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Original Paper

Exploration of the Application of Green Mining Technology in Coal Mines under the New Situation

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Abstract

This paper discusses the application of green mining technology in coal mines under the new situation, considering the environmental pressures and requirements for sustainable development faced by coal mining. Firstly, it introduces the definition and principles of green mining, along with its development history, and analyzes the importance of relevant policies and regulations. Subsequently, it analyzes the demands faced by coal mining under the new situation, including the relationship between environmental issues and sustainable development, the impact of new energy development on coal mines, and social demands and public opinion pressure. Furthermore, through application cases, it showcases the specific practices of green mining technology in coal mines, involving environmental protection technology, energy efficiency improvement technology, and green mining technology. When discussing the challenges and issues of technology application, it focuses on technical difficulties, economic feasibility, and human resources and training needs. Finally, it looks ahead to the prospects of green mining technology in coal mines, emphasizing the importance of sustainable development and proposing suggestions regarding technological innovation, policy support, and corporate responsibilities.

Keywords

coal mining, green technology, environmental protection, sustainable development, new energy, social demands

1. Introduction

With the increasing prominence of global environmental issues and growing attention to sustainable development, the environmental pressures and resource consumption brought about by coal mining are receiving more attention. Traditional coal mining methods not only cause serious damage to surface

and underground environments but also exacerbate global greenhouse gas emissions and climate change issues. In this context, research and application of green mining technology in coal mines have become urgent and critical. This paper aims to explore the application of green mining technology in coal mines under the new situation to meet the demands of environmental protection and sustainable development. Firstly, we will introduce the concept, principles, and development history of green mining, as well as the importance of relevant policies and regulations. Subsequently, we will analyze the demands faced by coal mining under the new situation, including the relationship between environmental issues and sustainable development, the impact of new energy development on coal mines, and social demands and public opinion pressure. Next, through application cases, we will showcase the specific practices of green mining technology in coal mines, involving environmental protection technology, energy efficiency improvement technology, and green mining technology. When discussing the challenges and issues of technology application, we will focus on technical difficulties, economic feasibility, and human resources and training needs. Finally, we will look ahead to the prospects of green mining technology in coal mines, emphasizing the importance of sustainable development and proposing suggestions regarding technological innovation, policy support, and corporate responsibilities. Through the discussions in this paper, we hope to provide some reference and inspiration for the green transformation of the coal mining industry, promoting the sustainable utilization of coal resources and the advancement of environmental protection efforts.

2. Overview of Green Mining Technology in Coal Mines

2.1 Definition and Principles of Green Mining

Green mining is a mining method aimed at minimizing environmental impacts and resource consumption to the maximum extent possible. Its core idea is to minimize damage to the natural environment during coal mining and maximize the integrity and functionality of ecosystems. Green mining emphasizes following a series of environmental principles and sustainable development concepts during mining activities to achieve efficient resource utilization and minimal environmental burden.

The principles of green mining include but are not limited to the following aspects:

1. Comprehensive planning and ecological priority: Conduct comprehensive environmental impact assessments and resource surveys before mining, formulate comprehensive planning schemes, and prioritize ecological protection and environmentally friendly development.
2. Reduction of mineral resource consumption: Adopt efficient mining techniques and equipment to minimize waste and loss of coal resources, achieving sustainable utilization of coal resources.
3. Energy conservation and emission reduction: Promote energy-saving technologies and clean production processes to reduce energy consumption and emissions of carbon dioxide and other pollutants, thereby reducing the environmental burden of mining production.

4. Recycling and waste treatment: Advocate the concept of a circular economy, promote the reuse and resource utilization of waste, and reduce secondary pollution to the environment.

5. Ecological restoration and environmental protection: Implement mine ecological restoration plans, restore the ecosystem functions of mining areas, and protect biodiversity and soil and water resources.

6. Social responsibility and sustainable development: Actively fulfill corporate social responsibilities, cooperate with local communities, promote local economic development and social stability, and achieve sustainable development of economy, environment, and society.

