

Research Progress of Land Reclamation in Mining Areas in China

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Abstract: The ecological environment of mining area is an important problem that affects the sustainable development of mining area and regional ecological security. The mining industry has promoted the global economic development, but also caused a series of ecological degradation. Ecological restoration of mining areas has become an urgent problem for all countries in the world. This paper expounds the research technology and development trend of ecological restoration in mining areas in China, and looks forward to the ecological restoration in mining areas in the future, which will provide reference for the ecological restoration of mining land reclamation in the future.

1. Introduction

With the rapid development of the global economy, the mining industry has also developed rapidly. The development and exploitation of the mining industry have led to the serious destruction and degradation of the ecosystem in the mining area. The degraded ecosystem needs to be restored and treated by people urgently, so as to form a mining area ecosystem that can be used forever and achieve the harmonious development between man and nature.

The problems of resources, environment and population are the three major issues of social sustainable development today. It is urgent to achieve the coordination and sustainable development of the three. Regional sustainable development is the basis of social sustainable development, and the ecological environment of mining areas is the core and hub of regional sustainable development [1]. When human beings are exploiting and utilizing mineral resources, they do not pay attention to the environmental protection in the exploitation and utilization of mineral resources, which makes the ecological environment problems in mining areas increasingly serious. It has a great impact on the sustainable, healthy and stable development of social economy. It will cause environmental pollution, water and soil loss and land desertification, and its consequences will pose a serious threat to economic development and human survival [2].

China is rich in mineral resources, and mining promotes economic growth. According to statistics, more than 95% of China's energy, more than 80% of industrial raw materials, and more than 70% of agricultural means of production all come from mineral resources, which are both the material basis for social and economic development and the source of social wealth creation. There are nearly 300000 large and small mining areas in China. However, under the current development technology and management level, the large-scale and long-term mining of mines has destroyed, eroded and polluted the land resources of the mining area, changed the original ecosystem and regional water system, damaged the flora and fauna, and led to the pollution and ecological degradation of the mining area environment. In particular, in recent years, the rapid development of science and technology has accelerated the mining of minerals, causing the ecological

environment in mining areas across the country to be damaged and polluted more and more seriously. It is estimated that the area of land destroyed is nearly $4\% \times 106\text{hm}^2$ is still being destroyed at the rate of hundreds of thousands of hectares every year [3].

Therefore, the study of ecological degradation and ecological restoration and related issues in the mining area is of great significance for scientific and reasonable restoration of the damaged ecosystem in the mining area, and ensuring the safety of production, food security, ecological security, and human settlement in the mining area. The study of environmental problems and ecological restoration in the mining area has received extensive attention at home and abroad [4].

2. Research on Ecological Restoration Technology in Mining Area

Ecological restoration of mining area is a science to study the restoration and management process of comprehensive functions of mining area ecosystem, which has become a current research hotspot. Restoration includes reconstruction, reconstruction, reconstruction, replantation, etc. It refers to the improvement and reconstruction of the degraded mining area ecosystem so that it can be reused and its biological potential can be restored.

1) Soil treatment and improvement.

Soil treatment and improvement is the primary link of ecological environment restoration in the mining area. Soil treatment and improvement methods include physical methods, chemical methods and biological methods. Among them, physical improvement mainly changes soil aggregate structure, increases soil capillary pores and non capillary pores, reduces soil bulk density, increases soil aeration, increases saturated hydraulic conductivity, retains water, reduces evaporation, and effectively improves precipitation utilization efficiency. Such as wheat bran sawdust chicken manure composite improver, pulverized coal ash, zeolite, bentonite, etc. Chemical improvement mainly increases soil organic matter, regulates soil pH, enhances soil buffer capacity, and increases soil resistance to water erosion. Biological improvement is mainly to increase the number of soil microorganisms; Improve enzyme activity.

2) Vegetation restoration.

The selection of tree species is the key to vegetation restoration. The following principles should be followed: ① Select fast growing, adaptable and stress resistant tree species; ② Select excellent nitrogen fixing tree species; ③ Select local trees and pioneer trees; ④ The selection of tree species should not only consider the economic benefits, but also highlight the ecological benefits and give full play to the ecological, economic and social benefits.

3) Research on joint recovery of plants and microorganisms mainly includes:

- ① Joint recovery of plants and obligate degrading bacteria;
- ② Joint recovery of plants and fungi.

4) Landscape restoration.

The restoration of the ecological environment of the mining area is to restore the original landscape of the mining area as the end goal.

5) Engineering measures.

The necessary slope protection and bank protection works are adopted for the restoration of the ecological environment in the mining area, which can promote the faster and better restoration of the ecosystem.

