

# Field Application of Near-horizontal Borehole Sealing Technology in Coal Seam

Fei Guo

School of Resources and Environment, Henan Polytechnic University, Jiaozuo 454000, China

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## Abstract

**Due to the low strength of coal and rock around the drilling hole in a single high gas and low permeability coal seam (especially in soft rock and coal seam), there are often micro-cracks around the drilling hole, which increases the difficulty of hole sealing. At present, the main hole sealing methods are: cement mortar hole sealing, polyurethane hole sealing, the former is easy to shrink after sealing, sealing effect is poor; The latter is often due to the length of the sealing hole is not up to the ideal sealing state, the material has a certain toxicity, and the price is high, the coal mine is difficult to bear. In view of this problem, this chapter will describe the principle and method of "strong and weak" pressure sealing hole technology, and verify the effect through field application, in order to improve the drilling and sealing technology of near horizontal gas extraction of coal seam.**

## Keywords

**Coal and Gas Outburst; Hole Sealing Method; Coal Seam Pressure Relief; Gas Drainage Rate.**

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## 1. Introduction

Coal industry is the basic industry of my country's national economy and has an important strategic position in the national economy. Coal accounts for about 70% of my country's primary energy production and consumption structure, showing an upward trend in recent years. my country's resource characteristics of rich coal, poor oil and little gas determine the important position of coal in primary energy. It is predicted that coal will remain the main basic energy and raw material in my country for a long time to come. Satisfying the current and long-term development of the national economy is a major task in my country's energy field. Therefore, the coal industry bears the historical responsibility of energy security, economic development, social progress and national rejuvenation.

For Lu'an Environmental Energy Development Co., Ltd., gas drainage under the condition of intensive mining of single high gas and low permeability coal seam is a worldwide problem. How to strengthen gas extraction under the conditions of high gas and low permeability coal seams of Lu'an Environmental Protection Energy Development Co., Ltd. and maintain efficient and intensive production is an urgent problem that Lu'an Environmental Energy Development Co., Ltd. is currently facing. The gas problem in the mining process of high gas and low permeability coal seams has become a prominent problem restricting safe and efficient mine construction and sustainable development. Therefore, Lu'an Environmental Protection Energy Development Co., Ltd. urgently needs to conduct in-depth research in a targeted manner to ensure safe mine production.

The main technical measure to solve the gas problem in the single high gas and low permeability coal seam mining process is to strengthen the gas drainage. By strengthening gas extraction, it can not only effectively reduce the gas gushing in the process of coal seam mining and ensure the safety of coal mine production; at the same time, the high-concentration gas extracted can be used to realize

dual-energy mining. However, Lu'an Environmental Protection Energy Development Co., Ltd. and even many high-gas coal seams in my country belong to low-permeability coal seams, and conventional gas drainage methods are difficult to play. The workload is large and the drainage efficiency is low. Effective technical measures such as pressure relief and permeability enhancement, expansion of the effective influence range of the borehole, and improvement of the hole sealing effect are required to achieve the purpose of improving the gas drainage efficiency of the coal seam.

## 2. Engineering Situation

N1-3 Pishun is adjacent to N1-4 working face (already mined) in the north, N1 belt lane in the east, N1 drainage lane in the west, and N1-3 track in the south. The absolute gas emission is 2.9m<sup>3</sup>/t, and the coal dust is explosive, not easy to spontaneously ignite, and has no threat of heat damage.

N1-3 is arranged with a 200mm gas pipeline once, which is led out from the extraction main pipe of the N1 return air lane, and extends to the N1-3 incision (the side of the rail) through N1-3. During the drilling process, the principle of "pulling, merging, and pumping at the same time" is implemented.

A total of 12 drilling sites are arranged in N1-3 Pishun, and each drilling site is constructed in a fan shape for the coal seam gas drainage drilling. The diameter of the drilling holes is 94 mm, and the diameter of a small number of drilling holes is 65 mm or 115 mm.

The N1-3 cut hole is constructed along the advancing direction of the working face perpendicular to the coal wall. There are 73 drill holes for gas drainage in this coal seam, with a diameter of 115mm and a drill hole spacing of 3m. Wait.

## 3. Design of Construction Plan for Near-horizontal Borehole Sealing Technology in Coal Seam

### 3.1 Drilling Arrangement

The on-site borehole is a near-horizontal gas drainage borehole in the coal seam, and is drilled into the coal body from the N1-3 working face transportation roadway. The hole is opened from the upper part of the roadway, and the drill hole is perpendicular to the roadway and has been extended in the coal body. The position of the hole is more than 150m away from the mining face, and the inclination angle of the coal seam is 1° to 2°. The hardness of the sample is moderate, and the drilling is representative.