In conclusion, green mining is not just a mining technique but also a reflection of social responsibility and sustainable development. By adhering to the principles of green mining, the coal mining industry can achieve a win-win situation of economic benefits and environmental protection, laying a solid foundation for future sustainable development.

2.2 Development History of Green Mining Technology in Coal Mines

The development history of green mining technology in coal mines can be traced back to the gradual enhancement of environmental awareness and the rise of sustainable development concepts. With the increasing awareness of environmental protection and the continuous improvement of environmental regulations, coal mining enterprises began to attach importance to the research and application of green mining technology. Firstly, the development history of green mining technology in coal mines is closely related to the progress of environmental protection technology. Through the research and application of environmental protection technologies such as wastewater treatment and air pollution control, coal mining enterprises can effectively reduce pollution and damage to the environment during production processes. Secondly, with the advancement and innovation of science and technology, green mining technology in coal mines has been continuously updated and improved. The introduction and efficiency improvement of new mining equipment make mining production more efficient, energy-saving, and environmentally friendly. Additionally, the development of green mining technology in coal mines is also guided and supported by government policies and regulations. Governments have enacted a series of policies and measures to encourage environmental protection and energy conservation, promoting the transformation and upgrading of coal mining enterprises and accelerating the application and promotion of green mining technology. In summary, the development history of green mining technology in coal mines is a process of continuous exploration, innovation, and adaptation to environmental changes. With the continuous progress of science and technology and society, green mining technology in coal mines will continue to develop towards a more intelligent, efficient, and environmentally friendly direction, providing solid support for the sustainable development of the coal mining industry.

2.3 The Importance of Relevant Policies and Regulations

Relevant policies and regulations play a crucial role in driving the development and application of green mining technology in coal mines. These policies and regulations aim to guide and regulate the production behavior of coal mining enterprises, promote environmental protection, and ensure

sustainable development. Firstly, environmental protection laws and regulations enacted by the government impose strict restrictions and requirements on coal mining activities. For example, the environmental impact assessment system requires coal mining enterprises to conduct comprehensive environmental impact assessments before undertaking projects and propose corresponding environmental protection measures. Additionally, emission standards and regulatory measures for wastewater discharge, air emissions, and other aspects also regulate the production activities of coal mining enterprises. Secondly, policies and regulations related to energy and resource management play an important role in promoting the adoption and application of green mining technology. Governments have implemented a series of energy-saving and emission reduction policies and energy management regulations to encourage coal mining enterprises to adopt advanced energy-saving technologies and clean production processes. This aims to improve resource utilization efficiency, reduce environmental pollution, and lower carbon emissions. Furthermore, the government supports green technology innovation and environmental investment by providing fiscal incentives, tax policies, and other means. For example, tax incentives and financial subsidies are offered for technologies such as clean energy and energy-efficient equipment, reducing the cost of enterprise transformation and promoting the application and promotion of green mining technology. In summary, the formulation and implementation of relevant policies and regulations are essential for driving the development and promotion of green mining technology in coal mines. Clear policies and strict enforcement provide strong institutional support for coal mining enterprises, promoting the sustainable development of the coal mining industry towards a more environmentally friendly and sustainable direction.

3. Demand for Green Mining in Coal Mines under the New Situation

3.1 Relationship between Environmental Issues and Sustainable Development

With the escalating global environmental issues, the development of green mining technology has become an essential component of sustainable development. There is a close relationship between environmental issues and sustainable development, and coal mining, as a representative of traditional energy extraction, stands out for its significant impact on the environment. Firstly, the pollutants emitted from coal mining activities, such as wastewater, gases, and solid waste, directly threaten the ecological balance of the surrounding environment and public health. Extensive wastewater discharge can lead to water pollution, affecting the survival of aquatic organisms, while gas emissions can exacerbate air pollution, increasing environmental burdens. Secondly, traditional coal mining methods often accompany large-scale destruction of mining areas and ecosystem degradation, resulting in problems such as land subsidence and soil erosion, seriously affecting the sustained stability of local ecological environments. Such destruction not only brings significant harm to local ecosystems but also limits the sustainable development of local economies and societies. Therefore, the development of green mining technology in coal mines is imperative. By introducing environmental protection technologies, improving resource utilization efficiency, and strengthening environmental protection

measures, the adverse environmental effects of coal mining can be effectively reduced, achieving a positive interaction between coal mining and environmental protection. Furthermore, the promotion of green mining technology can enhance the competitiveness of coal mining enterprises, reduce production costs, and facilitate the sustainable development of the coal mining industry. Thus, strengthening research and application of green mining technology is of great significance for achieving the dual goals of environmental protection and economic development (Huaiting, Wei, Mithal, et al., 2021).

