Study on hydrogeology and water control measures of close coal seam

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Abstract: In the process of mining, the distribution of groundwater has a great influence on mining safety and mining difficulty coefficient. In view of the complex situation of groundwater and the relatively large water pressure and inflow, it is necessary to pay attention to the further exploration of mine hydrogeological conditions and take this as the basis, combined with the mining area, the establishment of more targeted water control measures for enterprise safety mining play a significant role in promoting. In this paper, combined with the hydrogeological situation of the close coal seam, the corresponding analysis and discussion are made on its water prevention and control measures.

1. Introduction

In the process of mining, flooding accidents occur most frequently, and the consequences are extremely serious, especially in the process of connecting the mining face with surface water and groundwater, it is easy to appear a large number of water gushing, resulting in flooding accidents, resulting in casualties. With the increasing mining depth of coal field, the depth of shaft also increases, the situation of the bottom will become more and more complicated, the conditions of excavation are more and more severe, and the accident of water inrush well also shows an obvious rising trend, which has a very serious impact on the safety of mine production.

The hydrogeological conditions of mine in most areas of China are very complicated, which are easily affected by different factors such as the type and area of water threat. From 2012 to 2022, flood accidents in coal mines in China are still quite frequent, of which flood accidents in coal mines account for a large proportion of the total coal mine accidents, about 8.2%. At the same time, mine disasters will have different degrees of impact on the normal production of coal mines, especially on some relatively modern mines with high yield and efficiency. If floods occur, coal mines need to stop production, which will also cause greater economic losses. In addition, water disaster accidents will have a greater impact on the life safety of mining personnel, which is not conducive to the subsequent stable operation of coal mining enterprises [1]. Therefore, it is necessary to effectively curb the occurrence of mine flood accidents, which has become an urgent demand for mine safety production. It is necessary to assign special personnel to conduct in-depth exploration of the hydrogeology of coal seam in advance, and adopt relatively reasonable and effective prevention and control measures for water damage, so as to ensure the safe production and mining of coal mines .

2. Basic conditions of coal mines

2.1 The overall situation of the coal mine

In this analysis, a mine in Northwest China is selected. The north-south length of the mine field is about 5.643km, the east-west width is about 3.807km, and the total area is about 10.4804km2. Gully developed inside the well field, most of the time in the dry and no water state, there are a large number of gullies in the north and east of the well field, which also exist as the drainage channel of surface water in the well field, flowing east into the river outside the well field. In the mine area, the groundwater charging situation is relatively complicated, and there is a large amount

of water inflow, and the water pressure is also high. Therefore, it is necessary to find out the hydrogeological conditions of the region and formulate feasible water prevention and control measures, which is of great significance for the safe production of the mine, and at the same time, it can also provide more effective geological basis and safety guarantee for the coordination and unification of the follow-up water conservation coal mining and the construction of green mines.

2.2 Types of hydrogeological conditions

In the mine field, the main coal seams that can be mined are No. 14 and No. 15 coal seams, which are also approved for mining in the mine. The direct water-filling aquifer is the K2-K4 limestone karst fissure aquifer of Taiyuan Formation and the sandstone fissure aquifer are both direct water-filling aquifers. Through actual analysis, it can be seen that the water content of the coal seam of Taiyuan Formation is not strong, and the water inflow of the direct or indirect water-filled aquifer in the coal seam is generally lower than 0.1L/s•m, which belongs to the karst water-filled deposit with gold water in the roof, and the geological conditions are relatively simple. After the detection of the mine, it can be known that in the eastern part of the mine field, the overall structure is relatively simple, about 11 collapse columns were found, and caused certain damage to No. 15 coal seam, and the water conductivity is also very poor, among which the coal seam is about 27.0m thick water barrier from the Aoash top boundary. In the western mining area of the mine, a small part of karst water-filled deposits are prone to appear, mainly because the underlying Middle Ordovician karst fissure aquifer has high water content and relatively high water head. However, among them, the lowest floor elevation of coal seam No. 15 is + 800m, but the lowest coal seam in the west is far lower than the Ordovician limestone water level (+810m) 10m. Therefore, it is easy to have a large amount of water gushing in the mining of No. 15, especially in the subsidence column or the relatively weak zone of the coal mine structure, which is easy to have water inrush.

