Research and Exploration of Water Storage Law in Goaf of Merger and Reorganization Coal Mine Based on Computer

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Abstract. With the application of modern technology represented by computer, in recent years, the probability of coal mine safety production accidents has been declining. However, the current coal mine water disasters still occur, and a considerable proportion of accidents are caused by water inrush from goaf. The destructive characteristics of coal mine goaf water make it necessary to carry out the relevant research on the occurrence law of coalmine goaf water. Based on this, this paper first analyses the characteristics of water disaster in the goaf of merger and reorganization coal mine, then studies the computer-based investigation and exploration mode of water accumulation in the goaf of merger and reorganization coal mine, and finally puts forward the prevention and control strategy of water accumulation in the goaf of merger and reorganization coal mine based on computer.

Keywords: Water Storage Law, Merger and Reorganization Coal Mine, Goaf

1. Introduction

Mine water disaster in coal mine refers to the situation that groundwater flows into the mining space in the process of coal mine infrastructure construction and production, and the coal mine working face is flooded due to the relatively insufficient drainage capacity. The mine water disaster in coal mine seriously threatens the safety of mine production, at the same time, it will have a greater impact on the life and safety of staff. In the water disaster accidents of coal mines, a considerable proportion of accidents are caused by water inrush from goaf, and a large part of coal mines with goaf is formed by merger and reorganization[1]. The water accumulation in goaf of coal mine has several characteristics as shown in Figure 1 below. Therefore, it is of great value and role to strengthen the research on the occurrence law of water in goaf of merger and reorganization coal mine.
With the increase of mining depth, the shallow coal seam has been mined out, leaving a large area of goaf. Coal mine engineers usually inject more slurry water into the goaf to prevent possible fire hazards in the goaf. However, these artificially injected slurry water and sandstone water from the roof and floor of the goaf coalbed are accumulated in the goaf of the merger and reorganization coal mine, which leads to the goaf ponding becoming one of the biggest hidden danger factors threatening the safety production of coal mines. At present, the prevention and control of coal mine goaf ponding has become the key content to prevent coal mine safety production accidents. The degree of goaf water drainage is directly related to the effect of coal mine water prevention and control work, and more related to the safe driving of coal mine working face and the safe and stable promotion of coal production operation.

The mine water disaster can be prevented and controlled by merging and reorganizing coal mine goaf. Based on computer technology, it is helpful to understand the water filling characteristics of the mine, and take appropriate prevention and control measures, which can not only safely mine the coal resources threatened by water, but also improve the level of mine water prevention and control technology. The prevention and control of mine water in coalmine goaf based on computer is based on the analysis of hydrogeological conditions. The recharge, runoff and discharge conditions of groundwater are analyzed, and the hydrogeological conceptual model is established based on the analysis of groundwater flow field and hydro-chemical field in coal mine goaf, so as to lay a foundation for finding out the occurrence law of water accumulation in coal mine goaf. Therefore, it is of great practical value to study the water occurrence law of coalmine goaf based on computer.

2. Characteristics of water disaster in goaf of merger and reorganization coal mine

2.1. The concept of water accumulation in goaf after merger and reorganization

After the completion of mining operation, a large number of abandoned roadways and coal mining space will be left in the merger and reorganization coal mine. Due to the stop of drainage, a large amount of water accumulated in the goaf. According to the different geographical location of coal mine, the proportion of underground water in goaf is also different. Generally speaking, the underground water of coal mine in the north occupies a part of the goaf, while the groundwater of coal mine in the south occupies almost all the space of the goaf. Secondly, based on the differences in the formation time, coal seam, mine relative relationship and water medium properties of merger and reorganization coal mine goaf, the water accumulation in mining area can be divided into many different types.

