Analysis of Outburst Disaster Characteristics and Countermeasures of 3# Coal Seam in Hancheng Mining Area

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Abstract. In view of the current situation of 3# coal seam with large thickness, high gas pressure and content, weak coal seam, poor permeability and serious coal and gas dynamic disasters in the mining area, this paper combs and deeply analyzes the gas geological occurrence law and the characteristics of gas dynamic disasters in Hancheng mining area. The research results show that the gas disaster of 3# coal seam in Hancheng mining area is mainly the instantaneous outburst caused by the structural stress based on the high ground stress and the mining stress concentration, and the creep time-delay Outburst under the quasi-static load based on the high ground stress will occur in some abnormal soft areas. Based on this, the paper puts forward to strengthen the geological exploration work, and to prevent and control the coal and the coal from the aspects of gas drainage and stress removal The technical thinking of gas outburst disaster provides theoretical guidance for the prevention and control of gas dynamic disaster in mining area.

1. Introduction
Hancheng mining company is the main coal production enterprise in Hancheng mining area. There are four pairs of production mines, with design production capacity of 7.80Mt/a and approved production capacity of 6.45mt/a. With wenjialing fault as the boundary, Xiayukou coal mine, Sangshuping Coal Mine and Sangshuping No.2 well in the north area are coal and gas outburst mines, and Xiangshan coal mine in the south area is high gas mines.

Gas, water, coal dust and roof disasters coexist in Hancheng mining area, especially coal and gas outburst and water inrush. The main type of outburst disaster is the type of extrusion, which mainly shows that the stress plays a leading role and the gas takes the second place. With the increase of mining depth, the outburst disaster is becoming more and more serious. Coal and gas outburst disaster has become the main disaster restricting the safe and efficient production of Hancheng mining area.

2. Occurrence of coal seam gas in mining area
Hancheng Mining Company's XiaYukou Coal Mine 2, 3, coal seams for the prominent coal seam, Sangshuping coal mine 2, 3, 11, coal seams are outstanding coal seams, Sangshuping 2 well 3, coal seams for the prominent coal seam. According to statistics, a total of 145 coal and gas prominent
accidents occurred in the coal mines owned by Hancheng Mining Company, of which 144 times occurred in the coal seam and 1 time occurred in the coal seam. The mining area is mostly dominated by the type of pressure-out.

The difference between coal seam gas deposit in the mining area is large, and the gas content of the coal seam is high and the pressure is high. Sangshuping, XiaYukou mine 3, coal seam is currently mining horizontal coal seam soft, coal destruction type IV, V, class; Combined with the outstanding danger parameters of the 3-coal seam gas in the Hancheng mining area 3, the analysis has the following special features:

1) Sangshuping 2 well than the other two wells although buried shallower, the coal seam gas pressure is low, but the coal seam gas content is higher, the site mining process of gas disaster situation is relatively minor, has not occurred prominent accident, indicating that the South Cheng mining area gas power disaster is not coal seam gas content play a leading role.

2) Hancheng mining area 3, coal seam as a whole is relatively soft, the robustness coefficient f - 0.11 to 0.48, only buried in the shallower mulberry Tree Ping 2 well field, the coal seam is more rigid. The gas release capacity is medium-stronger, p-7 to 22, soft-layered coal-like release capacity is stronger.

3) In Hancheng mining area, the gas desorption capacity of the main 3 × coal seam is poor. With the increase of gas pressure, the increase of desorption index K1 is not obvious. The gas pressure P = 0.74mpa, the corresponding K1 = 0.12 ~ 0.26mL/(g·min^1/2), the index value is small; Laboratory analysis of K1 index in the prediction of the risk of face outburst is relatively poor.

3. Analysis on the characteristics of coal and gas dynamic disasters in mining area

3.1. Analysis of dynamic disaster law
The 3# coal seam of the main mining seam in Hancheng mining area belongs to the serious outburst coal seam, which has been outburst 144 times. The statistical outburst has the following characteristics:

1) The coal and gas outburst in Sangshuping Coal Mine includes outburst, extrusion and dumping, of which the main type is extrusion, 67 times in total, accounting for 55% of the total, 55 times in total, accounting for 45%; the total number of outbursts in Xiayukou coal mine is 22 times, and the main type of outburst is extrusion, accounting for 81.8% (18 times), indicating that the outburst dynamic phenomenon in Hancheng mining area is mainly geostress, and the second is gas pressure.

2) The outburst intensity of Hancheng mining area is generally small, mainly small and medium-sized; the outburst of coal lane accounts for the majority and the coal lane has obvious characteristics of delay outburst.

3) The protruding points are regular and concentrated in the geological abnormal area. 56% of the outburst positions in Sangshuping Coal Mine are located in the thick coal belt or thin coal belt with the change rate of coal thickness more than 30%. The regional characteristics of abnormal geological structure prone to outburst are that the coal seam is thinner and softer, the coal structure is disordered, dry and the gas desorption ability of coal is enhanced.

4) Most of them have obvious omens before protrusion.

