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INFLUENCE OF RADIATION EMISSIONS FROM INDUSTRIAL SOURCES ON SOIL PROPERTIES

Farmanova Mohigul Azamat qizi
Navoi State Mining and Technologies University,
Faculty of Agriculture, Department of Agronomy
mohigulabdullayeva3963@gmail.com

MAQOLA MALUMOTI

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During the production activities of industrial enterprises, the release of radioactive substances is considered one of the hazardous factors for soil. The entry of such substances into the soil directly affects its physical, chemical, and biological properties. In this study, the impact of radioactive pollutants emitted from industrial sources on soil conditions was examined. The analyses revealed that radioactive compounds reduce soil fertility, disrupt the balance of minerals, and limit the activity of microorganisms. Prolonged exposure slows down the natural recovery processes of the soil and worsens the conditions necessary for agricultural crops. The results indicate that controlling radioactive contamination in industrial areas, strengthening ecological monitoring, and implementing soil protection measures are of urgent importance. At the same time, it is necessary to develop methods for reducing and neutralizing radioactive waste. The findings of this research provide an important scientific basis for preserving soil quality, ensuring ecological sustainability, and improving agricultural productivity.

Introduction

Mining activities not only involve the extraction of valuable minerals but also give rise to serious environmental problems. Every year, thousands of hectares of land are transferred into the category of disturbed lands, and their restoration process requires decades. Failure to rehabilitate such areas leads to the penetration of industrial waste into the air, water flows, and soil cover, thereby disrupting the natural balance of the environment.

The impact of technogenic processes is not limited only to the areas where industrial facilities are located but also spreads to territories several times larger. This not only reduces soil quality but also poses a serious threat to the ecological, hydrological, and social stability of landscapes. Among the main factors contributing to soil degradation are erosion, deflation, salinization, desertification, floods, and compaction, which, together with technogenic pressure, sharply weaken the natural resources of the region [1, 2].

“Plants, perhaps, already possess certain algorithms. Radiation has existed on Earth since the earliest stages of the planet’s formation. At that time, radiation levels were much higher than today.

Therefore, when life was just beginning to emerge, plants were exposed to radiation, as a result of which they developed the protective mechanisms they currently possess,” notes Khaydukh. Hence, the issue of land reclamation is considered a pressing ecological and social problem worldwide [3].

Modern approaches to landscape restoration require consideration not only of mechanical aspects but also of ecological, economic, and social factors in an integrated manner. Determining the functional direction of reclaimed lands—such as using them for agriculture, establishing recreational areas, or incorporating reclamation measures into urban planning—is of crucial importance.

In addition, to increase the effectiveness of reclamation measures, it is necessary to apply long-term monitoring strategies, establish criteria for assessing soil and environmental parameters, and utilize the best available technologies. The restoration of areas disturbed as a result of technogenic activities is important not only for reusing the rehabilitated land but also for preserving the quality of the surrounding natural environment. In this regard, reclaimed areas may serve as the ecological foundation of the region in the future [4].

The main objective of this study is to assess the possibilities of ecologically, economically, and socially effective reclamation of lands degraded by mining and other technogenic activities. In the course of the research, the factors influencing soil degradation

in disturbed areas—erosion, deflation, salinization, desertification, floods, and technogenic pressure—were examined.

MethoDS

Methodologically, the research is based on a comprehensive approach. It involves monitoring soil and environmental parameters to determine the effectiveness of reclamation, establishing criteria for selecting the reclamation layer and its thickness, as well as analyzing the possibilities of applying advanced technologies. Defining the functional direction of reclaimed lands (such as agricultural use, recreational areas, or ameliorative zones) is also considered an important part of the methodology. In reclamation and amelioration studies of disturbed lands, the natural conditions of the region, including climate and soil properties, play a crucial role. During the research, reclamation methods and technologies were selected taking into account edaphic and ecological factors, as well as the impact of industrial waste on the soil.