3. Factors of mine hydrology water filling

3.1 Mine water inflow

Through actual prediction, it can be known that the annual coal production of the mine is relatively high, about 3 million tons, and the water inflow is also high, usually about 1 2000m3 per day. In some special cases, the water inflow will rise significantly, up to now, up to 2 100m3. During the actual mining, the application of grouting fire extinguishing method in the mine needs to control the grouting time every day, usually within the range of 6-18 hours, because the grouting time is easy to have an adverse impact, and the water injection of the coal seam itself is relatively large. Therefore, in the process of actual design of the mine, the set water inflow is about 200m3/h, and the maximum water inflow will not exceed 400m3/h.

3.2 Atmospheric precipitation and wellbore seepage

Atmospheric precipitation is the most important source of filling water in coal mining fields. Atmospheric precipitation mainly enters from the caving zone of mining air, or through the existing water-conducting cracks, and some of it enters the interior of the mine through the bedrock cracks. Moreover, the influence of precipitation is also quite large, which will directly or indirectly affect the water inflow of coal seam. In addition, the size of the goaf and coal mine output will also have a certain impact, but the overall impact is significantly weaker. In general, precipitation belongs to the category of direct influencing factors.

3.3 Height of caving zone and water-conducting fissure zone

After systematic investigation, analysis and calculation, it can be known that the height of the caving zone of No. 14 coal seam is about 3-4.3m, and the distance between No. 14 coal seam and No. 15 coal seam is not large, about 7m. During the mining of No. 15 coal seam, we can start from No. 14 coal seam to carry out more in-depth mining, and the thickness of both is about 7.27m. In the process of actual mining, it is necessary to strengthen and pay attention to the application of full

mining height, and after relevant analysis and calculation, it can be known that the height of the collapse zone is about 24.5m, and the fracture zone of the water is about 77m. According to the relevant data information obtained above, it can be known that if the joint mining of No. 15 coal seam is carried out, the quality of coal seam about 100m above No. 14 coal seam is easily affected, and the impact is relatively serious.

After calculating the relevant data, it can be found that the height of the water-conducting fissure zone of No. 14 coal seam does not match the depth of the gross reservoir. Moreover, in the actual mining process of No. 14 coal seam, the seasonal surface water is easy to have an impact, but the impact is small and can be directly ignored. Because there is a gray water rock formation on the roof, and the gray water rock formation can transfer water to the lower part of the well field along the water conduction cracks, so the smooth mining of the subsequent No. 14 coal seam cannot be guaranteed. Compared with No. 14 coal seam, the high probability of the water conductivity fracture zone of No. 15 coal seam exceeds its own reporting. If there is water accumulation in the goaf of No. 14 coal seam itself at this time, the water accumulation will easily enter the No. 15 coal seam directly through the water conductivity fracture zone, which will seriously affect the progress of coal mining and even lead to water damage accidents.

3.4 Maximum water inrush coefficient

After a relatively in-depth analysis of the hydrogeological data related to the coal mine field, it can be known that the elevation of the Ordovician limestone aquifer is about 0.81m. At the same time, it can be known that the floor elevation of No. 14 coal seam is about 0.82m to 1.28m, and the floor elevation of No. 15 coal seam is about 0.8m to 1.28m. Among them, the water pressure generated above No. 15 coal seam is about 0.1MPa, and the thickness of the floor water barrier layer is about 27m.

After systematic calculation, it can be seen that the critical water outburst in the structural failure area reaches about 0.060MPa/m, but the critical water outburst coefficient in the normal section is usually 0.1MPa/m. After further analysis and calculation, it can be found that the limestone layer itself is more water-resistant, and generally does not occur the problem of Ordovician ash water inrush, in the actual mining process, still need to pay attention to the problem of water inrush caused by cracks in the structure itself

3.5 Aquifers and mined-out water

In this mining area, the thickness of aquifer changes greatly, and the continuity of aquifer is not strong, and the water-rich is relatively weak. Because the atmospheric precipitation can play a certain control over the water supply of aquifers, it is easy to change with the change of seasons. In the mine field, the coal seam is buried relatively deep as a whole, because the mined area has also begun to expand, it is easy to appear ground cracks or surface collapse and a series of problems, it is necessary to pay attention to the problems such as the infiltration of groundwater or surface water into the underground, and control them to prevent the smooth mining of coal mines due to water seepage[2]. In general, the occurrence of the inner layer outside or near the well field is obviously higher than the coal seam in the well field, and in the actual mining process, it is easy to appear the problem of cross-border mining, so the water in the mining is also easy to affect the quality of coal mining.