3.2. Analysis on the characteristics and causes of dynamic disasters
In Hancheng mining area, the thickness of the main mining 3# coal seam is large, the coal seam is relatively soft as a whole, and there are hard and thick roof and floor in some areas. In addition, the high ground pressure background of the mining area, under this special occurrence condition, the occurrence type and mechanism of the gas dynamic disaster are different from the single type of vas disaster in the general mining area, especially the soft coal body near the structure will have large deformation and creep characteristics.

Coal and gas outburst is the result of the joint action of coal seam gas, in-situ stress and physical and mechanical properties of coal rock. The types of outburst disasters in Hancheng mining area are different due to the complicated occurrence conditions of coal seam gas, the interaction degree and coupling relationship among coal seam gas, in-situ stress and coal rock, which can be summarized as follows:
1) Instantaneous outburst with high energy gas as the main energy source. In the process of mining, after the coal and rock which play a protective barrier are destroyed, the coal and gas with high gas energy are suddenly sprayed into the mining space under the pressure, and the schematic diagram of outburst is shown in Figure 1.

![Figure 1. Schematic diagram of instantaneous highlights dominated by high-energy gas](image)

2) Based on the high ground stress, the instantaneous outburst caused by mining stress concentration. In this kind of outburst, the coal body itself is in a high geostress environment, and it is mainly damaged by tensile failure. Under the disturbance of mining activities, the stress state further changes dramatically, or the roof and floor break or slip and fall on a large scale, resulting in strong vibration or energy release (initial pressure, periodic pressure, etc.). When the thick and hard roof of coal seam is in danger of impact, the energy will be transmitted to the exposed coal body in the mining face, which will show this type of outburst. The schematic diagram of instantaneous protrusion under dynamic load is shown in Figure 2.

![Figure 2. Schematic diagram of instantaneous protrusion under dynamic load](image)

At present, in the outburst coal seam without protective mining conditions, if the mine still adopts the regional outburst prevention measures based on pre drainage of coal seam gas, it is obviously unable to effectively improve the high ground stress state of the mining coal seam. At the same time, the risk of dynamic pressure impact caused by the instantaneous breaking of the hard roof of the coal seam still exists, which can not fundamentally eliminate the outburst caused by the ground stress and the dynamic pressure of the hard roof Danger.

3) Based on the high ground stress, the creep instability delay under quasi-static load is prominent. Affected by the overall high ground pressure in Hancheng mining area, the coal body in the mining face is in the post peak stage under the action of high ground stress. When the mining face forms the exposed space, the coal body changes from the three-way compressive stress state under the original state to the two-way compressive stress state. However, due to the creep property of the soft coal seam, even if the overlying load does not increase, its deformation still increases with the increase of time, resulting in strain softening. Generally, there is no obvious stress peak area and stress distribution ladder in the coal
seam in front of the working face. With the further increase of deformation, it is possible that the instability will be delayed. As shown in Figure 3.

![Figure 3. Schematic diagram of creep delay instability under static load](image)

To sum up, the coal and gas dynamic disasters in Hancheng mining area are complex, and different types of outburst disasters should have different prevention and control technology ideas to achieve accurate and efficient prevention and control.

4. Disaster prevention and control measures

At present, the relevant laws and regulations have made clear the two-level "four in one" comprehensive outburst prevention measures for the coal seam with outburst risk. Pre drainage of coal seam gas is one of the most basic measures. However, for the stress dominated outburst in Hancheng area, only relying on pre drainage of gas can not completely eliminate the outburst risk, and technical measures should be taken to remove the stress in the coal seam and reduce the stress in the thick and hard roof and floor of the coal seam. The gathered elastic energy can reduce the risk of outburst caused by pressure in the process of mining, and prevent the coal and gas outburst from two aspects of coal seam gas and stress.

1) Even in a small area of Hancheng mining area, there may be different gas occurrence laws. We should actively adopt advanced technology to strengthen the detection work, strengthen the research on the outburst disaster mechanism under different gas geological units and mining technology conditions, and improve the prediction accuracy and outburst prevention efficiency of the outburst risk in the mining area.

2) Most of the coal and gas dynamic disasters in the mining area are concentrated in the geological abnormal area, which is closely related to faults, folds, coal thickness changes, structural disorder coal, etc. geological exploration should be added to provide basis for the prevention and control of coal and gas outburst.

3) According to the technical conditions of mining technology, study the coupling relationship between stress concentration, roof and floor pressure and outburst disaster, and prevent and control the coal and gas outburst disaster from the angle of eliminating and reducing the coal seam stress.

4) From the perspective of disaster prevention and control, Hancheng mining area should give priority to the exploitation of the protective layer, in the area without the conditions for exploitation of the protective layer, the measures for gas drainage and in-situ stress removal of the coal seam should be carried out at the same time, and the comprehensive outburst prevention technology idea of hydraulic pressure relief and permeability increase measures combined with the weakening and erosion reduction technology of hard thick roof can be adopted.

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4
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