

Research on the Problems Relevant for Water Resources in Coal Mines

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Abstract: As water resources are closely related to people's life and production, the proper demonstrating and effective utilizing water resources has become a very important strategic issue. Water argumentation for coal mines and recovery of mine water are contributing for water saving, water resources protecting and water resources reasonable developing and utilization. In order to safeguarding the sustainable development of the national economy and utilizing the limited water resources reasonably, the article carries on research in certain problems of water resources which is related to coal mines water argumentation and recovery. The main contents in report: surface and ground water quantity and quality analysis, water using reasonability analysis, diversion and drainage impact on environment and corresponding compensation analysis, diversion and drainage impact on other water users and relevant compensation analysis, method and analysis in mine water reutilization and so on are discussed in detail based on the Jinzhuang colliery project, and a typical example is presented in the article.

Introduction

With economic and social development, the coal that belongs to the non-renewable resources occupies a very important position in energy consumption and production in China. In order to satisfy the needs of the development demand of social economy, the scale in exploiting and using of coal must be expanded which makes it easy to cause the destruction of water resources and the deterioration of ecological environment^[1].

In consideration of the actuality of water shortage, how to ensure the continuous progress in coal mining enterprises makes sure that comprehensive treatment and development, rational utilizing, effective protection in water resources be realized and how to make good arrangement for the water-used between production, life and environment^[2] which consequentially insist coal mine that consider the condition of water resources adequately and control the unordered demand of water by scientific administration. The progress of coal mine water resources argumentation and reutilization not only form an effective system of coordinating the emulative using water and making sure reasonable allocation of water be realized, but also can solve the problem of wasting the shortage of the water and the pollution of water emission.

General situation of mining area

Zaozhuang Jin Zhuang coal mine is located in the north-east of Lunan Tengxian (South), the mine is located in the southwest of Shandong Province Tengzhou City, regional river include moat and Guo River. Western mining area is Zhaoyang Lake of in Nansi Lake,the lake is vast, and the water is perennial. This area belongs to the warm temperate semi humid continental monsoon climate,it has four distinct seasons,windy spring drought, summer is hot and rainy, sunny autumn cool, dry and cold in winter.

Jin Zhuang mine East-West length of 4 km,and the width of 6.5 ~ 9 km north-south tilt,,the area was 30.09 km²,it's coal geological reserves of 59410000 t which can use the reserves of 51190000 t, and the mine design annual production capacity of 300000 t, those can be adopted coal seam is mainly 3, 12, 16, 17 ,every coal seam has good cokeability and combustibility, as high calorific value coal.

According to the drilling data of coal, coal layer successively from the mainland : Middle Ordovician, Middle Carboniferous Benxi Formation, Upper Carboniferous Taiyuan formation, lower Permian system of Shanxi Formation and Lower Shihezi Formation, Upper Jurassic Mengyin system group and Quaternary. This coal mine is a wide and slow fold, which is dominated by faults, and the coal measures strata are changed along the trend and the trend is changing, and there are some natural coke in the local area. In the complex degree of geological structure, the mine structure belongs to the medium type. The whole Quaternary sedimentary thickness, from northeast to southwest gradually thickening. The top group under the Quaternary clay, sandy clay soil section of stable distribution., water resisting property good, and the precipitation, surface water ,quaternary group water and coal measures aquifer without direct hydraulic connection.

Water Resource Argumentation

The significance and content of argumentation

With the circumstance of water shortage in China, the argumentation provides the security basis of the continuous, healthy, steady development in Chinese economy which conforms with the objective demand^[3].The argumentation of coal mine water plays a very important role in exploiting and using water even regulating water resource effectively. Meanwhile, it can guarantee the sustainable water using and the development in coal mining production.

The argumentation which principal contents include: the analysis of the area's water and its situation of exploiting and using; the analysis of rationality of water withdrawal; the argumentation of headwaters; the analysis of water intaking and water-break; the argumentation of compensation schemes^[4].

The situation of water using and the analysis of rationality in water withdrawal

The situation of water using

Jin Zhuang colliery is located in Tengxi plain. According to Tengzhou water resources sustainable utilization planning, the average of Tengxi plain total water resources is 346,778,807m³ which includes surface water 186,468,809m³, groundwater 182,820,401 m³, double counting 22,510,403m³.The amount of Tengxi plain water resources and the amount of utilization water in different guaranteed rate is shown in Table 1,Table 2.

