

Research Article

Intensive Reclamation of Landfills and Polygons for Solid Waste Disposal

Vitaliy V. Chelnokov¹, Elena Zabolotnaya^{1,2*}, Aleksey V. Matasov¹, Anna S. Makarova¹, and Andrey N. Glushko³

¹D. Mendeleev University of Chemical Technology of Russia

²JSC "Fine Chemicals R&D Centre"

³SIC Kurchatov Institute – IREA.

ORCID

Zabolotnaya Elena; 0000-0002-5461-5145

Abstract. This research proposed the use of one of the most effective complexons – oxyethylidenediphosphonic acid, namely its derivative compound – phenyldiacetic acid, for the active sorption matrices of humus of mineral origin. The application of active components that stimulate plant growth and photosynthesis processes in hybrid preparations during reclamation were also proposed.

Keywords: recultivation of landfill, plant growth stimulation, phytoremediation

Corresponding Author:

Zabolotnaya Elena; email:
zabolotnaya.e@inbox.ru

Dates

Published 13 January 2022

Publishing services provided by
Knowledge E

© Vitaliy V. Chelnokov et al. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the 8th Scientific and Practical Conference Conference Committee.

1. Introduction

In the second half of the last century, the dipotassium salt ligand polyfunctional biological activity, low toxicity, and resistance to microbial decomposition were discovered and proved on the basis of the results of microbiological studies, test vegetation experiments, and modern knowledge about the functioning of a set of plants with associated microorganisms (PGPR bacteria - Plant Growth-Promoting Rhizobacteria) [1]. Such studies are not conducted in Russia. As for the "live" iron complexonates, this technique is widely used in hydroponic nutrient formulations. However, no information was found in preparations for the intensification of phytoremediation of disturbed lands.

2. Methodology

It is obvious to the authors that it is to stimulate the growth of recultivating plants, first of all, it is necessary to provide them with a sufficient supply of iron ions in the tissues. The object for field research was selected, the field survey of the landfill "Levoberezhny", Khimki (Moscow region) was conducted and soil samples were taken. The leading role of heavy metals in the list of potential soil pollutants in the landfill zone

OPEN ACCESS

has been identified and confirmed by information in the literature. It is proposed to use the method of induced phytoextraction using complexons in complex measures of landfill reclamation. The use of a compound derived from a class of organophosphorus complexons as an effector of phytoextraction was proposed, taking into account the biological activity of these compounds. A series of microbiological studies was conducted on the basis of selected soil samples from the landfill "Levoberezhny", from which accessions of microorganisms were isolated. In the course of microbiological studies, the influence of mineral (diatomite and bentonite fractions) and organic (potassium humate) sorbents, as well as the dipotassium salt of oxyethylidenediphosphonic acid (a derivative of organophosphorus complexon) on the growth, vital activity and ability to destroy potential pollutants by isolated isolates of microorganisms was studied. The microorganisms resilience to heavy metal ions, which stabilizes but does not determine the role of the introduced components, was revealed [2]. The principles of intensification of the process of biological reclamation of landfills are formulated. The approach to the component composition of new generation tools and remedies, which includes the use of components-phytohormones, adaptogens and iron complexonates to ensure full photosynthetic function in remediation plants, is scientifically justified.

3. Experimental

A test series of vegetation experiments was conducted on 7 plants of the influence of the hybrid preparation "Pochvovit", which includes an active complex (gibberellin acids and a derivative of ortho-chlorophenylacetic acid). The positive effect of the introduction of the active complex in the preparations on the growth and biomass of plants in the conditions of model contamination with increased doses of heavy metals was shown.

It was shown that native microorganisms capable of destroying organic compounds (particularly, oil) are resistant to the presence of heavy metal ions in the environment. This also removes restrictions on the selection of the sorption matrix material based on the ionic composition. The revealed nature of soil contamination in landfills as a result of the conducted analyses, together with the literature data, suggested that the intensification of reclamation processes should be based on measures aimed primarily at the extraction/neutralization of heavy metals and, then, the subsequent restoration of the disordered function of the soil as a living organism [3].

4. Conclusion

The influence of the composition of a new hybrid biological product "Pochvovit" with components of an organic biocatalyst on the development and ability of phytodegradants plants to destroy pollutants and dispose of toxic substances in industrial polluted soil substrates, as well as in general on the process of soil restoration due to the native phyto-microbial potential is studied. A new method of recultivation of solid waste landfill depositing has been developed, a patent search has been conducted and a patent application has been issued.

5. Acknowledgement

This study was carried out in the framework of the grant RFBR № 18-29-25071.

References

- [1] Brylev SN, Samiullin RA, Shubin II. Methods of neutralization and recultivation of lands occupied by old burials of production and consumption waste. Science-Intensive Technologies in Melioration. Moscow: Izdatelstvo VNIIA. 2005.
- [2] Sereda TG. Environmental requirements for the design, construction and operation of landfills for solid waste disposal (storage) within the Perm region: Methodological recommendations. Perm: Perm State Technical University; 1995.
- [3] Stabnikova EV, Reva ON, Ivanov VN. Selection of active microorganism-destroyer of hydrocarbons for oil-contaminated soils cleaning. Applied Biochemistry and Microbiology. 1995;31(5):534-539.