**Engineering And Technology Journal e-ISSN: 2456-3358**
**Volume 3 Issue 01 January-2018, Page No-357-360**
**DOI:10.18535/etj/v3i1.03, I.F. - 4.449**


# Status Quo and Countermeasures of Groundwater Utilization in Pingdingshan Coal Mine

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**Abstract:** The groundwater in Pingdingshan mining area can be divided into three types according to the type of aqueous medium: carbonate rock karst fissure aquifer (group), clastic rock fissure interstital aquifer (group) and loose rock aquifer (group). Combining with the utilization status of groundwater in Pingdingshan coal mine, this paper selects the existing wells for monitoring according to the hydrogeological characteristics of the mine and the scheme of mine exploitation and utilization. The paper analyzes and summarizes the groundwater prevention measures and countermeasures of groundwater level, water volume change and mine drainage. Through the use of protective mining technology, optimization programs, pumping of aquifers and other programs for better utilization and prevention and control of groundwater in coal mines.

**Key words:** Aquifer; Water resources; Utilization countermeasure; Pingdingshan mining area

## 1. Regional Hydrogeological Profiles

Pingdingshan mine is the first large-scale mining newly developed after the founding of the People's Republic of China [1]. The Pingdingshan coalfield is an inclined coal bearing basin whose main body is the Likou syncline. Its northwest, southeastern, north east and south edges are affected by the Lixian fault, the Luogang fault and the Xiangfan fault And Lu Ye faults and other structural cutting, a basement structure, so as to form a relatively independent hydrogeological unit.

During the development of coal mines, gangue piled up in the open air will undergo a series of physico-chemical reactions due to exposure to air and long-term external environment such as rainfall. The soluble inorganic salts and some heavy metal elements contained therein will elute as the leaching Water overflows the ground in the form of overflow springs to contaminate groundwater[2]. Pingdingshan mine is located in the southern wing of the Likou syncline. The northern part of the mining area consists of the surface watersheds of Hongshan, Longshan, Leigu, Taishan, Pingdingshan and other low mountains with the elevation of 300～500m and the slope of 8～50º. The Permian sandstone is exposed along the low mountain and can be directly accepted Atmospheric precipitation recharge. Mine precipitation statistics in Figure 1. The mine is located between trough valleys in the hilly hills and is a low profile north-south sloping plain [3] that can be directly recharged by atmospheric precipitation.

