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Research Article

A Study on the *in-situ* Purification Technique of Organic Farming Open-pit Hydrops

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Abstract: The primary objective of this study is to demonstrate the use of the *in-situ* nanoelectronics purification technique of open pit hydrops for the green mining technology. Open pit mining can result in serious groundwater seeping, while direct drainage of the open pit hydrops may cause pollution of surface water and decrease of ground water, which has a negative influence on the vulnerable ecological environment of Shendong mining area. It is necessary to exploit a hydrops purification technique in open pit that could lead to a positive evolution of the open desert mining area. Based on the climate characteristics and the open pit conditions, the *in-situ* nanoelectronics purification technique and treatment process of open pit hydrops was presented. The natural oxidation pond has been applied, which had been high-effectively applied into Majiata open pit mine area. It has both theoretical and practical value for the green mining technology with similar conditions.

Keywords: Ecological environment, mining engineering, natural oxidation pond, organic farming

INTRODUCTION

In the 1970s, the contradiction between the America's widening coal production scale and the water environment has been increasingly acute. More and more people pay attention to the phenomenons, such as the river bed dewatering, the water quality deterioration and the ecological system damage caused by the mining (Chen *et al*., 2010), at the same time, the contradiction between the coal resources mining and water consumption caused different industries competitive of the water resources (Hickcox, 1980). Since the late 1970s, the western of United States thinks the water saving will affect its strategy of development, so the government formulate the law about the mining and environment protection (Lu and Zhang, 2010).

Open pit caused by organic farming open-pit mining is the equivalent to a large well, which is the objective collection conditions from atmospheric precipitation, surface runoff and underground water gushing (Maddalena and Carlo, 2004). The pit water caused by organic farming open-pit mining discharged in the form of waste water, destroy the circulation law of drainage, waste the water resources, cause the decline of ground water level, at the same time, the harmful substances in industrial waste will pollute ground water (Plotkin *et al*., 1979).

Shendong mining area is located in the desert area on the border of Ordos Plateau and Loess Plateau. The mining area has the following characteristics: dry climate, shortage of water supplies, sparse vegetation, poor soil, serious water loss and soil erosion, water and wind erosion. The ecological environment in this area has high levels of fragility and sensitivity, but low levels of reversibility, endures and self-recovery (Thomas and Anderson, 1976). Water resources and its utilization become the key factors of the ecological construction about Shendong mining area. If not take effective measures about the pit water caused by organic farming open-pit mining, it would make further destruction of fragile ecosystems and further desertification of land about Shendong mining area. Aiming at this situation, the development of the waste water purification technology, would provide a new way of the purification and utilization of mine water.

CASE STUDIES

Ecological environment characteristics of mining area and the situation of organic farming open-pit mining pit: Shendong mining area is located in the center area of Shaanxi and Inner Mongolia's common band, it is located the common area of the ordos plateau and the loess plateau on the landform aspect, the north has the Maowusu Sandy Land, the South has the loess plateau, it is a typical transition zone about landform evolution of loess plateau, desertification and the potential desertification land area accounts for about

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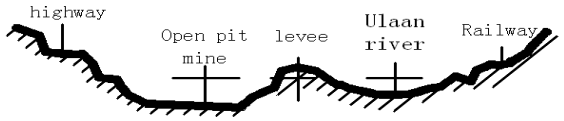

Fig. 1: The relative position of open pit

Table 1: Water quality

	Water quality indicators/mg/L
Biochemical oxygen demand BOD5	≤80
Chemical oxygen demand COD	≤135.4
Suspended solids SS	≤182
Ammonia nitrogen NH_3-N	≤22
Oil class	≤10

85% of the total area, the wind erosion area accountes for 70% of the total area. The cold winter is long and the hot summer is short, the annual average precipitation is 362 mm, the precipitation is make up about 55% from July to August, the precipitation is make up about 20% of June and September, precipitation often occurs in the form of rainstorm, a rainstorm's precipitation always accounts for about 1/3~1/7 of the amount throughout the year, rainstorm always erupt suddenly; the average annual evaporation is 2554 mm, it is 7 times the amount of precipitation; the annual average temperature is 7.3°, the annual average temperature's difference is large, it is always 13.2~14.9°C, the extreme maximum temperature is 38.9°, the extreme minimum temperature is 30.7°; the wind for mining areas is frequent disasters, >5 m/sec of sandy wind 70 days; soil particles is coarse, it has loose structure and it has the poor ability of reservoir water and fertilizer, if it face water flow, it would rapidly disintegration. Ulam river flows through the mining area, it became serious soil erosion area caused by seasonal rainstorm and easy be corroded loess, the ground is gully and incoherent. The diving is buried deep in 20~30 m, the surface water is poor, the groundwater cannot be utilized by plants and the original vegetation types is monotonous.