2.2. Characteristics of water accumulation in goaf of merger and reorganization coal mine

The water accumulation in goaf of merger and reorganization coal mine often has the following characteristics. Firstly, the spatial position and scope of water accumulation can be found out by the mining engineering plan. Secondly, the amount of goaf water can be estimated by goaf area and mining upper and lower limits. In addition, the hidden danger of goaf ponding caused by some small coal mines near large-scale coal mines is similar to that of old coal mines. As long as the water exploration and drainage is insisted when mining the lower level or lower coal, the water disaster accidents can be avoided. If the water is not explored and discharged, the impact on the mine water
filling is similar to that of the old mine water, and the damage is especially serious due to the large amount of water accumulated.

2.3. Harm of water accumulation in goaf of merger and reorganization coal mine

In recent years, with the technical transformation and related advanced detection equipment put into use, the number of coal mine major water disasters and the number of deaths overall showed a downward trend, but occasionally, coal mine water accidents will still cause significant economic losses and casualties\(^4\). Figure 2 shows the data and development trend of coal mine water disasters in China in recent 20 years. In recent years, there have been many serious water disasters, and the water accumulation accidents in the goaf account for the vast majority of the proportion. The water accumulation in coalbed goaf of merger and reorganization coal mine is one of the most dangerous water disasters in coal mine production and construction. No matter the water volume, once it breaks out, it often causes casualties and heavy losses.

![Figure 2](image-url)  
**Figure 2.** Data and development trend of coal mine water disasters.

In addition, there are many old mining areas in many merged and reorganized coal mines, which have a long mining history, and leave a large number of goafs, especially near the shallow coal seam outcrop, small coal mines are scattered everywhere, forming a large area of goaf, and a considerable part of the area has ponding water and buried major hidden dangers. With the depletion of coal resources, small mines and even some large mines have been scrapped one after another, forming a large number of mined out areas. The water level of closed pit mine rises, which brings serious safety risks to the production of adjacent mines.

3. Computer based investigation and exploration of water accumulation in goaf of merger and reorganization coal mine

For the prevention of water accumulation in goaf of merger and reorganization coal mine, the key is to determine the scope and amount of accumulated water\(^5\). With the continuous iteration and development of computer technology, the current investigation and exploration of the occurrence law of water in coal mine goaf is mainly based on the comparison map between the upper and lower wells of coal mining, or when the coal mine lacks more accurate surveying and mapping data of water accumulation range in goaf, investigation or exploration means should be adopted.

3.1. Investigation on occurrence law of water in goaf of merger and reorganization coal mine
The investigation content of water occurrence law in goaf of merger and reorganization includes several aspects as shown in Figure 3 below, and the investigation content is timely input into the water investigation information database of reorganization coal mine goaf. After the completion of the above information input, we should also recheck and verify the source of the investigation data, the basic information of the investigators, the investigated personnel and the investigation time, and input the rechecked verification results into the water investigation information database of the reorganization coal mine goaf.

**3.1.1. Investigation means of water storage law in goaf of merger and reorganization coal mine**

The purpose of carrying out the investigation on the occurrence law of water in goaf of merger and reorganization coal mine is to find out the number and distribution of the old mine in the working area, carry out scientific evaluation on its harm degree, and lay a reasonable basis for the treatment of water accumulation in the coal mine goaf. The investigation contents of the occurrence law of water in goaf mainly include data collection, ground survey and personnel visit, etc., as shown in Table 1 below.

**Table 1. The investigation contents of the occurrence law of water in goaf.**

| Measures          | Contents                  | Results               |
|-------------------|---------------------------|-----------------------|
| Data collection   | Collection of mining data | Search for drawings   |
| Ground survey     | Field observation         | Mine conditions       |
| Personnel visit   | Questionnaire             | Personnel information |

In addition, the investigation on the occurrence law of water in coal mine goaf should also include the investigation of mine basic conditions, geological and hydrogeological conditions, as well as the distribution of goaf and water accumulation, so as to draw the distribution map of layered goaf and water accumulation based on the survey results[6]. Through the investigation of the collapse of the goaf, the present situation of the mine production facilities and industrial square, the main hidden dangers and dangers of the mine, and the main disposal measures taken after the mine closed. After the survey results are completed, the survey summary report is prepared, and based on computer technology; the investigation report is composed of text, necessary drawings and attached tables. If necessary, video and image data can be taken.