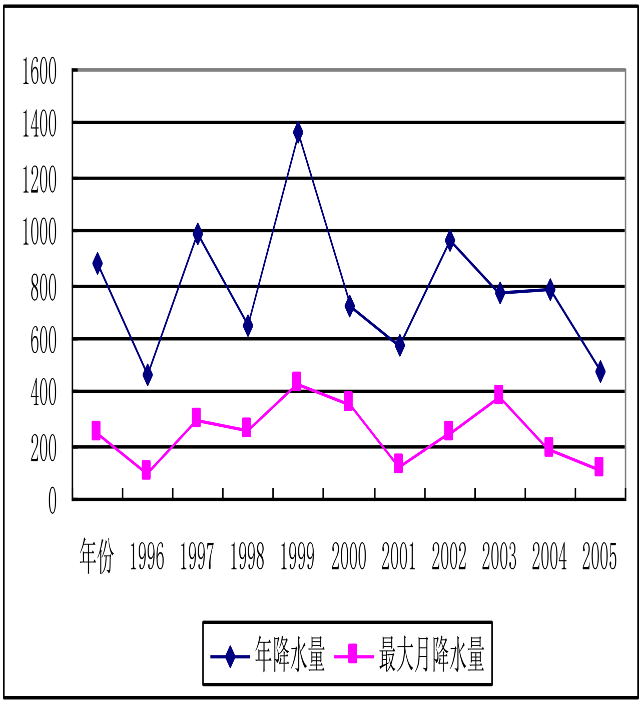


**Figure 1** Pingdingshan mine precipitation statistics (unit: mm)

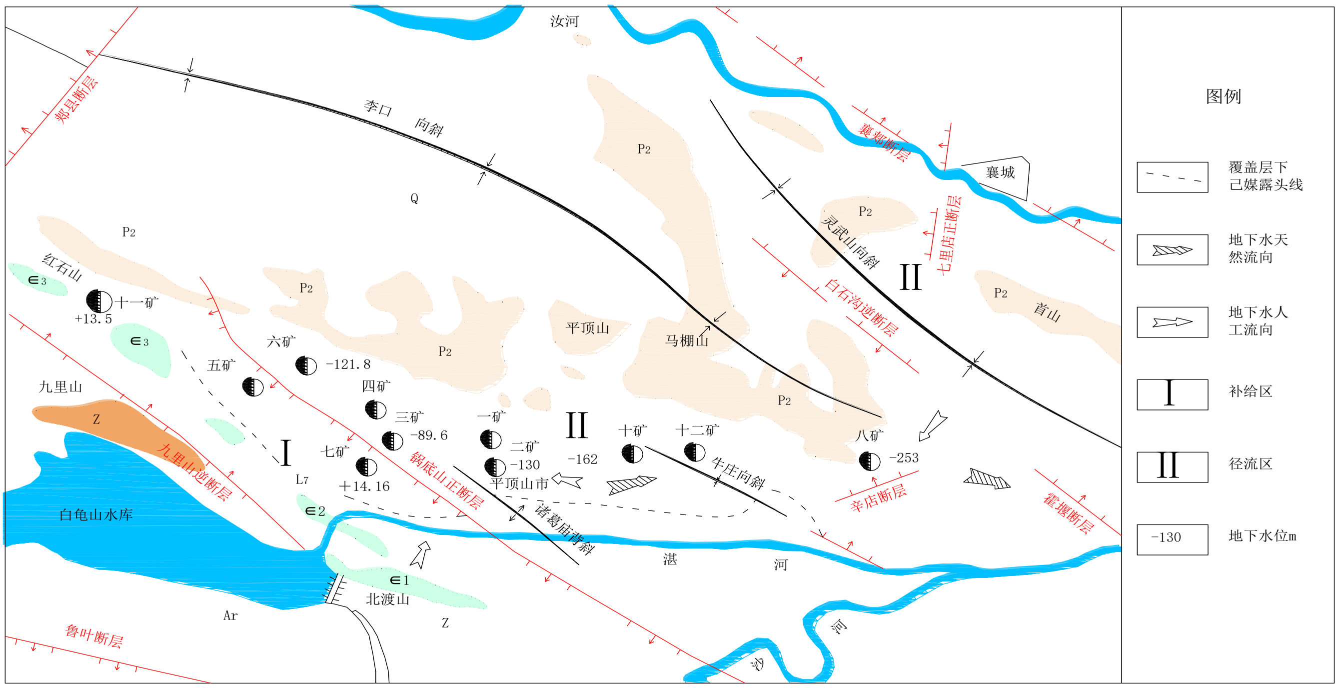


**Figure 2**. Pingdingshan area hydrogeological map

## 2. Hydrogeological Conditions

### 2.1 Aquifer (group) Characteristics

According to the lithology, the non-uniform distribution of tectonic distribution, and the regional climate, geomorphology and hydrodynamic conditions [4], the groundwater in Pingdingshan mining area can be divided into carbonate type karst fissure aquifer (group) Clastic rock fissure interstice aquifer (group), loose rock pore aquifer (group) of three types. Mining hydrogeological map in Figure 2.

#### 2.1.1 Carbonate karst fissure aquifer (group)

Including Cambrian limestone, Carboniferous Taiyuan limestone and Neogene marl aquifer.

Cambrian dolomitic limestone and oolite limestone constitute the basement of coal-bearing strata. The development of outcrops and shallow karst fissures in this group provided favorable conditions for atmospheric precipitation and groundwater recharge. Pumping test units influx q: 0.00105～3.781L/s.m, permeability coefficient k: 0.000398～7.47m/d. Mineralization degree M: 0.19～0.5g/L, water quality type: HCO3 -CaNa, HCO3-CaMg type. One of the major aquifers filling the mine.

The Carboniferous Taiyuan Formation is 50～95m thick with 7～11 layers of limestone and the total thickness of limestone is 24～48m. Quaternary sediments are all covered in the area, and the karst fractures in the shallow fissures of the strata are well developed. The water inflow of the pumping unit q: 0.00535～18.00L/s.m, the permeability coefficient k: 0.25～64.80m /d, the salinity M: 0.26～5g/ L and the water quality of HCO3-Ca and HCO3-Na, HCO3-CaNa, HCO3 -CaMg type.

