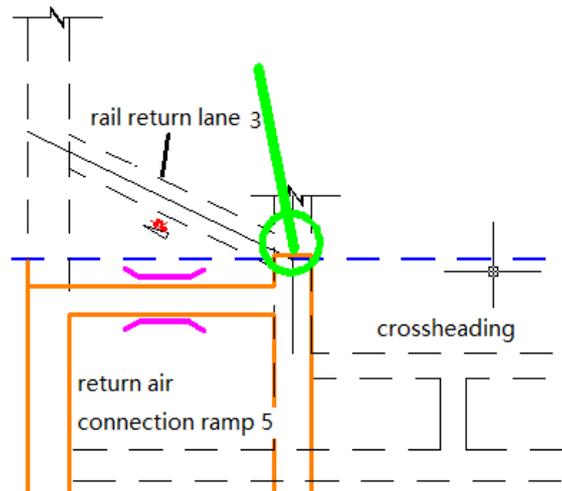


Fig 2. Determination of drilling layout

#### 4. PRESSURE MEASURING EQUIPMENT AND TOOLS

The tools required to measure the pressure of coalbed gas is: 1 rig, standard ZLJ-350; 1 grouting machine for 2ZBQ-20 / 5 (complete piping and U-type clips are available), 130 pressure measuring tubes for the case of the steel pipe, and 15 tubes for the 2m/root sieve hole, the accuracy should be better than the 1.5 pressure gauge (measuring range is 1.5 times the maximum pressure), cement ash ratio 2:1 several cement mud (cement label 425; Contain 12 % expansion agent; Expansion coefficient  $\geq 0.02\%$ ) and so on.

Each section of the pressure measuring tube is connected by a pipe joint, the outermost section is connected to the pressure gauge by three links, and the outermost section is connected to the sieve tube. The interface is wound with raw material tape to achieve sealing effect. Sealing materials are cement mud and polyurethane seal, and the depth of sealing hole is the whole rock hole section. In order to ensure the quality of the sealing, the cement slurry should be sealed half an hour after the polyurethane seal. The cement slurry should be fully stirred. The baffle is fixed on the pressure measuring tube at the depth of 25 m to control the length of the sealing hole. Some of the preparations are shown in Figure 3.



(a) pressure gage, three-way valve and court; (b) processed pressure tube;  
 a- pressure gage, three-way valve and court; b- processed pressure tube;

Fig 3. Preparation for pressure measurement

## 5. PROCESS OF CONSTRUCTION

(1) Drilling construction. The hole opening position should be selected in the complete position of the rock (coal wall). It should ensure that the hole is straight and the hole shape is complete. From the surrounding rock roadway to the coal seam, it should be drilled with a  $\Phi 100\text{mm}$  explosion-proof rig. The direction and inclination of drilling should be constructed strictly according to the design, and the depth of the hole should be 0.5m through the coal seam.

During the drilling construction process, the drilling orientation, inclination angle, length, length of the drill hole and the length of the borehole in the coal seam, drilling opening time, coal seeing time and drilling drilling time should be accurately recorded. After the drilling is completed, the debris in the borehole section is washed with clean water or compressed air.

(2) Sealing the hole. Sealing method: using cement slurry sealing method.

Sealing materials, instruments, tools, etc. are prepared during drilling. After the drilling is completed, the hole is sealed within 24 hours. Insert a mesh tube in the borehole and connect the piezometer tube section by section. In order to ensure its airtightness, the joint between the piezometers must be wrapped with a sealing tape. Then check whether the piezometer is unobstructed and its airtightness is connected with the pressure gauge. According to the design requirements, the orifices are 2 to 3 m with polyurethane to block the orifices, and then the cement slurry is prepared (water to cement ratio 2:1, ash contains 12% expansion agent). Pour 425 Portland cement and appropriate amount of expansion agent into the mixing tank, add water and mix well until it is viscous. The grouting pump is used to pump the stirred expansion cement into the hole. After the designed sealing hole length was reached, the valve was closed, the grouting pipe was processed, and the sealing work was completed.

## 6. DATA OBSERVATION AND PRESSURE DETERMINATION

The observed results are drawn on a coordinate map with time (d) as the transverse coordinate and gas pressure (MPa) as the longitudinal coordinate. If the gas pressure change is less than 0.015 MPa within 3 days, the pressure measurement work can be completed; otherwise, the pressure measurement time should be extended. After the pressure measurement work was finished, the gas pressure rose with time.

At the end of the pressure measurement, the amount of water released from the borehole shall be measured, the static water pressure of the borehole water shall be calculated according to the borehole parameters and the sealing parameters, and the water pressure shall be deducted from the measurement pressure. The gas pressure value of the primary rock of coal body is the surface pressure value plus the atmospheric pressure at the location of the measurement point. The highest pressure is used as the determination result at the same location.