3. Development Trend of Mining Area Ecosystem Restoration

1) Environmental geochemistry of mining area

The theory and method of environmental geochemistry can provide the exact basis for the investigation and diagnosis of the current situation of the ecological environment in the mining area, which is an important means to promote the restoration and construction of the ecological system in the mining area. The study of environmental geochemistry in the mining area will help to accurately grasp the ecological environment of the mining area, especially the water and soil resources, so as to select appropriate plants for land reclamation and ecological restoration in the mining area, reduce the harm of water and soil pollution in the mining area to human life, and reasonably determine the direction and steps of ecological environment protection and ecosystem construction in the mining area.

2) Ecological technology in mining area

The application of ecological technology in mining production can reduce the damage to the ecological environment of the mining area and the harm to the ecosystem and its components during the development and utilization of mineral resources. The application of ecological restoration and construction technology in the mining area can restore and utilize the changed or severely damaged ecological environment and its components in the mining area [5-6]. The advanced mining ecological production process can make full and effective use of mineral resources, and at the same time, it is the easiest to minimize the harm to the ecological environment. Advanced mining area ecological restoration and construction technology can make the damaged mining area ecological environment be fully and effectively restored in the shortest possible time.

4. Expectation

Land reclamation abroad has developed for nearly a hundred years. With the progress of science and technology and the improvement of human understanding, the theory of land reclamation has been deepened, the law has been

perfected and the technology has been improved. The land reclamation work in China has only started for a few decades. Now there are theories and relevant laws on land reclamation, and the level of reclamation technology is gradually improving. The newly issued Regulations on Land Reclamation in 2011 has higher requirements for land reclamation in China. With reference to the development history and experience of foreign land reclamation, future land reclamation research in China needs to be strengthened in the following aspects

(1) Strengthen the research on the prediction of the land to be damaged before mining

The Regulations on Land Reclamation requires that in the future production and construction activities, "no new accounts should be owed and old accounts should be repaid quickly". It is necessary to not only reclaim the damaged land, but also conduct reclamation design for the land to be damaged in the mining area and the new mining area. It is clearly stipulated that: "The land reclamation obligor shall submit the land reclamation plan together with the relevant approval materials when handling the application for construction land or mining right; if the land reclamation obligor has not prepared the land reclamation plan or the land reclamation plan does not meet the requirements, the people's government with the right of approval shall not approve the construction land, and the competent department of land and resources with the right of approval shall not issue the mining license." The previous land reclamation work in China was mainly aimed at the damaged land in old mining areas, and the relevant reclamation design was carried out after the completion of coal mining. The land reclamation theory and practical experience formed on this basis can no longer meet the requirements of the current pre mining land reclamation plan design of all mines and the reclamation while mining.

(2) Exploit the application potential of 3S and other advanced technologies

At present, the integrated application of 3S technology in land reclamation in mining areas is still relatively few, and it is still in the experimental stage. How to fully use this technology in land reclamation work, there is no systematic theoretical guidance at present, and this problem also needs to be solved urgently. The Regulation on Land Reclamation stipulates that "the competent department of land and resources under the State Council and the competent departments of land and resources under the people's governments of provinces, autonomous regions and municipalities directly under the Central Government shall establish and improve the land reclamation information management system, collect, summarize and publish land reclamation data" [7]. This means that to maximize the application potential of 3S technology and other advanced technologies, to make the data acquisition, suitability evaluation and inspection and acceptance of reclaimed land more convenient and scientific in land reclamation, and to use these technologies to establish land reclamation information management system is one of the future research contents.

(3) The target of reclamation should focus on agricultural and ecological needs

Due to the special national condition that China has a large population and little land, and the per capita land resources, especially the per capita cultivated land resources, are extremely scarce, the Land Management Law stipulates that the balance between occupation and compensation of cultivated land should be achieved, and the requirements for

damaged cultivated land should still be reclaimed as cultivated land or other land with the same area should be reclaimed as cultivated land; The Regulation on Land Reclamation also clearly stipulates that the reclaimed land should be used for agriculture first. At present, China still pays more attention to the agricultural use of the reclaimed land. In the future reclamation research, safe and high-yield farmland construction will also be an important content. From the perspective of the development history of foreign land reclamation, in the early stage of foreign land reclamation, more attention was paid to the reuse of abandoned land, and most of the abandoned land was reclaimed for agricultural use or aquaculture to obtain economic benefits; In recent years, attention has been paid to ecological problems, and reclamation methods and directions are also focused on meeting ecological needs. Using the experience of foreign land reclamation for reference, with the development of national economy and the improvement of people's understanding, China should also pay attention to the problem of ecological construction as soon as possible, try to adopt biotechnology in reclamation, and pay attention to the protection of pre harvest habitat and the restoration of post harvest habitat in reclamation areas with good ecological environment; In areas with fragile ecological environment, more attention should be paid to habitat protection. In post mining reclamation, more attention should be paid to ecological benefits to improve the ecological environment of the mining area. Under the condition of ensuring that the red line of "1.8 billion mu" of cultivated land is not broken, the ecological community reconstruction in the mining area and the measures that should be taken to protect the animals and plants in the reclamation area are also one of the focuses of future research work.

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