

The Influence of Coal Mining on Groundwater Resources and the Analysis of Water Resources Protection Countermeasure

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Abstract

The large-scale development of coal resources, coupled with the impact of the extensive mode of production and mining technical limitations, many environmental problems have been caused, especially coal mine area water resources destruction. In the paper, we study the influence of coal mining on the groundwater factors, from mine drainage and mining damage and solid waste etc. Based on the analysis of different influence factors are given corresponding countermeasures to alleviate this effect, which provides the basis for the mining area water resources protection utilization and the sustainable development of coal mining.

Key words: coal mining, mine drainage,

mining failure, groundwater quality, countermeasure

In recent years, the environmental quality problem gradually become the focus of attention, and water environment problems as the source of life, more become a focus in the focus. According to the geological department statistics, 97% of the national city groundwater pollution problems exist, and pollution is increasingly serious, at the same time, by overexploitation of groundwater resources, the groundwater drawdown area has reached 150000km². China is a drought serious country, freshwater resources per capita is only 1/4 of world average per capita, available water amount is only 900m³, is one of the poorest countries in the world per capita water resources.

China is a big coal mining country. The

large-scale development of coal resources, coupled with the impact of the extensive mode of production and mining technical limitations, many environmental problems have been caused, especially coal mine area water resources destruction. How to realize "sustainable development", based on the exploitation of a resource while the other one or more resources do not have devastating effects, will become the only path to the future development of coal industry. Therefore, we study the influence of coal mining on the groundwater factors in the paper, fundamentally the analysis of the effect of coal mining of groundwater, and put forward reasonable and effective protection measures, to protect precarious source of life.

1. The influence of coal mining on groundwater

1.1 The influence of mine drainage on groundwater

Under natural condition groundwater resources in a state of dynamic balance, the mining area of drainage for a long time, breaking the balance of nature condition of groundwater and forming to mine as the center of the cone of depression, changing the original recharge, runoff and discharge relationship of mining area groundwater, which not only affects the quantity and quality of groundwater resources, but also destroy the dynamic balance of water and the ecological environment, resulting in a series of adverse consequences.

1.1.1 The influence on the groundwater circulation

The water circulation is in the natural state before mining, because of the function of mine dewatering and surface subsidence after mining, the mining area water circulation system changes. Main performance: before the mining surface water supply to groundwater relationship is stable. After mine drainage the groundwater level regional decline, lead to surface river water directly recharge underground. Surface water flow was significantly reduced or exhausted stop when cracks occur due to mining and even cause surface subsidence makes cracks extended to the ground. The surface water will be through the water flowing fractured zone infiltrate into pit water, destroyed the natural hydraulic connection of surface water and groundwater; a large number of mine drainage accelerates the infiltration of surface water and groundwater runoff speed, and the discharge of mine water recharges groundwater by leakage. Thus changing the relative proportion of surface runoff, basic flow and subsurface flow in the basin, which was originally closed basin becomes non-closed basin, so that complicates the regional water circulation [1].

1.1.2 The influence on the groundwater level and flow field change

In order to maintain the normal production of mine, and the need for living water in mining area. The exploitation of groundwater possibly threatened the safety of water discharge, which destroyed the balance of natural groundwater, formed to mine as the

center of the cone of depression. Groundwater around the pit to keep the confluence, within the radius of influence, the groundwater flow speed, and a sharp decline in groundwater level. In recent years, the continuous expansion of coal mining in the breadth and depth, and the drainage of groundwater caused the scope and magnitude of the cone of depression is also growing. Mine drainage not only destroyed the natural groundwater flow state, and severe over-exploitation of groundwater may also cause ground subsidence, cracking buildings, tilt. Affect the safety of the mine and the building on the floor. For example Tangshan area due to coal mine drainage, water level is decreased from +5m to -57.98m now, the water level dropped by 62.98m [2].

1.1.3 The influence on the quantity of groundwater resources

Under the natural conditions, groundwater supply is equivalent to the sum of the change of recharge rate and groundwater storage. However the mine drainage based on the normal extraction increased the burden of additional groundwater, making supply far exceeds the recharge and the recharge of groundwater can not get the corresponding guarantee, which can lead to groundwater aquifer was dewatered, water storage capacity reduced, local changed into non-pressure from confined, eventually lead to fracture water above coal measure strata was obviously damaged, so that the original aquifer into permeable layer [3].