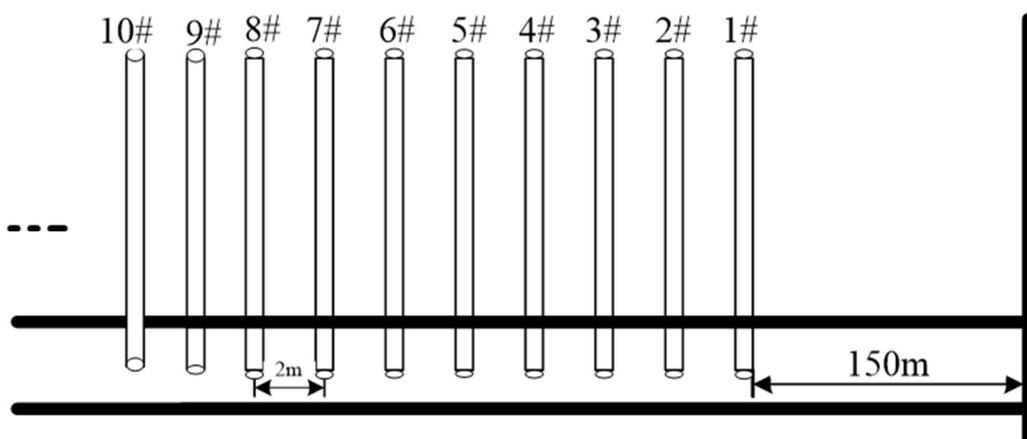


Figure 1. N1-3 Pishun Gas Drainage Drilling Schematic Diagram

### 3.2 Drilling and Sealing and Field Implementation

The application of the "strong, weak and strong" sealing method with pressure can be divided into two stages: the static sealing stage (also called PD static pressure sealing) and the dynamic sealing stage. Among them, the static sealing stage is completed by grouting twice. The specific process is: drilling into the coal seam in the roadway to the design depth, and then wrapping the new high-strength water-absorbing polymer expansion material at the front end of the drainage pipe to enter the drilling hole. The agent reacts with the residual liquid in the drilling hole, and the volume expands to L3 by controlling the reaction direction. Further, the front end of the sealing section is sealed. PB reaction bags are used as plugs in the middle part of the drilled hole and the orifice part. The first grouting uses high-strength PD slurry to seal the position outside the loosening ring of the drilled hole, with a length of L1; the second grouting uses a weak-strength jelly-like colloid to seal the position within the loosening ring, with a length of L2.

## 4. Investigation and Analysis on Sealing Effect of Near-horizontal Borehole in Coal Seam

In this sealing test, a total of 34 holes were sealed with the complete "strong, weak and strong" pressure sealing technology, and 23 holes were effectively drilled. , 62 polyurethane contrast holes and 37 effective drilling holes. The implementation site is Pishun N1-3 of Changcun Mine, and relevant personnel of Changcun Mine's extraction team track and measure its concentration respectively.

In order to investigate the practical application effect of "strong, weak and strong" sealing under pressure, according to the principle of "strong weak and strong" sealing technology under pressure, more than 100 drilling holes were constructed in the transport roadway of N1-3 working face where the coal seam was drilled. The coal seam is drilled along the layer, the inclination angle of the drill hole is 1-2°, the included angle with the centerline of the roadway is 90°, and the hole depth is 120m. 40 effective boreholes under the same conditions were selected for concentration detection for nearly 3 months. Among them, 1#---10# drilling and sealing method: completely adopt the "strong weak strong" belt pressure sealing technology. 11#---20# Drilling and sealing method: The sealing technology in the static grouting stage using the "strong, weak and strong" sealing technology with pressure is referred to as "PD static pressure sealing". 11#---201# Drilling as the corresponding comparative drilling and sealing method: using traditional polyurethane sealing technology, first pour the prepared polyurethane on the towel, then wrap the towel on the sealing tube and send it to extraction In the borehole, after the polyurethane expansion is completed, it is merged into the drainage pipeline for drainage.

## 5. Conclusion

- (1) The sealing test shows that the drainage concentration of "strong, weak and strong" pressure sealing is significantly higher than that of static pressure sealing and polyurethane sealing, indicating that its air tightness is higher than that of polyurethane; the relatively stable concentration after 80 days is static pressure. It is 1.5 times that of the pressure-sealed hole and 3.8 times that of the polyurethane-sealed hole. Therefore, the new sealing process has significantly improved the drainage concentration of the hole sealed by the polyurethane material.
- (2) "Strong, weak and strong" pressure-sealed holes have high drainage stability and continuity, and the decline trend is slow in the later period, which provides a solid foundation for efficient gas drainage and gas utilization.
- (3) The field application shows that the "strong weak strong" pressure sealing process is simple and easy to learn, and the single hole sealing can be completed within 20 minutes after mastering the equipment operation and sealing process.

(4) Compared with the cost of single hole sealing with polyurethane, in the case of greatly increasing the gas concentration and flow rate, the cost of sealing holes using "strong, weak and strong" belt pressure sealing is only increased by 10%.

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