Table 1 The total amount of water resources in Tengxi plain
Unit:m³

Project	The amount of surface water	The amount of groundwater	The amount of double counting	The total amount of water resources
Annual average	186,468,809	182,800,401	22,510,403	346,778,807
50%	159,849,450	176,440,300	21,210,499	315,079,251
75%	95,632,706	144,234,150	18,207,780	221,659,076
95%	38,781,308	102,212,050	11,946,195	129,047,163

Table 2 the amount of utilization water in Tengxi plain
Unit:m³

Project	The amount of surface water	The amount of groundwater	The amount of double counting	The amount of utilization water
Annual average	66,050,900	171,974,080	32,383,100	205,641,880
50%	65,909,700	146,639,300	32,052,700	180,496,300
75%	64,913,700	119,635,400	34,463,500	150,085,600
95%	19,730,700	76,894,300	33,430,600	63,194,400

The analysis of rationality in water withdrawal

According to the investigation and study, besides the local inhabitants using water for living and irrigating the farmland there is not large-scale water intake behavior near in Jin Zhuang coal mine industry field. Because of the consumption of life water in coal mine industry is relatively small, at the same time, coal mine inflow is larger, the mine water which be discharged outside can completely satisfy the standard of farmland irrigation water that the using of mine water to irrigation can save nearly 20000 m³ of groundwater resources yearly. So there will not be happened the argument of water using. The coal mine choose the quaternary gravel and sand layer underground water to act as construction project and fire protection headwaters which can meet the requirements of all coal mining and it act as the living water source o is reasonable.

Jin Zhuang coal mine accesses the quaternary groundwater water is 377 m³/d which only be used in the coal industry field living quarters and fire reserves, and other miscellaneous living, industrial water service and so on all use mine drainage. At the same time, coal mine form the complete equipment that be used for dealing with the mine water and sewage in the progress of construction which has realized the water recycling and reduce the exploiting of fresh groundwater. It can save the water resources also meet the requirements of the development of energy conservation and emissions reduction. Therefore, the mine utilization water is reasonable based on the above data.

The argumentation of using groundwater

The calculation of groundwater supplementary amount

The supplementary amount of groundwater includes the supplementary amount of rainfall infiltration, The supplementary amount of well irrigation flyback, river runoff infiltration recharge and so on. Through the formula figure up can get the amount.

(1)The supplementary amount of rainfall infiltration

Formula: $Q_s = \alpha \cdot P \cdot F$

Q_s --the supplementary amount of rainfall infiltration,

α --the supplementary coefficient of rainfall infiltration,
P—annual precipitation,
F—the calculative area.

The supplementary coefficient of rainfall infiltration is 0.262, annual precipitation is 763.8mm, the calculative area is 11.52km².The result of the supplementary amount of rainfall infiltration is 2,305,300m³.

(2) The supplementary amount of well irrigation regression

Formula: $Q_w = \beta_w \cdot R \cdot F$

Q_w --the supplementary amount of well irrigation tropical year,
R—irrigation norm,
 β_w -- the regression coefficient of well irrigation,
F—the area of well irrigation.

The area of well irrigation is 7000 mu, β_w is 0.25, the irrigation norm is 200m³/mu·year, so the supplementary amount of well irrigation regression is 350000 m³.

(3)The supplementary amount of riverway runoff infiltration formula:

$W_r = K \cdot M \cdot I \cdot L \cdot d$

W_r -- The supplementary amount of riverway runoff infiltration,
K—filtration coefficient,20m/d,
M—the thickness of aquifer,25m,
I—hydraulic slope (1/800),
d—the number of days in annual riverway runoff,120days,
L—the length of fluvial cross section,7000m.
The result is 525,000m³.

So, the annual average supplementary amount of groundwater in the argumentation area is 3,180,300m³.

The argumentation of groundwater headwaters

Though the above calculation, the annual average supplementary amount of groundwater in the coal mine argumentation area is 3,180,300m³,the assurance coefficient is 0.8,the available amount of the area water is 2,544,200m³,the annual average exploiting amount in personal condition is 2,036,600m³,the annual residue exploiting amount is 507,600m³.Jin Zhuang coal mine using water resource which is 377m³ daily (totally is 137,600m³ yearly) is permitted, meanwhile, the supplementary coefficient of rainfall infiltration and the supplementary amount of well irrigation regression are stably. So the headwaters of the area is reasonable that can make sure the assurance rate of using achieving 95%.

the analysis of water intaking and water-break

the analysis of water intaking

Because of the Jin Zhuang coal mine use the groundwater in their production and life living there will not have an effect on the surface water, but the drainage and water-break of the coal mine will influence the surface water partly. The headwaters choose the quaternary gravel and sand layer water which is rich in water resources and the supplementary amount is abundant, The supplementary coefficient of rainfall infiltration and well irrigation regression are stably. In the condition of coal mine using water resource which is 377m³ daily, there will not influence largely the groundwater even the industry, agriculture and the lives of residents.

the analysis of water-break

With the exploiting of coal resources and the construction of supporting facility in all kinds of production, the discharge of sewage and industrial waste will be increased heavily. Without planning It will seriously polluted the surface water and quaternary system groundwater that it is easy to cause deterioration of water environment and certain harm to the ecological environment without reasonable emissions. After the mine production, therefore, it should ensure that form the normal operation of sewage treatment system and formulate the corresponding contingency plans in order to prevent water pollution of surface water quality. Meanwhile, the amount of emissions is larger and the water quality is meet the demand, there are part of pollutant (COD_{cr}) is exceed the government regulations. The coal mine must pay most attention on the amount and quality outside water and improving the standard of water management.

