

ANNOTATION

to the dissertation work of the dissertation of Assel Yerzhanovna Tleukeyeva on the topic "Development of fertilizers based on the processes of complex conversion of phosphorus-containing waste in Shymkent" for the degree of Doctor of Philosophy (PhD) in the educational program 8D05120-"Biotechnological aspects in the agro-industrial complex"

General characteristics of the work. In the dissertation work, the work on the biological conversion of phosphorus-containing waste (slags, slimes, sedimentary waters) with the use of green microalgae in order to obtain a fertilizer to increase the fertility of depleted soils and increase crop yields was investigated.

The relevance of the topic. The problem of utilization of mineral and man-made industrial waste is one of the urgent environmental problems of our time. Currently, the Republic of Kazakhstan is one of the parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal of March 22, 1989 (Basel, Switzerland), the Stockholm Convention on Persistent Organic Pollutants of May 17, 2004 (Stockholm, Sweden), the Rotterdam Convention on the Prior Informed Consent Procedure for a Number of Hazardous Chemicals and pesticides in international trade from 1993 (Rotterdam, the Netherlands). Measures are gradually being taken for the safe storage and disposal of solid household waste throughout Kazakhstan. But, in addition to solid household waste, there are also man-made waste after mining and processing of minerals. Analysis of statistical data showed that the volume of hazardous waste generated in 2018 compared to 2017 increased by 23 088.1 thousand tons (by 18%), and in 2019 by another 30 544.35 thousand tons (by 20%). The volume of non-hazardous waste generated in 2019 increased by 57,302.55 thousand tons (by 14%) compared to 2017.. The main industries generating hazardous and non-hazardous waste in 2019 are mining and manufacturing industries, which generated hazardous waste -131,203.75 thousand tons, non-hazardous waste -318,683.45 thousand tons. The total volume of hazardous waste generated in the Turkestan region in 2019 amounted to 124,345.6 tons, non-hazardous waste -206,111.2 tons. Various technologies for processing solid and liquid waste are known, but the most promising are biotechnological methods based on the vital activity of various biological objects. The production of phosphorus fertilizers, unfortunately, involves the formation of solid and liquid waste, which contain a residual amount of phosphorus and a number of trace elements. The fact of the presence of biogenic elements in industrial waste suggests the possibility of using them as raw materials for the cultivation of various microorganisms. For example, the use of biodiesel production waste for the synthesis of organic substances, the use of agricultural waste for further microbial fermentation or organic waste for the cultivation of microorganisms. On the other hand, the south of Kazakhstan is characterized by the presence of huge areas of depleted and saline soils, where the problem of increasing fertility is also relevant.

In this regard, in the biotechnology of Kazakhstan, the actual direction of scientific research is the utilization of phosphorus-containing waste and the production of fertilizers in increasing soil fertility to solve urgent environmental problems in the south of Kazakhstan.

Objects of research: phosphorus-containing waste – slags, slimes, sedimentary waters - Kaynar LLP (Shymkent), 68 isolates of green algae from 6 rivers (Mashat, Kushata, Keles, Arys, Badam, Koshkar-ata) of the south of Kazakhstan, 5 types of agricultural crops (*Solanum lycopersicum*, *Cucumis sativus*, *Ocimum basilicum*, *Zea mays*, *Rhaphanus sativus*).

The goal of the work is to develop a fertilizer based on a composition of microalgae cultivated on liquid phosphorus-containing waste, slags and slurries of Shymkent

To achieve this goal, the following tasks were solved:

- study of the distribution of green microalgae in small rivers of Turkestan region, promising for use in biofertilization;
- development of the composition of the fertilizer and selection of optimal factors for the cultivation of green microalgae on phosphorus-containing waste Shymkent;

- study of the effect of alga fertilizers on the morphometric characteristics of phyto-test cultures;
- development of a technological scheme for the production of fertilizers based on phosphorus-containing waste in Shymkent.

Scientific novelty. For the first time, 68 isolates of green microalgae attributed to the genera *Chlorella*, *Botryococcus*, *Scenedesmus*, *Desmodesmus*, *Chlamydomonas*, *Oocystis*, *Parachlorella* were isolated from small rivers in the south of Kazakhstan, from which new strains of *Chlorella vulgaris* ASLI-1, *C. vulgaris* ASLI-2 and *Oocystis borgei* ATP were isolated, for which optima of industrial cultivation were established. The presence of allelopathic properties in *O. borgei* ATP was revealed.

On the basis of new strains of microalgae *C. vulgaris* ASLI-1, *C. vulgaris* ASLI-2, *Oocystis borgei* ATP, a “PhosphITA” fertilizer with optimal cultivation conditions on a new ITA medium containing phosphorus-containing slags and aeration using a mixture of oxygen with 2.0 ± 0.2% carbon dioxide content, a 12-hour light day and the temperature is +23+270C.