3.2 Impact of New Energy Development on Coal Mines

With the increasing global demand for clean energy, the rapid development of new energy has profound implications for the traditional coal mining industry. The rise of new energy, particularly the widespread application of renewable energy such as solar and wind power, is gradually challenging and replacing traditional coal energy. Firstly, the development of new energy has slowed down the growth in demand for coal. The gradual replacement of coal by clean energy has reduced the market demand for coal, leading to challenges such as declining production and increased sales pressure for coal mines. In some regions, governments have enacted policies to encourage the development and utilization of clean energy, accelerating the process of coal substitution. Secondly, the popularization of new energy is driving the transformation and upgrading of the coal mining industry structure. To adapt to the trend of new energy development, some coal mining enterprises have begun to adjust their product structures, increase investment in clean energy development, and transform into comprehensive energy enterprises. Meanwhile, advanced coal mining enterprises are actively exploring clean production technologies and green mining techniques to improve resource utilization efficiency and reduce environmental impacts. Additionally, the proliferation of new energy also brings opportunities for the coal mining industry. Although the coal market has been somewhat affected, many critical materials and infrastructure construction required for the development of clean energy still rely on support from traditional energy sources such as coal. Furthermore, with the advancement of clean energy technologies and the reduction of costs, coal mining enterprises are expected to participate in the clean energy industry chain and explore new market opportunities. In conclusion, the development of new energy has profound implications for the coal mining industry, bringing both challenges and opportunities. Coal mining enterprises need to actively respond to the challenges posed by the development of new energy, promote technological innovation and industrial upgrading, and achieve sustainable development in the coal mining industry.

3.3 Social Demand and Public Opinion Pressure

In today's society, there is an increasing focus on environmental protection and sustainable development, which has led to growing concern and apprehension regarding coal mining activities. Faced with issues like environmental pollution and resource depletion, the public is expressing more and more skepticism and opposition towards coal mining, creating significant public opinion pressure. Firstly, public concern about environmental pollution and ecological degradation has driven social

attention towards environmental issues in coal mining. Past coal mining activities have often been associated with significant environmental pollution such as extensive wastewater and gas emissions, leading to the deterioration of surrounding environments and damage to ecosystems, which has triggered widespread social attention and discontent. Secondly, with the rising environmental awareness, the public's reliance on coal energy is gradually decreasing while the demand for and support of clean energy are increasing. More and more people are recognizing the importance of clean energy, advocating for reduced reliance on traditional energy sources like coal, and turning towards more environmentally friendly and sustainable energy alternatives. Additionally, social organizations, environmental agencies, and other entities are actively involved in supervising and evaluating coal mining activities, promoting transparency and accountability in coal mining operations. Some environmental organizations, through public scrutiny and legal avenues, are urging coal mining companies to fulfill their environmental responsibilities and promote the application and dissemination of green mining technologies. Social demand and public opinion pressure play a crucial role in driving the promotion of green mining in coal mines. Coal mining enterprises need to fully recognize the public's concerns and expectations regarding environmental protection, strengthen communication and cooperation with various sectors of society, actively respond to public opinion pressure, promote the widespread application of green mining technology, and achieve a win-win situation of economic benefits and environmental protection.

4. Application of Green Mining Technology in Coal Mines

4.1 Environmental Protection Technology

Environmental protection technology plays a crucial role in green mining in coal mines, aiming to reduce the environmental pollution and damage caused by mining activities and protect the integrity and stability of surrounding ecological environments. The following are several common environmental protection technologies applied in coal mining:

1. Wastewater Treatment Technology: Advanced wastewater treatment technologies such as biological treatment and membrane separation are used to effectively remove pollutants from wastewater generated during coal mining, meeting emission standards and reducing the impact on water environments.