Mine water reutilization

The necessity of mine water resources

With the development and utilization of coal in China, water resources have been seriously polluted, and the coal mine water is one of the largest coal mine emissions. The national coal mine drainage water is about 2.2 billion m^3 , and the utilization rate is only 26%.so,It is an effective way to alleviate the contradiction between supply and demand of water resources and improve the ecological environment of the mine. Especially in the severe water shortage in mining area, it has good social, environmental and economic benefit. Making use of mine water as an important way to solve the shortage of water resources in water shortage area^[5].

Regional mine water survey

According to the preliminary design of coal mine, Jin Zhuang coal mine normal inflow is $12528m^3/d$, and the water quality is good, After treatment and purification, it can be used as a living miscellaneous water, underground mine fire, dust sprinkler, water supply of coal wall water, water resources。 Jin Zhuang coal mine water quality as shown in Table3.So, Mine water treatment using partial purification method, Mine water precipitation process is illustrated in Figure 1.

Table 3-1 Jin Zhuang coal mine water quality list

Type of water source	Main pollutant concentration (mg/L)		
	SS	COD _{Cr}	BOD ₅
Mine water inflow	400	110	30
Deep underground mine water	60	80	20
After the purification of mine water	5	50	10
two standard samples	300	150	60

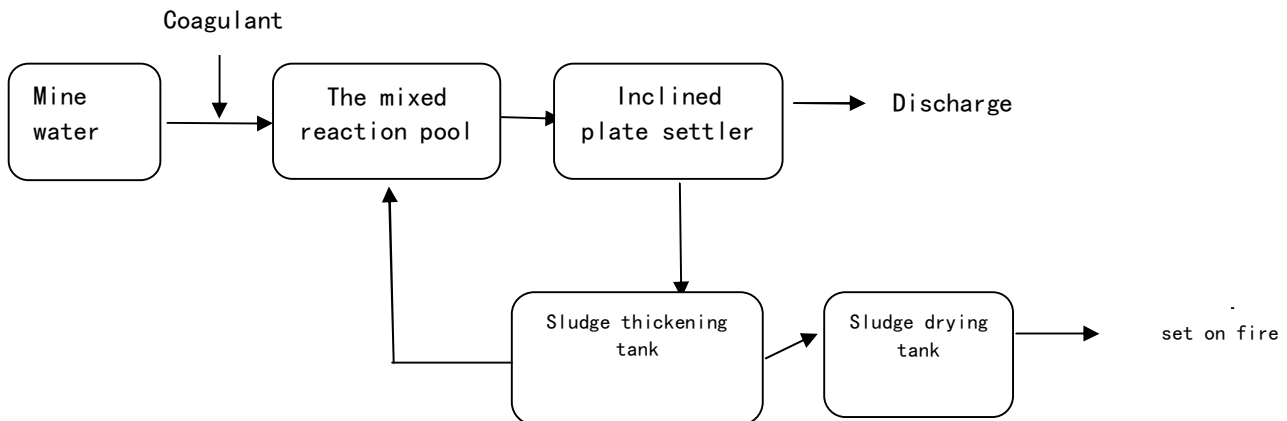


Figure.1 Mine water precipitation process diagram

Utilization of Mine Water Resource

Due to the impact of mine water only by pulverized coal mining process and man-made pollution, external drainage water quality is relatively clean, the mine water quantity and water quality are relatively stable, after a simple treatment process, it is easy to meet the requirements of all kinds of water, But the amount is only 867 m³/d, the utilization rate only 6.7%, most of mine water after treatment is still discharged into the Guo River, due to the larger displacement (12184 m³/d, together with a small amount of sewage), the total emissions of COD_{Cr} in drainage reached 324t/a, far more than the control index. so, the mine water treatment standard should be improved, or the utilization rate of the mine water should be improved, and the displacement of the mine water should be reduced. Out into the river of the mine water meet the "water quality standards for irrigation (GB5084-92)", it can be used for irrigation water Guo River farmland, which saves the precious water resources, but also reduce the pollution of Zhao yang lake. Meanwhile, the development of coal mines in the late development of coal preparation and other industries, can also be used as coal preparation supplementary water.

Sustainable development of coal mine water resources

In the process of construction and production, we should pay attention to the technology improvement, strengthen water conservation, water conservation consciousness, save water, reduce

the amount of fresh groundwater, increase the comprehensive utilization of water, and continuously improve the level of water use.

Conclusion

In this paper, the problem of water resources in the coal mine, the mine water resources demonstration and mine water resources are analyzed with examples of specific aspects, comprehensive. The water resources argumentation involves many aspects, such as the guarantee of the mine water, the rationality of the water, the protection of the ecological environment, the contradiction between water use and the compensation. Paved the way for the normal operation of the coal mine, with auxiliary significance in science and justice. In this view of the shortage of water resources in our country, it is necessary to develop and utilize the water resources reasonably. The reclamation of mine water is an effective means to reduce or eliminate the excessive use of water resources, We should vigorously promote it, and gradually improve it, to achieve the purpose of protection of water resources and sustainable development.

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