Neogene marls are mainly distributed in the low-lying terrain in the southwestern part of the mining area and on both banks of the upper reaches of Zhan River. They are 0-40 m deep and 0-22 m thick, generally 3-6 m thick. Drilling data show that the karst cave in the mining area generally developed, strong water. The inflow rate of pumping unit q: 0.244 ~ 45.00L/s.m, the permeability coefficient k: 0.487～2.90m/d, the salinity M: 0.3g/L and the water quality types as HCO3 -CaMg type. The limestone in this layer overrides the unconformity over the underlying strata of different ages.

#### 2.1.2 Clastic fissure aquifer (group)

Including Triassic, Permian coal seam roof sandstone and Pingdingshan sandstone. Triassic sandstones are thick, widely distributed and developed in fractures. The 3137 and 3132 wells in deep construction are all artesian wells. The unit inflow Q: 0.000114～0.202L/s.m, permeability coefficient k: 0.00255～0.972m / d, water quality Is: HCO 3 -CaNa,

HCO3-CaMg type. Degree of salinity M: 0.19～0.5g/L.

The Pingdingshan sandstone is exposed in some watersheds in the middle part of the coalfield. This layer is composed of medium-coarse quartz sandstone and can be directly recharged by atmospheric precipitation with a thickness of 109-134m. It develops well in joint fissures and is rich in water. Pumping test unit inflow q: 0.478L/s.m, the permeability coefficient k: 0.0957～1.44m/d, water quality type: HCO3-Ca type.

There are sandstone aquifers in every Permian coal seam, among which sandstone, sandstone, sandstone pottery kiln and Tianjiagou sandstone are larger in thickness and distribution is relatively stable. However, in general, sandstone monolayers are relatively small in thickness with thick mudstone or sandy mudstone separated from each other, so the hydraulic connection between sandstone aquifers is relatively poor. The water inflow rate of the pumping unit q: 0.00039～0.202L/s.m, the permeability coefficient k: 0.000047～0.952m/d and the water quality types as HCO3-Ca and HCO3-Na and HCO .

### 2.1.3 Loose Rock Pore Aquifer (Group)

The most commonly used method of obtaining the impact of coal gangue on shallow groundwater is to compare the trace element contents of water from a monitor well and a nearby[5].The aquifer is mainly Quaternary fluvial sediments. The lithology is mainly sandy soil, sub-clay and gravel, mainly distributed in the piedmont plain, alluvial plain and alluvial plain. Upper Shahe, Ruhe bed sand and gravel layer, strong water-rich, unit inflow q: 3.18～16.198L / s.m. The permeability coefficient k: 34.91～191.35m/d. The lower subcritical calcareous calcification tuberculosis is characterized by weak water-richness, unit inflow q = 0.0023～0.072L/s.m, permeability coefficient k: 0.0026～40.73m / d and water quality type HCO3 -CaNa and HCO-CaMg type.

## 2.2 Water Barrier

In normal situations, it is generally considered that thedischarge capacity in direct water filling aquifers is weak[6].Each aquifer has a relatively water-impermeable layer, in order from bottom to top: Lower Cambodian Mantou Formation mudstone, Taiyuan Formation bottom bauxitic mudstone, middle sandy mudstone Permian multi-layered sandy mudstone, mudstone Quaternary clay.

(1) Lower Cambrian mudstone a quifuge

Lower Cambodian steamed bread group, mainly purple mudstone, about 200m thick. Distribution is relatively stable, weak water-rich. Poor water permeability, a good area water barrier.

(2) Carboniferous Taiyuan Formation at the bottom of bauxite mudstone a quifuge

At the bottom of the Taiyuan Formation, there is a layer of bauxitic mudstone with a thickness of about 1.5-15m. The aquitard is stable with good water-proofing properties. Under normal circumstances, can block the upper and lower aquifer hydraulic contact. However, the sedimentary thickness changes greatly. It is difficult to play the role of water-resisting in the areas where the thickness of the a quitard is thinner and the structure is broken.

(3) mudstone and sandstone mudstone between each coal seam

There is mudstone between the main coal seams above the Taiyuan Formation, and the relative thickness of the sand mudstone is between 5 and 35m. The permeability of such rocks is poor, weak water-rich, with good water barrier. However, its lithology and thickness in the horizontal changes are large, it is difficult to form a continuous and stable impermeable layer, only in some local water from the role.