The Majiata open-air mining area is the first large-scale open pit coal mine of shendong mining area, it is located in the compound erosion center area of desertification and loss of soil and water. Average thickness of coal seam is 4 m, design of mining area is 1.4513 million m^2, take the simultaneous coal mining method of stripping and backfilling reclamation, layered backfill, the mullock at lower stratum, the topsoil at upper stratum. First, the total area of mining and backfilling is 1.1333 million m^2, the platform reclamation area formed after backfilling is 1.1333 million m^2, the concave mining pit water area without backfilling is 186700 m^2. The open air mining is located in the bed of the Ulam river, the river along the east side of the open pit mine which flows from north to south, it goes through the territory of shaanxi into the Yellow River, its relative position is shown in Fig. 1.

Mining depth is located in below the groundwater level of Ulaan river, the river water will supplement the mine water when the open mining depth below the water level, as the harmful substances in the industrial waste will pollution into the groundwater; if the sewage is directly discharged to the ground surface, it must destroy the water cycle rules. The water quality characteristics of organic farming open-pit mining pit technology is: according to the provisions of the water quality indicators, the concentration of pollutants in sewage is low and only the suspended solids and chemical oxygen demand (cod) exceed the standard, as shown in Table 1.

With the principle such as advanced technology, reasonable economy, processing and utilization simultaneously and close combination with the actual situation, we choose in situ purification technology and treatment process of open pit water based on oxidation pond (stability pond) with advantages such as high processing efficiency, good stability, less infrastructure investment, low operating cost, simple operation, less maintenance process, may carry on the comprehensive utilization.

Because of organic farming open-pit mining cut open the aquifer, in order to prevent harmful substances in industrial waste pollution the groundwater, the bottom edge of the open pit previously covered waterproof material, such as clay, agricultural vinyl film; In hard rock is adopted in the method of drilling and grouting to establish the water-resisting layer. This formed the natural oxidation pond.

The water processing system of open pit oxidation pond include two parts: sewage conveying system and oxidation pond system be used to processing and utilization.

Sewage conveying system: After field reconnaissance and experts and relevant departments to prove, drainage route is completely gravity flow route. Not only set inspection Wells (drop well) in feature point of the gravitational flow pipeline, but also set inspection Wells at point which is located between every 30 to 45 m, part of the pipeline in backfilling soil and thermal insulation. Pipeline route engineering without mechanical operation equipment, the engineering content is relatively simple, the operation cost is low; all pipeline is reinforced concrete pipe and the bottom of the pipe is provided with concrete strip foundation; A part of the pipeline needs to set up local retaining walls and local heat preservation measures.

Oxidation pond processing system: The oxidation pond processing system including two parts: strengthening pretreatment project and the principal part project of the oxidation pond. The water purification and entertainment, landscape, farming and purifying of water reuse organically combined by the oxidation pond processing system, which is good to the unify of environmental, social and economic benefits.

Strengthening pre-treatment project: Strengthening pre-treatment project covers an area of 0.86 ha, it including 4 parts: the total pumping station, a combined oxidation pond, blower room, the sludge drying field and aided engineering. The total station: its role is to improve the sewage into the compound oxidation pond. It is consists of gate grille wells, catchment regulation pool and water pump, etc., which is half underground type.

The function of the gate grille wells is to control the water inlet and remove large particles suspended solids and floating debris in sewage. When the water catchment regulation pool and other subsequent processing facilities need to repair or the processing system is not water, we should close the gate, while the sewage can directly inflow into the facultative oxidation pond from the overflow tube temporary. In side of the grille room has a grille deslagging machine and a enhance sand hopper, grid slag and sand must be outbound to landfill or burned sanitary.

The water catchment regulation pool has a certain function of adjusting water yield and balance water quality, in order to make the sewage pump and treatment facilities in a operation state of stable and economic. In front of the pool provided with submersible sewage pump, so the pressurization can be delivered into the mud pipe; the inner of the pool provided with hydraulic flushing and drum wind stirring pipe.

Compound oxidation pond: Mainly in order to reduce the concentration of pollutants in the oxidation pond water, to solve the problems of the oxidation pond in the cold region covers an large area and easy sedimentation and makes the oxidation pond operate in the short time of sewage residence, so that it can achieve good effluent quality and satisfy the entertainment, aquaculture and the quality requirements of reuse water.

The pool is a integration enhanced composite oxidation pond, it can change the operation mode according to the operation characteristics of oxidation pond in each period and the water quality situation. If it is running in high temperature season (4~12 months), it does not need aeration, its biochemical reaction in the hydrolysis and acidification phase is stable, it can effectively remove the suspended solids and improve the biodegradability of the sewage; if it is running in low temperature season (1~3 months), add low oxygen to auxiliary aeration, to form biological concentration membrane oxidation pond at the rear of the pool, the sewage is after better processing and then get into the body of the oxidation pond to conducting the concentration purification.