2. Air Pollution Control Technology: Advanced air pollution control technologies such as dry dust removal, smoke desulfurization, and denitrification are used to reduce pollutant concentrations in emissions and improve ambient air quality.

3. Land Reclamation Technology: Land reclamation technologies such as vegetation restoration, surface covering, and land management are used to restore abandoned mining areas, restore ecological functions, and reduce land waste and environmental damage.

By adopting these environmental protection technologies, coal mining enterprises can effectively reduce the environmental impact of mining activities, lower environmental risks during production, and

achieve the goal of green mining. Additionally, the application of these technologies enhances the environmental image and social reputation of coal mining enterprises, contributing to increased competitiveness and sustainable development.

4.2 Energy Efficiency Improvement Technology

Improving energy efficiency is a key aspect of green mining in coal mines, aiming to reduce energy consumption, emissions, and improve production efficiency. The following are several common energy efficiency improvement technologies applied in coal mining:

1. Efficiency Improvement of Mining Equipment: Advanced mining equipment and technologies such as high-efficiency mining machinery and automation equipment are introduced to reduce energy consumption and production costs (Erhu, Wenbing, Yi, et al., 2023).

2. Energy Management and Monitoring Technology: Comprehensive energy management systems and real-time monitoring systems are established to monitor and manage energy consumption during mining production. Through refined management and optimized scheduling, energy utilization efficiency is maximized, reducing energy waste and costs.

By adopting these energy efficiency improvement technologies, coal mining enterprises can achieve energy conservation and emission reduction, reduce production costs, and enhance competitiveness. Additionally, the application of these technologies helps reduce energy consumption, alleviate energy shortages, and promote sustainable energy utilization. Therefore, energy efficiency improvement technology plays an important role in green mining in coal mines and is one of the crucial means to achieve green mining goals.

4.3 Green Mining Technology

Green mining technology refers to the adoption of environmentally friendly, efficient, and sustainable mining methods and technologies in the process of coal mining, with the aim of minimizing environmental impact and achieving sustainable resource utilization. The following are several common green mining technologies applied in coal mining:

1. Smokeless Mine Technology: Advanced smokeless mine technologies, such as closed mine ventilation systems and wet blasting techniques, effectively control the generation and emission of harmful gases in mines. This technology not only reduces air pollution within the mines but also enhances safety and comfort in the working environment.

2. Mine Ecological Restoration Technology: By employing green mine ecological restoration technologies such as vegetation restoration, land reclamation, and water source protection, it is possible to effectively restore the ecological environment left behind after coal mining, reducing problems like land desertification and soil erosion, and protecting the integrity and stability of local ecosystems.

By adopting the above green mining technologies, coal mining enterprises can achieve a win-win situation of environmental protection and economic benefits. The application of these technologies not only reduces the environmental impact of coal mining activities and lowers production costs but also improves resource utilization efficiency. Moreover, it enhances corporate image, social responsibility,

competitiveness, and sustainable development capability. Therefore, green mining technology plays a significant role in promoting the transformation and development of the coal mining industry towards green, low-carbon, and sustainable directions (Shengrong, Yiyi, Fangfang, et al., 2022).