**3.1.2. Investigation results of water occurrence law in goaf of coal mine**

Based on the investigation data of gob, the investigation report should be compiled based on the detailed data and attached drawings. At the attached table level, there are the total table of resources/reserves, the statistical table of the annual output, loss, mining recovery rate and loss rate, and the statistical table of the basic information of the main water disasters, engineering and
environmental geological hazards of coal mines. The physical data mainly include photos, videos, etc., and the attached drawings mainly include traffic location, coal mine geology, mining engineering plane, and ground subsidence scope and water accumulation.

3.2. Exploration on the occurrence law of water in goaf of merger and reorganization coal mine

The exploration of the occurrence law of water in goaf of merger and reorganization coal mine should be carried out based on the principle and policy of combining geophysical exploration and drilling. The goaf or goaf water accumulation area delineated by the former needs to be further verified by the latter, so as to control the shape of goaf, the depth of water accumulation, estimate the water accumulation, and carry out detailed modeling and drainage of the occurrence law of water accumulation in coal mine goaf. With the deepening application of computer technology in coal mining safety and the iterative development of exploration technology, the current computer-based exploration method for the occurrence of water in goaf has the advantages of fast speed, low cost and high quality. In addition, the original goaf is modified based on the detection results of computer, and the water accumulation in goaf is compiled on relevant maps in time.

4. Prevention and control of water accumulation in goaf of merger and reorganization coal mine

4.1. Exploration and drainage of goaf water in merger and reorganization coal mine

The exploration and drainage of water in goaf of merger and reorganization coal mine based on computer is to find out the specific position and shape of water in the roof and floor, side slope and front goaf of mining face by applying advanced exploration, so as to release the water. Secondly, the exploration and drainage of water in goaf of merger and reorganization coal mine should be carried out based on the principles of active exploration and drainage, isolation before exploration and drainage, depressurization before exploration and drainage. In addition, after determining the ponding line, water detection line and warning line, the water exploration and drainage work is carried out in the area beyond the warning line, and the water exploration and drainage work is summarized and input into the computer system after the water drainage in the goaf is completed.

4.2. Isolation of water accumulation in goaf of merger and reorganization coal mine

The separation of water accumulation in goaf of merger and reorganization coal mine is mainly implemented by retaining waterproof coal pillar, strengthening weak link of coal pillar, filling goaf and water passage grouting plugging and construction of water release gate wall, and isolating water accumulation in goaf of coal mine. The safety evaluation of waterproof coal pillar is based on the size calculation of waterproof coal pillar:

\[
P_{30.5} \geq 20M
\]

In a word, computer-based merger and reorganization of coal mine goaf ponding prevention and control should be based on the principle of prediction and prediction, exploration before excavation, treatment before mining, to ensure the complete prevention and elimination of water accumulation in coal mine goaf.
5. Conclusion
In summary, the prevention and control of mine water in coalmine goaf based on computer is based on the analysis of hydrogeological conditions. The recharge, runoff and discharge conditions of groundwater are analyzed, and the hydrogeological conceptual model is established based on the analysis of groundwater flow field and hydro-chemical field in coal mine goaf, so as to lay a foundation for finding out the occurrence law of water accumulation in coal mine goaf. In this paper, through the research on the characteristics of water disaster in goaf of merger and reorganization, the characteristics and actual harm of water in goaf are analyzed. Based on the analysis of computer-based investigation and Exploration on the occurrence law of water in goaf of merger and reorganization coal mine, the means and methods for investigation and exploration of water occurrence law in coal mine goaf are given. Finally, through the computer-based merger and reorganization of coal mine goaf ponding prevention and control strategy research, pointed out the coal mine goaf water detection and isolation strategy of specific implementation.

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