In order to improve the efficiency of drilling, pressure measurement, permeability coefficient and gas flow attenuation coefficient can be realized in one hole. At the end of the pressure measurement, the pressure gauge is replaced with a gas flowmeter to record the gas flow and time, and then the permeability coefficient and the gas flow attenuation coefficient can be calculated.

The concrete results of pressure measurement of No. 2 coal seam are as follows. Measurement records as shown in table 1. The pressure measurement curve is shown in Figure 4.

Coal seam name: No. 3 Coal seam, pressure measurement location: Track straight forward;

Coal seam thickness: 5.4 m, coal seam inclination:  $-11^{\circ}$ ;

Pressure elevation: 370m, atmospheric pressure: 762 mmHg;

Drilling time: August 24, 2014, coal extraction time: August 28, 2014; Diamond completion time: August 29, 2014, seal time: August 29, 2014.

Table 1. Gas pressure measurement record of hole 2 in coal seam No. 3

Holes Number	Drilling parameters			Rock hole length (m)	Coal hole length (m)	Seal length (m)
	Direction (°)	Dip Angle(°)	Length (m)			
NO.2	left 20°	+35	48	35.5	12.5	2.5
Time	Pressure(Mpa)		Time	Pressure(Mpa)		
8.29 14:00	0		9.07	1.00		
8.29 14:30	0.10		9.08	1.01		
8.29 18:40	0.40		9.09	1.01		
8.29 19:45	0.45		9.10 0:40	1.02		
8.29 23:00	0.75		9.10 11:30	1.03		
8.30 0:30	0.85		9.10 19:10	1.04		
8.30 3:00	0.91		9.11	1.03		
8.30 5:25	0.95		9.12	1.03		
8.30 7:40	0.95		9.13	1.03		
8.30 11:00	0.95		9.14	1.04		
8.30 23:30	0.98		9.15	1.04		
8.31 12:00	0.99		9.16	1.04		
9.01 0:45	1.00		9.15	1.05		
9.01 12:00	0.99		9.16	1.05		
9.02 0:30	0.98		9.17	1.04		
9.02 11:40	0.98		9.18	1.05		
9.03 0:30	1.00		9.19	1.05		
9.03 11:10	1.00		9.20	1.05		
9.04 0:30	1.00		9.21	1.05		
9.05	1.00		9.22	1.05		
9.06	1.01		9.23	1.06		

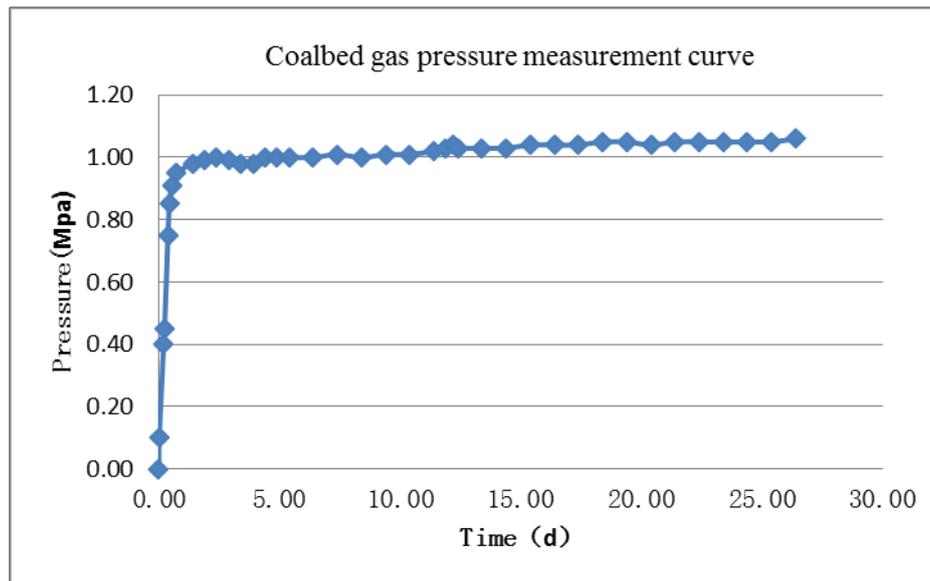


Fig 4. Gas pressure measurement curve of coal seam No. 2

## 7. CONCLUSION

According to the gas pressure measurement curve of coal seam No. 3 coal in Pingshan mine, we can obtain:

- (1) The pressure of coalbed gas increases with time after the completion of sealing construction.
- (2) The coal seam gas pressure increased linearly within 5 days after the completion of sealing, and the coal seam gas pressure changed from 0 Mpa to 1 Mpa. The gas pressure rising trend is slowed within 5-30 days after the sealing construction is completed, and the peak value is basically the same within 5 days after the sealing is completed, and the coal seam gas pressure is maintained above 1 Mpa. The law of coal seam gas pressure change is of great significance for the formulation of reasonable anti-burst measures.

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