

## ANNOTATION

Of the dissertation for the degree of doctor of philosophy (PhD) on specialty  
6D073100 - Life Safety and environmental protection

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for the theme "Technology of the bioindication and bioremediation polluted with  
elements of technogenic heavy metals (As, Pb, Cd) of soils in Shymkent city"

**General characteristics of the dissertation research.** The dissertation considers the ways of developing technology for recultivation of soils contaminated with heavy metal ions with the help of lumricafauna.

**The relevance of the dissertation.** One of the most pressing issues in a temperate climate is the rational use of soil. Therefore, the detection of important soil pollutants and effective methods of their elimination, bioremediation and bioindication technologies contribute to solving this problem.

In order to establish the effect on vermiculture of heavy metal ions released by technogenic ways used in recultivation and bioindication, a device for bioremediation of tillage has been developed. The octagonal-shaped device consists of eight sections with a round central hole and a balanced volume. The outer cover has holes for air penetration, the center of which is made in the form of a cylinder with eight holes and twisting opens or closes the way to individual parts. In this regard, the study of bioremediation processes of soils contaminated with heavy metals, the development of express-indication devices and their practical recommendations are relevant.

**The purpose of the study:** to develop a technology for recultivation of surface soils contaminated with heavy metal ions in industrial areas of the Turkestan region with the help of lumbricofauna, to determine the stability and reactivity of heavy vermiculture species used in bioremediation and bioindication.

**Research objectives:**

- to determine the main patterns of the spread of vermiculture in the Turkestan region;
- to identify the diversity of composition, morphological, weight, color characteristics of common earthworm communities in the main types of soils of the Turkestan region;
- to determine the diversity of vermiculture in soils contaminated with heavy metal ions in industrial cities;
- to determine the predominant types of earthworms living in industrial cities of the Turkestan region, and the influence of metal ions of various concentrations on them as a result of comparative studies with reference earthworms;
- disclosure of the degree of purification of the soil layer from contamination by heavy metal ions of the lumbricofauna.

**Objects of research.** Waste of JSC "Yuzhpoly metal", the village of Aschysay, Turkestan region, industrial and transport sites of Shymkent.

**The subject of the study.** The subject of the study is the regularities of the spread of vermiculture in the soil layers of the Turkestan region, the indicators of purification from the contaminated soil layer using lumbricofauna.

**Research methods.** To accomplish the tasks, the following sets of methods were used: analysis, generalization of scientific and technical literature data in the field of research; conducting experiments in laboratory and industrial conditions; mathematical modeling and statistical generalization; expert evaluation; technical and economic analysis; conducting research using modern physico-chemical means to determine the properties and structure of raw materials and products.

**Scientific novelty of the dissertation:**

- taking into account the patterns of vermiculture distribution in the districts of Shymkent, four families of Lumbricidae (lumbricides) of vermiculture - *Ap. c. trapezoides* (trapezoids), *Ap. c. Caliginosa* (caliginos), *Ap. c. rosea* (roseus), *Eisenia foetida* (foetida);

- on the basis of modern methods of taxonomic research, the types of vermicultural associations in typical soil layers of the Turkestan region have been identified. The size and morphological features of the identified worm communities and the specific physiology of life are revealed;

- with the help of modern methods of energy analysis, the rate of contamination of the soil of Shymkent with heavy metal ions has been stabilized. According to the chemical analysis of samples taken from the Badam River, the content of lead is 4.8 times higher than the maximum permissible concentration (MPC), copper 20 times, zinc 60.2 times and arsenic more than 22 times;

- bioindication method of express expression of soils in ecosystems contaminated with heavy metal ions, based on additive reactions of vermicultures to concentrations of heavy metal ions. The stability of vermiculture to various concentrations of heavy metal ions has been experimentally established;

- the technology of bioremediation of contaminated soil layers has been developed, taking into account the resistance of vermiculture to various concentrations of heavy metal ions;

- according to the results of chemical analysis by biological soil purification using stimulants, the content of lead ions in the areas of Shymkent contaminated with heavy metal ions can be reduced by  $68,9 \pm 3,5$ ,  $77,4 \pm 4,8$ ,  $85,3 \pm 5,6$  %;

- as a result of the application of vermiculture, a mathematical model has been developed for planning experiments on biorecultivation of contaminated soils.

