Mining ecological restoration technology and ecological protection measures

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Abstract

Based on the analysis of the current development status of mine restoration, the main technical measures of mine ecological restoration, and the protection and restoration measures of different construction types, combined with the research of various technical means, we aim to improve the restoration of ecosystem functions and the comprehensive utilization of resources in the future, and promote the orderly development of economy, society, and ecological environment.

Keywords

Abandoned mines; Ecological restoration technology; protective measures.

1. Introduction

The exploitation of mining resources has promoted the development of China's economy, and the ecological environment problems that come with it need to be taken seriously. The ecological restoration of mines in our country started in the 1950s, but in the early days, it was mainly a spontaneous and scattered activity of land reclamation and tree planting. Ecological restoration of mines is the restoration and reconstruction of damaged mining ecosystems through scientific and rational means, in order to promote the restoration and improvement of the ecological environment. With the transformation of the economic development concept from "emphasizing economic development and neglecting environmental protection" to "emphasizing both economic construction and ecological protection", mine ecological restoration has become a national strategy and policy direction. Relevant departments of the country have also issued a series of policies and regulations to promote the implementation of mine ecological restoration work. The essence of ecological environment restoration lies in relying on the power of nature to achieve the restoration of existing landforms, while also requiring people to actively participate, improve land productivity, and restore polluted water and air quality.

2. Main technical measures for ecological restoration of mines

2.1. Slope repair

Mine slope refers to the mountain slope formed after mining. Due to mining activities and other reasons, mine slopes often suffer from collapse, landslides, and collapses, seriously endangering the surrounding environment and ecological safety. Due to the changes in the original geological layers caused by mining work, the stability of the slope rock layers is affected, leading to the emergence of local secondary stress fields, which in turn cause deformation, instability, and collapse of the slope rock mass. As a result, the overall stability and safety of the mine are affected. To reduce the impact on the original ecological environment, effective restoration methods such as topsoil cover, vegetation cover, bioengineering, and greening are needed to effectively prevent further collapse and erosion of the slope, and improve the stability and ecological environment of the slope.

ISSN: 1813-4890

2.2. Vegetation community restoration

During the mining process, the land is severely damaged, resulting in the disappearance of a large amount of original vegetation, which has a serious impact on the ecological environment. After stabilizing the waste rock field and improving the soil, vegetation restoration is usually carried out through hole planting and sowing methods. The vegetation configuration mainly includes three modes: grass, grass shrub, and grass shrub tree. Priority should be given to using mixed coniferous and broad-leaved tree species, mixed deep rooted and shallow rooted tree species, mixed evergreen and deciduous tree species, and mixed trees and shrubs. By introducing suitable vegetation species, seed dispersal, and creating suitable habitats, broad-leaved plants can accelerate land restoration and improve the ecological environment. These measures can effectively increase soil water retention and erosion resistance, and promote the accumulation of organic matter and nutrients in the soil, thereby improving soil fertility.

2.3. Soil remediation

During the mining process, soil is often damaged and lost, causing serious environmental impacts. Therefore, soil plays an important role in mine remediation. Common soil remediation methods include adding organic matter, applying fertilizers, and introducing suitable plant species. These methods can effectively improve the structure and quality of soil, increase soil fertility and water retention, and provide support for vegetation growth and ecological environment restoration. In addition to common remediation methods, soil cover, suspended sediment treatment, and limestone neutralization can also be used to alleviate soil acidification and pollution problems. These methods can effectively reduce the acidity and heavy metal content of soil, improve the ecological environment of soil, and enhance the suitability and fertility of soil.

3. Measures for ecological protection and restoration of mines

3.1. open pit

Open pit mining can lead to the formation of an overlying slope in the main mining area. In order to maintain the integrity of the slope rock mass, controlled blasting needs to be carried out near the slope to reduce rock collapse and sliding, ensuring the stability of the slope. During the mining process, when placing explosives, efforts should be made to consider the damage caused by explosive explosions to vegetation within the hazardous boundary of the mine, and measures should be taken to protect the existing vegetation. This can maintain the stability of surface vegetation and reduce environmental damage. During the mining process, it is also necessary to clean loose rocks to prevent rock collapse and ensure the safety and stability of slopes. At the same time, the quarry can be filled in to reduce surface damage and soil erosion issues. As the mining face gradually advances, a protective layer or vegetation cover can be placed on the surface of the quarry to prevent further erosion and loss of land and promote vegetation growth. When each step is formed, preventive control measures should be taken for the slope of the step, such as spraying guest soil containing grass seeds, shrub seeds, fertilizers, and soil stabilizers, to keep the green grass growing on the exposed rocks for several years or more, thereby maintaining the stability and ecological environment of the step slope. For exposed rock surfaces, methods such as covering with stones or hanging to simulate rock habitats can be used to simulate the ecological environment of natural rock surfaces, promote vegetation growth and land protection. The bottom of the mining pit can be designed as a pond water surface, serving as a reservoir for atmospheric precipitation and groundwater seepage in the mining site, and providing irrigation water for surrounding reclaimed land. Effectively utilize water resources to support the ecological restoration of surrounding land and agricultural irrigation needs.