1.1.4 The groundwater pollution caused by mine water discharge

Coal resources in the process of mining and the mine water gushing in the process of underground flow, dissolved in many minerals. The minerals including: mercury, lead, chromium and other heavy metals; fluoride, cyanide and other inorganic toxicants and inorganic acids, salts and inorganic suspended particle. It also contains a certain amount of cinder, quicksand and other impurities. The part of the mine water seepage into the formation, causing direct contamination on groundwater; another part of untreated mine water directly discharged. In the process of discharge, because acid mine water has hydraulic connection with surrounding rock fracture water. The release of these harmful and noxious substances will also pose a serious threat to groundwater.

1.2 The influence of mining failure on groundwater

Underground rock porous media are deformable body. Under load and fluid pressure, the deformation of the porous medium can cause changes in pore, fracture and solution crack channel, resulting in pore fluid flow, pressure and velocity changes.

Before coal seam mining, coal seam and groundwater are in stress equilibrium. After coal seam mining, changes the original stress in the surrounding rock, resulting in increased and decreased stress zones in the surrounding rock of coal seam. These changes will lead to overlying strata above coal seam produced fracture, caving, abscission layer, deformation and displacement, etc. Destroyed the original structure of rock

and formed mining-induced fractures network conductor. When the coal seam surrounding rock occurrence of aquifer and water, mining caused fractures in the overlying strata can form new conductor. The seepage of groundwater to mine, resulting in loss of groundwater resources. With the increase of mining depth and breadth, formed caving zone and fractured zone gradually increased. It will be possible to make the original aquifuge break, and then change groundwater original occurrence condition and movement pattern.

1.3 The influence of solid waste on groundwater

Groundwater pollution caused by coal gangue solid waste discharge. Coal gangue is the main solid waste during coal mining. It is account for coal mining quantity more than 15% in the process of coal mining. Coal gangue piles in the open air under the action of rainfall, snowfall leaching and its contained water, occurring a series of physical and chemical changes. Its harmful and noxious substances(sulfide, carbonates mixture, inorganic salts) into the groundwater environment in the hydrodynamic effects. Cause the surrounding area of soil and groundwater pollution (as showing in Fig. 1).

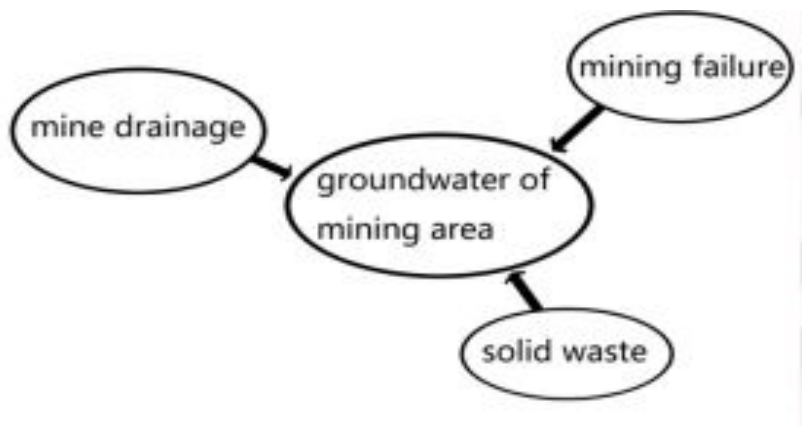


Fig. 1 The analysis of main influencing factors of mining area groundwater

2. Analysis of protection countermeasure on mining area groundwater resources

Mine water is underground gushing water generated in the process of coal mining. Mine water as well as groundwater, only in the process of emergence and pooled dissolved many minerals and a certain amount of cinder,

quicksand, etc. Annual discharge of mine water in China is about 2 billion m³. If not classified processing and reasonable utilization of mine water, not only causes the pollution and waste of water resources, but also produces corrosion to underground equipment. Therefore, it is necessary for the proper processing mine water, to achieve the reasonable utilization of resources.

2.1 Adopt scientific methods of coal

mining

In the process of mining, coal mining methods, phases, area, depth, breadth and mining speed and so on can lead to varying degrees of influence on groundwater resources. TO do a good job of protection of water resources, it is should first start from the root cause of damage. Therefore coal mining should plan scientifically, distribute rationally and use scientific, green coal mining method. To achieve "water preserved mining", ensure the sustainable development of mining area.

2.2 Mine water conversing to resource

On the one hand, a large number of mine drainage pollutes environment in the process of coal mine construction; on the other hand, a serious shortage of water supply in mining area due to groundwater resources are destroyed. At present, as the shortage of mine water resources, many mines are utilizing comprehensively of mine water in different levels. But utilization rate is relatively low, and only a minority of the mining area to adopt the method of scientific and effective to utilize mine water.