5. Challenges and Issues in the Application of Green Mining Technology

5.1 Technical Challenges and Research and Development Needs

The development of green mining technology in coal mines faces numerous technological challenges and research and development needs, requiring continuous innovation and breakthroughs to promote the coal mining industry towards a more environmentally friendly, efficient, and sustainable direction. Here are some specific technological challenges and research and development needs: Clean Coal Mining Technology: Current traditional coal mining processes commonly suffer from issues such as high carbon emissions, significant waste generation, and environmental pollution. Therefore, there is an urgent need to develop efficient, low-emission clean coal mining technologies, including green sorting technologies, harmless coal gangue treatment technologies, etc., to reduce environmental impact. Utilization Technology of Coal Mine Waste Resources: The utilization of waste resources generated during coal mining is an important research area. Transforming ore slag, tailings, coal gangue, and other waste into renewable energy or other valuable products to reduce resource waste is one of the urgent technological challenges to be addressed. Intelligent Mining Technology: With the continuous advancement of technology, intelligent mining technology has become a research hotspot in the field of coal mining. This includes automation equipment, remote monitoring systems, intelligent scheduling systems, etc., aimed at improving production efficiency, reducing labor intensity, lowering accident rates, and achieving intelligent and informatized management of coal mining. Mine Ecological Restoration Technology: The ecological damage caused during the coal mining process is a major challenge, thus there is an urgent need to develop efficient mine ecological restoration technology. This includes vegetation restoration, land reclamation, water source protection, and other technical methods to restore the ecological functions of mine sites, reducing problems such as land desertification and soil erosion. Carbon Capture and Storage Technology: In response to the significant carbon dioxide emissions produced during coal combustion, there is an urgent need to develop efficient carbon capture and storage (CCS) technology. This involves researching and developing new carbon capture technologies, finding efficient carbon storage methods, permanently sequestering carbon dioxide underground or converting it into useful products to reduce greenhouse gas emissions and address the challenges of climate change. Through continuous research and innovation to address the above technological challenges and meet the needs of green mining, sustainable development of the coal mining industry can be achieved, promoting the coordinated development of the economy and the environment.

5.2 Economic Feasibility and Cost Considerations

When promoting green mining technology in coal mines, economic feasibility and cost considerations

are crucial factors. Introducing green mining technology often requires enterprises to invest significant funds in areas such as technology research and development, equipment upgrades, and system enhancements. These capital investments may have a certain impact on the financial condition and liquidity of enterprises, especially for smaller-scale coal mining enterprises, which may face considerable pressure. Additionally, the operating costs of green mining technology are also important considerations. Maintenance expenses for environmental protection equipment, operating costs for energy management systems, etc., will all increase the operational costs of enterprises. Therefore, enterprises need to carefully assess the investment payback period and risk control when introducing these technologies to ensure that the investment can achieve reasonable economic returns.

In addition to technological investments, government policy support also plays a crucial role in the promotion of green mining technology. Governments can reduce the cost of introducing green technology for enterprises by implementing tax incentives, providing financial subsidies, establishing technology research and development grants, and other measures, thereby encouraging enterprises to actively adopt environmentally friendly technologies. Furthermore, governments can guide enterprises towards green mining by establishing industry standards, promoting technological innovation, and facilitating the transformation and upgrading of the entire industry (Chuming, Yongkui, Xin, et al., 2022).

When considering market demand, enterprises need to closely monitor consumers' preferences for and willingness to purchase environmentally friendly products. If there is a high level of recognition and demand for green products in the market, enterprises will be more motivated to invest in the research and application of green technology. Additionally, risk management is also a key concern for enterprises when promoting green mining technology. Factors such as immature technology and uncertainties in the policy environment may bring certain risks, and enterprises need to establish sound risk management mechanisms to timely respond to potential risks and ensure sustainable development.

In conclusion, economic feasibility and cost considerations are multifaceted factors that need to be comprehensively considered when promoting green mining technology. It requires joint efforts from governments, enterprises, and various sectors of society to achieve the widespread application of green mining technology and promote the coal mining industry towards a more environmentally friendly and sustainable direction.

5.3 Human Resources and Training Needs

In the process of promoting green mining technology in coal mines, human resources and training needs are important aspects. Introducing new technology requires the support of corresponding talents for implementation and operation, so enterprises need to focus on the following aspects:

1. Training of Technical Talents: Green mining technology typically requires certain professional knowledge and skills. Enterprises need to cultivate and introduce relevant technical talents through training programs, technical exchanges, etc. These talents include engineers, technicians, operators, etc., who need to possess professional knowledge and practical operational skills in green mining

technology to effectively apply new technologies to their work.