3.2. Waste dump

During the mining process, a large amount of earthwork is excavated, resulting in the formation of a waste dump. The construction project of the waste dump will damage the original ecosystem and cause pollution and impact on the surrounding living environment. The sloping bottom of the pit will be cleared of topsoil and weak rock layers, and excavated into a stepped shape. For rock pits with large and smooth slopes, intersecting drilling and blasting can be used to increase surface roughness and anti slip force: promote comprehensive utilization of ore, reduce waste rock accumulation, control waste rock accumulation height (≤ 10 m), and avoid transportation roads and drainage channels. The slope gradient of the waste dump is steep, the rock and soil are loose, the stability is poor, the moisture content is low, the plant growth is difficult, and soil erosion is prone to occur. Therefore, a comprehensive treatment combining plant measures and engineering land preparation is needed. Firstly, implement slope cutting measures, followed by grass bag protection and vegetation measures. Utilize the holding effect of vegetation and the retention effect of engineering land preparation to prevent soil erosion on the slope surface of the waste dump. Timely restoration measures should be taken for the stable slope and platform formed during the mining process to ensure that the platform forms an appropriate inward slope to prevent surface water from converging and eroding the slope. During the disposal process, in addition to the natural settlement of soil and rock, the platform should form an inward slope of 2% to 5% to prevent surface water from converging and eroding the slope. When the height of the waste dump exceeds a certain level, protective embankments need to be built at the slope corners to ensure the stability and safety of the waste dump. In addition, intermittent soil dumping ecological restoration measures are adopted in sections without centralized dumping to slow down the subsidence of the soil dumping site. First, the platform is preliminarily leveled on the ground, and then covered with soil to a thickness of 0.3 meters. Suitable tree species are planted and restored according to the requirements of the ecological landscape. At the same time, drainage ditches should be set up around the waste dumping site, and the slope should be stabilized.

3.3. mine road

The construction of roads in mining areas may cause direct damage to the ecological environment. In order to reduce the damage to soil and water resources, it is possible to choose a roadbed with a small excavation depth and gentle slope during the construction of roads in mining areas, and use vegetation and other measures to reinforce it, reducing the damage of roads to soil and water resources. When constructing roads in mining areas, the surface soil in the mining area should be stripped in layers according to the principles of "layered stripping, layered stacking, and layered backfilling". During the backfilling process, place relatively poorly matured or soil rock mixture below, and cover the upper surface with relatively well-developed soil. And temporary protective measures such as sowing grass seeds will be taken as a source of cover soil during the later reclamation process of the mine.

4. Countermeasures and suggestions

In the early stage environmental impact assessment of mines, public hearings are adopted to widely solicit opinions from various sectors of society. At the same time, during the mining process and after ecological environment restoration, it is necessary for the public to supervise and inspect, in order to protect their own interests while achieving the goal of social development of the ecological environment. Strengthen the publicity and education of mining knowledge, and introduce the significance, methods, and achievements of mining ecological restoration to the public through materials such as posters, brochures, and promotional videos. Actively use new media platforms such as We Media, WeChat official account, Weibo and Tiktok to publish articles, pictures and videos about mine ecological restoration, attract more young

people's attention and enhance the communication power of mine ecological publicity.During the construction process, a large amount of earthwork and blasting work is required, therefore, there are many safety hazards. To reduce the impact on the environment, mining enterprises need to control environmental pollutants such as noise, dust, and sewage during the construction process. At the same time, they need to carry out hygiene management and garbage cleaning on the construction site to maintain its cleanliness and beauty. Mining enterprises need to establish a safety production system, develop safety standards and regulations, provide safety training for construction personnel, strengthen safety inspections and supervision, adopt safety protection facilities such as safety helmets, safety ropes, and protective nets to reduce the occurrence of safety accidents and ensure safety during the construction process. In addition, improving the safety production technology and equipment level of mining enterprises and the safety quality of employees, enhancing the safety production conditions of mines, and curbing the occurrence of major accidents.

5. Conclusion

The environmental problems caused by mining resource exploitation cannot be solved solely by ecological restoration of mines. It is necessary to combine prevention and control measures, optimize mining methods based on the existing conditions of the ore body, and reasonably determine the production capacity of the mining area to reduce environmental hazards. The success or failure of mine restoration depends on the ability of the ecosystem to self repair, gradually restoring and improving the natural environment of the restored mining area. By strengthening research and innovation in mine restoration technology, promoting mature restoration techniques, and improving the effectiveness and efficiency of mine ecological restoration, mining enterprises need to establish environmental protection awareness, enhance corporate social responsibility awareness, and balance sustainable development of economy, society, and environment. By combining diversified financing models and actively utilizing economic measures and social policy support, we can effectively promote the active participation of the government, mining enterprises, and social capital in the ecological restoration of mines, and achieve sustainable development of people, economy, society, and environment.

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