Because the source of the mine water is different, according to the characteristics of mine water pollutants, generally can be divided into: clean mine water, containing suspended solids mine water, highly mineralized mine water, acidic mine

water, alkaline mine water and mine water containing special pollutants^[5]. Mine water adopts different techniques and methods according to different water quality types. Based on the principle of "decontamination triage, classified processing, respective utilization" for processing and utilization of mine water.

2.2.1 To achieve "decontamination triage, classified processing" of mine water

"Decontamination triage, classified processing": First of all, take out of the water that comes from the underground aquifer to the ground to utilize. That can make it not be polluted by the rock dust, coal powder and acidic mine water. Then classify the contaminated mine water according to the levels of pollution. Kailuan Mining save a lot of electricity, water and sewage charges fees in mine water processing through decontamination triage and building water treatment plant. Among those, Fangezhuang Mining Branch use mine water 9.46 million t/a, save mine drainage utilities 1.29 million yuan/a, saving water resources fee 1,892,000 yuan/a, close living area water wells and save electricity 301,000 yuan/a through the transforming of 204 fissure water and 208 water burst, this measure had a huge economic and social benefits.

2.2.2 To establish underground mine water processing system

Carried out the treatment to mine water in the underground. For heavily contaminated mine water, it can be used for mine dust, fire sprinkler, mining machinery water and others which demand less quality water after primary treatment. The remaining part is discharged to the ground. It may also be used as industrial water or domestic water after advanced treatment. For the part which contains suspended solids or less polluting and easily to be purified, it can be discharged to the ground after mine treatment, and can be used in industrial, agricultural and domestic directly. To establish underground mine water processing system which can turn mine ground water into the underground water, and it can save a lot of mine drainage water costs, and can also effectively protect the underground mine water drainage path from mine water's corrosion.

2.2.3 Expansion of mine water's treatment and utilization

On the one hand, the mine water is one of geological disasters. It threatens the mine production safety seriously. On the other hand, it also is the precious fresh water resources and has great value of development and utilization.

1) Using mine water to realize the air conditioning of office buildings. It will use the water heat pump technology

which is a new energy-saving air conditioning technology. The technology can cut the investment and operating costs, save energy and water, reduce the impact on the environment.

2) Integrating the mine water to the city water planning and management. After the mine water processing system's treatment, addressing the mine water to the city water company for deep processing and distribution. In this way it would be able to achieve proper utilization of water resources and reduce mining water cost. It can also make reciprocity with other enterprises and achieve sustainable utilization of mine water resources.

3) Making the mine water as a water source in power plant. The scarcity of water resources is often a major factor constraining power plants to be built. Through simple biochemistry depth processing such as coagulating, precipitating and filtrating, then the mine water can be used in industry, it happens to solve the water source problem of power plants.

4) Supporting mining subsidiary industries. Thanks to the mine water matching the high quality mineral water standard, we can take the advantages and seek the partner positively to develop range of high quality mineral water. It could be made as mining subsidiary industries to widen the revenue channel and increase economic efficiency.

2.3 Establishing a strict management system of mine water resources

Protecting mine water resources should be based on the spirit of "put prevention first, combine treatment with utilization" "who pollutes, who deals with it" to establish a strict management system of water resources.

1) To perfect the policies and regulations and increase awareness of water resources protection in mining areas.

2) To establish the mining areas' environment appraisal system, specially water environment appraisal system.

3) To implement the mining areas' water resources compensation system and create the reasonable compensation system of water resources which is caused by mining coal.

4) To establish the mining areas' water resources management system and implement the unified plan and management to the mining areas' water resources.

5) To implement the award-winning reporting system and encourage the public to report mining areas which causes serious water pollution.

The mining areas should strictly strengthen mine water quality and water monitoring in accordance with "the regulations for coal mines to combat water disasters"; They should take the measures to control mine drainage, such

as reserving water coal (rock) column and masonry walls gates and sluice gates; Taking the "decontamination triage, classified processing, respective utilization" measures to the mine water utilization to convert mine water into resources; The following mine water treatment project should be established to store the mine water that has not been processed or used to prevent wasting water resources.

3. Conclusion

This paper summarily describes the adverse influences of coal mining on groundwater and the coping strategies for alleviating it. We can see that it is not only a kind of damage to the environment, but also a waste of water resources if not addressed any of the emissions according to the mine water emissions on current annual. On the one hand, it can reduce the damage to the environment caused by mine water; on the other hand, it can ease the tension of water by using reasonable processing methods. The damage of groundwater resources caused by conventional coal mining methods is inevitable, but it can be controlled. It will provide new ideas for the development of enterprise, create a better economic and huge social benefits by taking seriously protection, treatment and utilization for mine water resources.

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