**Practical significance of the work.** A set of recommendations for monitoring the ecological state of soils in the areas of industrial cities and measures to improve their quality has been developed. In this regard, a scientifically based method has been developed for isolating a group of resistant earthworms prone to monitoring and cleaning soil types contaminated with various heavy metal ions and their compounds.

RK patent for utility model №5451. A device for bioremediation treatment of soils contaminated with heavy metals has been developed and presented. In addition, the results of the study can be used in lectures on the topic "Human life safety" for students of the specialty "Life Safety" of the Belarusian State Agricultural Academy.

### **The main results recommended for protection:**

- patterns of distribution of earthworms by the main types of soils of the Turkestan region, anatomical, taxonomic structure and morphometric characteristics of the selected communities;
- indicators of resistance to the effects of toxic compounds of toxic heavy metal ions of worm species effectively selected for cleaning the soil layer, the results of biotesting reactions;
- results of the development of purification technology based on express biotesting and the use of lumbricofauna in the contaminated soil layer;
- technology for cleaning the soil layer contaminated with heavy metal ions based on the use of lumbricofauna;
- the possibility of using mathematical modeling of vermiculture in biorecultivation of contaminated soils.

**The contribution of the doctoral student in the preparation of publications.** 28 articles have been published on the topic of the dissertation. The total contribution of a doctoral student is 55-60%. The contribution to the articles is represented by such components as conducting experimental studies, processing the results in the form of tabular values and graphical dependencies, obtaining computational equations.

The results of the research are presented in the International Journal of Engineering Research and Technology, included in the Scopus database: "The impact of heavy metals on the environment and methods of soil bioremediation control", 2020, Volume 13, Issue 13, pp. 1120-1125; In the journal Proceedings of the National Academy of Sciences of the Republic of Kazakhstan Series of Geological and Technical Sciences "Study of the action of heavy metals on the soil cover and methods of their bioremediation control", 2021, 1 (445), pp. 52-57.; - 2 articles have been published in total. Two articles have been published in journals submitted by the Ministry of Education and Science of the Republic of Kazakhstan: Bulletin of KazNITU - (2020, No. 5 (141) and (2020, No. 2 (138) Bulletin of the Al-Farabi Kazakh National University (2021 No. 2 (61)). Published in the Collections of the Republican Conference: International Scientific Journal "Internauka" (Ukraine, December 2018) of the V International Scientific and Practical Conference "Industrial Technologies and Mechanical Engineering" dedicated to the 75th anniversary of the South Kazakhstan State University. Academician Sultan Tashirbaevich Suleimenov conducting the Industrial Revolution within the framework of 4.0.ICITE-2018, Volume I., IV, November 28, Shymkent-2018.(Shymkent, 2018)Materials of the International Scientific and Practical Conference "Auezov Readings-16" The Fourth Industrial Revolution: Opportunities for modernization of Kazakhstan in the field of science, education and culture Yu.V. Actual conference, Sheffield, Science and Education LTD, 2019; Industrial technologies and mechanical engineering (Shymkent, No. 2 (31) 2019); Collection of scientific papers "Innovative solutions in technology and mechanization of agricultural production" (Gorki, 2020); IX Global Science and Innovation 2020: Central Asia (Nur-Sultan, 20-22, 2020); Bulletin of the

Belarusian State Agricultural Academy (Gorki, No. 4, 2019); Materials of the V International Scientific and Practical Conference "Integration of the scientific community into the global challenges of our time" (Tokyo, February 12-14, 2020); Collection of articles based on the materials of the XVI International Scientific and Practical Conference dedicated to the 100th anniversary of the Ministry of Agriculture (Gorki, June 23-24, 2020); V International Scientific Conference "Theoretical and applied aspects of the application of modern science" (Tokyo, 2022); "Scientific foundations of modern research" Materials of the VIII International Scientific and Practical Conference (Helsinki, Finland, March 01 - 04, 2022). During the internship at the State Agrarian University of the Republic of Belarus, the work was performed at the Department of "Life Safety" and received a positive assessment.

**Information about publications.** The main provisions, results, conclusions and conclusions of the dissertation are presented in 28 publications, including in international scientific publications included in the Scopus – 2 database; In journals recommended by the CES of the Ministry of Education and Science of the Republic of Kazakhstan - 3; In the materials of international conferences - 15 articles, foreign - 8 articles.

**The structure and scope of the dissertation.** The dissertation is typed on 126 pages, includes 34 figures and 29 tables. The list of references is 118 sources. The content of the dissertation consists of an introduction, a literary review, research materials and methods, research results, their discussion and conclusions.