2. Training of Management Talents: The promotion of green mining technology also requires talents with certain management capabilities who can effectively organize and manage green mining projects, coordinate various resources, and ensure the smooth progress of projects. Therefore, enterprises need to pay attention to the training and development of management talents to enhance their leadership and management skills.

3. Design of Training Programs: Enterprises should develop comprehensive training programs tailored to the actual needs and skill levels of employees. Training content should cover theoretical knowledge, operational skills, safety, and environmental protection aspects of green mining technology. The aim is to enhance employees' comprehensive qualities and professional skills, laying a solid talent foundation for the application of green mining technology.

4. Employee Incentive Mechanisms: To encourage employees to actively participate in the promotion and application of green mining technology, enterprises can establish related incentive mechanisms such as bonus systems, promotion mechanisms, honorary titles, etc. These incentives aim to encourage continuous learning and improvement among employees, thereby increasing their acceptance and willingness to apply new technologies (Moses, Margaretha, & Andrew, 2021).

By properly planning human resources and training needs, enterprises can effectively enhance employees' professional skills and comprehensive qualities, providing solid talent support for the promotion and application of green mining technology, and promoting the coal mining industry towards a more environmentally friendly, efficient, and sustainable direction.

6. Conclusion

The application of green mining technology is one of the key paths for the transformation and upgrading of the coal mining industry and achieving sustainable development. Through the discussion in this article, we can draw the following conclusions: Firstly, the application of green mining technology is of great significance for reducing environmental pollution, protecting the ecological environment, and achieving sustainable resource utilization. With the increasing global awareness of environmental protection and the call for green development, it is necessary for coal mining enterprises to actively adopt green mining technology and promote the coal mining industry towards a more environmentally friendly and efficient direction. Secondly, the promotion of green mining technology faces many challenges and problems, such as technological research and development, economic feasibility, and human resources training. To overcome these challenges, governments, enterprises, and all sectors of society need to work together, increase investment in technological research and development, formulate relevant policy support, cultivate talent, and provide solid guarantees for the promotion of green mining technology. Finally, as the main body of the coal mining industry, coal mining enterprises bear the important responsibility of promoting the application of green mining technology. Enterprises need to establish green concepts, strengthen technological innovation and

management innovation, establish sound environmental management systems, cooperate with governments, industry associations, and other relevant parties, and jointly promote the coal mining industry towards a more environmentally friendly, efficient, and sustainable direction. In conclusion, the application of green mining technology is not only an inevitable choice for the development of the coal mining industry but also an effective way to achieve sustainable development of the coal mining industry. Through joint efforts of all parties, it is believed that green mining technology will play an increasingly important role in the future, making positive contributions to the sustainable development of the coal mining industry.

References

Chuming, P., Yongkui, S., Xin, W., et al. (2022). Study on a High-Efficiency Mining Technology System for Gas Outburst in Coal Seams—Example of an H Coal Mine. *Minerals*, *12*(7), 795-795. https://doi.org/10.3390/min12070795

Erhu, B., Wenbing, G., Yi, T., et al. (2023). Green coal mining under buildings by overburden grout injection for coalmine sustainable development of central China. *Heliyon*, *9*(8), e18965-e18965. https://doi.org/10.1016/j.heliyon.2023.e18965

Huaiting, L., Wei, Z., Mithal, I. J., et al. (2021). Analyzing Characteristics of Particulate Matter Pollution in Open-Pit Coal Mines: Implications for Green Mining. *Energies*, *14*(9), 2680-2680. https://doi.org/10.3390/en14092680

Moses, N., Margaretha, H. P. D. V., Andrew, J. P. D. V. (2021). A Conceptual Framework for Greener Goldmining through Environmental Management Accounting Practices (EMAPs): The Case of Zimbabwe. *Sustainability*, *13*(18), 10466-10466. https://doi.org/10.3390/su131810466

Shengrong, X., Yiyi, W., Fangfang, G., et al. (2022). Application of Pre-Splitting and Roof-Cutting Control Technology in Coal Mining: A Review of Technology. *Energies*, *15*(17), 6489-6489. https://doi.org/10.3390/en15176489