The order of phosphorus solubilization by the developed “PhosphITA” fertilizer has been established and a negative correlation between the indication of solubilized phosphorus and pH values has been revealed. It was revealed that the rate of phosphorus solubilization from sludge is higher than from slag. It was found that phosphorus-containing slag with a content of 7.5 ± 0.5% has a stimulating effect on the development of phytotest plants, acute toxic effects begin with inhibition of the development of vegetative organs at 15.0 ± 1.5% and fatal at 20.0 ± 2.0% and higher.

The scientific basis for the use of phosphorus-containing waste and the composition of strains of green microalgae for the bioconversion of phosphorus-containing waste has been developed.

The degree of validity and reliability of the dissertation work. The results obtained during the study were proved as a result of statistical processing of microbiological, physico-chemical, X-ray, microscopic methods and experimental data. In order to carry out the planned research and biotechnological experiments, special certified methods, GOST standards and standards of the Republic of Kazakhstan were used. The equipment and materials used in the course of the study comply with the requirements of regulatory and technical documents.

The main provisions submitted for protection.

- Distribution and identification of green microalgae in small rivers of southern Kazakhstan and selection of promising strains resistant to high concentrations of phosphorus-containing waste, such as slags, sludge and sedimentary waters.

-The developed composition of the fertilizer “PhosphITA” based on microalgae *C.vulgaris* ASLI-1, *C. vulgaris* ASLI-2, *Oocystis borgei* ATP with optimal conditions for industrial cultivation. The developed ITA nutrient medium for industrial cultivation of microalgae, g/l: phosphorus-containing slags - 10; KNO₃ - 0.10 MgSO₄×7H₂O - 0.01 (patent RK No. 36030).

- Features of phosphorus solubilization by “PhosphITA” alga-fertilization, while the rate of phosphorus solubilization from sludge is higher than in the case of using phosphorus-containing slag. Stimulating effect of a suspension of phosphorus-containing slag up to 7.5 ± 0.5% with an increase in the toxic effect on phytotest plants with a further increase in the content of waste in aqueous solutions.

-The developed technological scheme of low-waste production of “PhosphITA” fertilizer based on liquid phosphorus-containing waste of Kaynar LLP in Shymkent.

Theoretical and practical significance of the work. Strains of *Chlorella* microalgae have been isolated, which, when cultivated in wastewater, effectively accumulate biomass and neutral lipids, which is promising for biotechnological purposes of a wide range. It was revealed that the *O. borgei* ATP strain has allelopathic properties and suppresses the growth of algae, which can be used in the fight against eutrophication of reservoirs.

The composition of the fertilizer “PhosphITA” and the composition of the nutrient medium for the cultivation of microalgae have been developed, which solve the problem of utilization of phosphorus-containing waste and increase the fertility of depleted loamy gray soils in the Turkestan region.

A technological scheme has been developed for the low-waste production of “PhosphITA” fertilizer based on liquid phosphorus-containing waste from Kaynar LLP in Shymkent and the composition of strains of green algae *C. vulgaris ASLI-1*, *C. vulgaris ASLI-2*, *O. borgei* ATP, which allows creating a new production with more than 12 jobs and improving the environmental situation in the industrial region.

The results of the study were introduced into production in the SEC "Nomad agro group", OOEO "Bios", and also introduced into the educational process in the disciplines "Genetics", "Modern achievements of biotechnology".

Approbation of the work. The main results of the dissertation work were reported at international scientific and practical conferences: "Advances in Sciences and Technologies" XXV International Scientific and Practical Conference (Moscow, 2021), "Innovative approaches in modern science" CXXVIII International Scientific and Practical Conference (Moscow, 2022), "Experimental and theoretical Research in Modern Science" LXXXII International Scientific and Practical Conference (Novosibirsk, 2022).

Publications on the topic of the dissertation. According to the research results, 3 articles have been published in the collections of international conferences, 4 articles in the journals of the Scopus database, 2 articles in the journals recommended by the CCSON, 1 patent for an invention.

Personal contribution of the dissertation. All experimental studies were conducted with the personal participation of the author. The author independently analyzed the literature data on the topic of the study, processing and analyzing the results of the study, writing and formatting the manuscript of the dissertation.

The connection of this work with other research works. The research was carried out within the framework of the projects of the Ministry of Education and Science of the Republic of Kazakhstan: "Biologics of a wide spectrum of action" (2011- 2014), "Development of a method for cleaning polluted waters using macroscopic filamentous green algae" (2015-2017), "Optimization of the functioning of decentralized biological wastewater treatment systems in the pharmaceutical and cosmetology industry by selecting the composition of phytomeliorant plants" (2021), "Technology for obtaining organic fertilizers based on the utilization of phosphorus-containing and carbon-containing waste to increase the yield of vegetable crops cultures of the Turkestan region" (2022-2024).

The structure and scope of the dissertation. The dissertation contains 118 pages, titles of 51 figures, 15 tables, 2 appendices and 167 literary sources.