Technologies used in the mining industry are being continuously modernized in order to minimize soil damage and to carry out overburden removal operations as much as possible through internal waste dumps. The study envisages the adaptation of technical and biological reclamation methods in quarries and industrial sites, the improvement of existing methods, and the development of more efficient technologies.

Furthermore, the development of reclamation projects was based on the creation of an initial database, including the composition and properties of soils and rocks. An important direction of the research is the assessment of the ecological condition of disturbed lands and their adjacent areas, the restoration of soil fertility, and the study of the dynamics of artificial landscape formation. This approach allows for the stable formation of new landscapes under different conditions and ensures maximum ecological, social, and economic benefits.

RESULTS AND ANALYSIS

The chemical composition of soils formed in technogenic areas mainly depends on the parent rocks and the composition of industrial wastes. At the same time, the success of reclamation activities largely relies on researchers and practitioners focusing on restoring soil fertility. Taking into account industrial production and natural conditions, the state and regional directions of the reclamation process are determined [5]. Based on the experience of different countries and regions, it is possible to study the regularities of new landscape formation in areas affected by technogenic activities and to systematize knowledge in this field.

During the process of land restoration, it is necessary not only to rehabilitate degraded areas for targeted use but also to restore neighboring lands that have partially or completely lost their value due to negative impacts, while improving environmental conditions. For this purpose, it is important to develop guidelines for drafting reclamation projects to improve the condition of degraded lands in accordance with the normative-legal documents of the Republic of Uzbekistan. For example, in the in-situ leaching method of uranium mining, the reclamation of disturbed land plots within state land reserves is completed only after the full scope and quality of the works specified in the project have been assessed [6].

In planning reclamation works, the main criteria include ecological, agro-technical, sanitary-hygienic, construction, and other regulatory requirements. At the same time, the rational use of reclamation resources and consideration of soil and ecological principles are of great importance [2]. The purpose of the study is to develop scientific and practical methods to improve the reclamation condition of degraded lands for use in agriculture, forestry, water management, construction, recreation, ecological and sanitary-health purposes, by maintaining ecological balance, restoring, increasing, and improving soil fertility. To achieve this goal, agro-technical and phytoreclamation measures such as the application of organic and mineral fertilizers, gypsum, and the planting of perennial legumes are required [7].

Improving degraded soil cover includes removing fertile soil layers from certain areas, storing them, and subsequently applying them to reclamation sites. At the same time, the industrial development of uranium deposits requires the organization of ecological measures aimed at preserving the natural habitats of wild animals.

This, in turn, necessitates the development of new ecological concepts in the planning of industrial projects.

CONCLUSION

The results of the study show that restoring soil fertility and improving the reclamation condition of areas affected by technogenic activities requires a comprehensive systematic approach. To achieve this, a number of agro-technical and phytomeliorative measures must be implemented, including the application of organic and mineral fertilizers, gypsum treatment, the cultivation of perennial leguminous plants, and other biological reclamation methods. These measures serve not only to restore the chemical and physical properties of the soil but also to enhance its biological activity.

Furthermore, the temporary removal, storage, and subsequent application of fertile soil layers from disturbed areas to reclamation sites is considered an essential part of effective

reclamation practices. This process not only restores soil fertility but also helps maintain ecological stability within the region.

Technogenic activities, such as industrial uranium mining, can become a new source of threat to wildlife and other biological resources. Therefore, the development and implementation of ecological protection measures and new concepts are required. These concepts should aim to preserve natural habitats for wildlife, protect water and soil resources, and ensure that reclamation efforts align with the socio-economic significance of the area.

In general, reclamation and biological restoration efforts play a crucial role in conserving natural resources, promoting ecosystem recovery, and creating opportunities for sustainable future use. In this way, areas affected by technogenic activities are prepared not only for economic reuse but also transformed into ecologically stable systems that maintain natural balance.

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