## 2.3 Groundwater Recharge, Runoff and Drainage Conditions

Due to the influence of Pan Dishan fault, the Pingdingshan mining area is divided into two hydrogeological sub-areas of East and West, and the groundwater pay-off conditions of each sub-area vary greatly. The major aquifers in the eastern part are all covered by Quaternary loose sediments, and the recharge conditions are relatively poor. The groundwater in the blocking zone of the potamountains runs from west to east. Therefore, the groundwater in the eastern part is mainly supplied by shallow aquifers. The main aquifers in the western area are Cambrian limestone, Carboniferous limestone and Tertiary marl sporadic sporadic outfalls in the southern recharge area, both of which can receive atmospheric precipitation and surface water recharge. As a result, the recharge water is abundant and the water is plentiful. Karst groundwater recharge mainly for precipitation [7]. The main aquifers in the southern minefield are Cambrian limestone, Carboniferous limestone outcrop area, and Tertiary marl distribution area. In addition to directly or indirectly receiving the recharge of atmospheric precipitation, they also accept Zhanhe, Hongqi Canal and other surface water bodies The supply.

## 3. Groundwater Development and Utilization

Major factors that affect groundwater resources in coal mine production include goaf collapse and mine drainage [8]. Minefield within the scope of groundwater utilization to mine drainage, agricultural irrigation and water for domestic and animal husbandry mainly mine drainage to Cambrian aquifer as the main mining object, the average mine water inflow 958m 3 / h, shallow irrigation for agriculture and livestock and poultry water Groundwater is the main mining target. The local agricultural water crops are mainly wheat. The wheat is irrigated twice a year in spring and winter with a water requirement of 80m per acre 3 / a and drinking water for inhabitants is 50m per person 3 / a. The total population in the field is 21096 People and arable land of 13949 mu, together with mine drainage, the annual mine drainage of 839 × 104m 3, irrigation water 223.2 × 104m 3, residents drinking water 216.0 × 104m 3, total exploitation of groundwater is about 1258.2 × 104m 3.

## 4. Groundwater Utilization and Control Measures

Select a reasonable technical program of the basic principles, first, technical feasibility; the second is economic and reasonable [9]. According to the existing mining conditions in coal mines, the following measures can establish a relatively perfect groundwater protection and utilization system:

1) Timely carry out groundwater level, water quality, displacement monitoring; pay attention to waterproofing in the process of coal mining, reduce the leakage of pit water.

2）To adopt protective mining technology and optimize the mining plan, adopt the technologies of "limited height mining" and "strip mining" to design reasonable mining parameters and reduce the height of water-conducting cracks. In the meantime, the design and optimization of the optimal roof management plan, the enhancement of the roof management, the improvement of the goaf treatment to reduce the damage to the aquifer structure and the slowdown of the water level.

3）Do a good job of surface water control. All mining areas should be combined with the actual situation in this area, accurately grasp the annual precipitation and the maximum flood level and other relevant information, the scientific establishment of drainage system [10].

4) Advance pumping of aquifers that may produce gushing water can greatly reduce the amount of mine water that is discharged during the mining process. In addition, the mine water extracted by this method is clean groundwater without coal pollution and prevents mine drainage Cause water pollution, is conducive to the protection of groundwater quality.

5) Optimize the treatment of groundwater in the scheme of mine development and utilization. Mine development and utilization of the program design will mine drainage for the production of water, greening and dust removal. The revised program is: mine production, living and auxiliary production of water all use pit drainage, the remaining drainage after treatment for farmland irrigation, as far as possible zero discharge of groundwater to reduce the other aquifer water consumption.

6) Optimize mine drainage system to ensure discharge standards.

7) For those residents who have caused groundwater leakage or groundwater pollution, look for alternative sources of water and ensure the drinking water safety of the residents in the mining area.

## 5. Conclusion

Pingdingshan Coal Mine through the pit to take a centralized pumping row, pre-drainage pit, seepage control project, pre drainage coal seam project, sewage treatment works and comprehensive utilization of dry dewatering, a good solution to the stop and surface water damage to the production, The threat posed by security has some reference to open mine coal mine to prevent and control water.

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