Composite oxidation pond with the function of sludge digestion, which can make the sludge in them get a better digestion and stabilization, the discharge of the mud quantity is little, as we don`t need to set the sludge disposal facilities. Sludge can be discharged periodically and directly applied in nursery, forestland, grassland and farmland, which has the function of improving the soil and increasing the fertilizer effect; it also can be dewatering in the sludge drying field.

The gas of the auxiliary aeration is come from blowers, the gas water ratio is (8~10): 1, the gas heat is using waste heat of gas heating boiler.

It equipped with an upper water discharge pipe and the lower water filtration layer, so the water in the sludge can discharged into the catchment regulating pool. The sludge caused by the process has been digestive and stability, it can be directly applied to farmland and sinotrans by a sludge car. In order to reduce the transportation volume and the number of traffic, it also can sinotrans after the sludge discharging and dewatering in the sludge drying field. The sludge drying field is divided into 12 lattices, which were used alternately.

The principal part project of the oxidation pond: The principal part processing system of the oxidation pond is consists of facultative pond, aerobic pond and aquaculture ponds, etc. A pumping station was provided at the end of the system, as the purified water is discharged into the Ulaam river or be directly reuse. If the purified water as the reclaimed water reuse, it need for further purification in subsequent. The total area of the oxidation pond is 18.9 ha.

The area of the pond water is 1.2 ha, the effective depth is 2.5~3.0 m, the upper layer is aerobic layer, the middle layer is facultative transition layer and at the bottom is anaerobic layer. The floating plant was planted on the pond water surface in the growing period. The water inlet mode of the facultative pond is the eruption type (the water inlet modle is the bottom of submerged in winter), the effluent with the suspended solids removed by the gravel filter dam; the modle of entering the aerobic pond is drop aeration form, it can increase the dissolved oxygen in water.

The effluent water of the faculative pond after dropping aeration entering the aerobic pond. The area of the pond water is 9.2 ha, the effective depth is 1.5~2.0 m. Through the action of microorganisms (mainly is aerobic bacteria) in the pond, water quality has been further improve, it can be used as a recreational water. In order to ensure the best flow state of effluent water, we set up a reinforced concrete dam in the pond and a central pavilion at the rear of the dam. The dam can play the role of diversion, it as the channel to reach the central pavilion and it is the starting point for boating and other water recreation activities.

The effluent water of the the aerobic pond get into the breeding pond after filtering in the gravel dam. The area of the aquaculture pond is 2.8 ha, its water quality has meet the demand of fish culture, so it can be used as

Table 2: Treated water quality and treatment efficiency

	Water quality indicators /mg/L	Removal rate /%
Biochemical oxygen demand BOD5	≤20~40	≥50~75
Chemical oxygen demand COD	≤70~105	≥30~50
Suspended solids SS	≤30~50	≥65~80
Ammonia nitrogen NH_3-N	≤12~15	≥20~45
Oil class	≤3~6	≥40~70

a fishpond. Fish not only can be time catching, but also can be fishing by tourists.

Because of low water level of the oxidation pond, we need efflux or external transportation after ascension by pump as directly reuse water. The pump station is half underground type, equipped with efflux pump, its start modle is self filling type. The use of directly reuse water are mainly used as green water, agricultural water, fire control and general municipal water and so on, the yield of reuse water is 5000~10000 m^3/day.

RESULTS AND DISCUSSION

According to the basic ideas of the *in-situ* nanoelectronics purification technology of open mining pit hydrops, after some simple construction process, such as backfill, bottom and side slope reinforcement, a tertiary wastewater treatment plant has been constructed, which include 3 parts and it can processing 10000 m^3 wastewater of Majiata organic farming open-pit coal mine and Bulianta coal mine. The water quality indicators after processing (take low limit of the plant growth period, take high limit of the plant non growth period) and the processing efficiency as shown in Table 2.

In-situ water purification technology in organic farming open-pit mining area can save water, mitigate desertification problem in desert area and the ecological mining areas became possible.

The eco-efficiency of the technology is mainly showed in the following aspects:

- Basically eliminating the surface water body pollution caused by coal mine drainage
- Reducing the use of surface water
- Reducing the quantity of groundwater exploitation, slowing down decline speed of groundwater level, maintaining the topsoil water retention capacity
- Mine water can be directly applied to greening and ecological improvement of the surrounding area

CONCLUSION

In-situ nanoelectronics purification technology of open mining pit Hydrops can hold water *in situ* and relieves the problem of desert water shortage, it can be make possible to realization of ecological mining area. Break the tradition developing model of the coal industry of "treatment after pollution". Majiata open-pot mine created a new way of resource development and environmental protection.

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