4. Influence factors of hydrogeological hazards in close coal seam

4.1 The water table rises and falls

In the process of geological investigation of the close-range coal seam mining area, hydrogeological disasters are easy to affect the quality and efficiency of the investigation work, which increases the difficulty of the investigation itself to a certain extent. If the hydrogeological disasters cannot be analyzed more fully, more useful solutions need to be formulated, which will further expand the hidden safety risks existing in the mining area. And affect the later mining

smooth mining and operation. During mining, groundwater, as an important factor of hydrogeological disasters, is easy to significantly affect the bearing capacity of mining ground. Under this condition, if more effective ways can be adopted to achieve effective control of the change of groundwater level, a series of negative effects brought about by the change of groundwater level can be reduced to a certain extent. If the water level changes beyond the critical value, it is easy to cause irreversible damage to the operation of the mine.

4.2 Changes in groundwater pressure

In the process of distinguishing hydrogeological types, it is necessary to take the geological investigation process as the main basis, combine with the terrain characteristics and the actual formation of aquifers, and take into account some influencing factors such as the environment around the groundwater table for comprehensive analysis and research. If the current surveyor does not pay obvious attention to the changes caused by the groundwater pressure itself, then when the formal mining operation is launched at the late stage of construction, it is easy to affect the previous groundwater pressure leveling state, and it is easy to increase the safety risks of subsequent construction. In the actual construction, if the groundwater level pressure changes significantly, it is easy to appear a series of problems such as surge or quicksand, which will eventually have a significant impact on the stability of the foundation of the mining area, so it is difficult to ensure the safety of the mining area operation.

5. Hydrologic measures for preventing and controlling water in close coal seam

5.1 Do real-time monitoring

In the process of mining, field operators need to do a good job of monitoring, mainly real-time monitoring of the water volume of the goaf. Usually, drilling technology and geophysical exploration technology can be used to explore the water accumulation, select a reasonable location of the goaf area, and orderly construction of several water drainage holes [3]. If the amount of water suddenly increases or is significantly higher than the maximum amount of water, the mining needs to be temporarily stopped, the staff needs to be evacuated in time, and the information needs to be reported to the higher authorities. If the amount of water is also rising during the actual extraction, then the anti-inrush work plan should be applied in a timely manner.

5.2 Focus on information collection

In the process of mining coal mines, it is necessary to conduct advance investigation, comprehensively collect and understand the relevant hydrogeological information of mining areas, further screen and integrate the collected information, and upload useful information to relevant departments, so as to provide strong data support for subsequent coal mining work and ensure the safety and efficiency of coal mining [4].

5.3 Do a good job of drainage

In the process of coal mining, drainage system is an indispensable part, it is necessary to do an effective management of drainage system, in order to ensure the soundness of drainage equipment itself. Among them, it is also necessary to carry out regular inspection of basic drainage equipment and do corresponding maintenance work, so as to ensure the safety and stability of drainage system operation [5]. In this process, it is also necessary to strengthen the cleaning work of the working face ditch, and the cleaning work of the water tank is also a part that needs attention to ensure the fluency of the ditch drainage.

5.4 Keep a record of the amount of water gushing

Usually in the rainy season or flood season, the rainfall will increase significantly, which will lead to significant changes in underground water inflow. Therefore, in the rainy season or flood season, it is necessary to pay attention to the record of underground water inflow, record its changes completely, use a special ledger to record it separately, and upload the recorded data to the database

for analysis and sorting. This paper analyzes the change of water inflow and the main reasons for the large change of water inflow, so as to analyze the parts that need attention in the process of coal mining and minimize the occurrence of safety accidents [6].

6. Conclusion

After systematic analysis, it can be known that the coal seam itself of the mine has relatively more water, which is easy to affect the smooth progress of coal mine construction work, so it is easy to limit the efficiency of actual mining. Under normal circumstances, many factors such as atmospheric precipitation and water accumulation in goaf will affect the normal operation of mine mining. Therefore, during the prevention and control of water threats, relevant staff should cooperate with each other, check in advance, investigate and determine parameters such as mining thickness, and carry out more in-depth analysis and investigation of mine geological conditions. Pay attention to and strengthen the application of a series of technologies such as advanced water exploration and drilling and banding, so as to realize the joint development of coal mining and water conservation work, and prevent water damage from a more comprehensive perspective. After systematic investigation and analysis, it can be known that many of them are involved in the work, and applied to a variety of water prevention and control measures, and achieved rich results, greatly improving the efficiency and quality of coal mining, reducing casualties, and greatly improving economic benefits.

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