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REMEDIATION OF CONTAMINATED SOILS APPLICATION OF BIOSORPTION TECHNOLOGIES

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Biosphere pollution with various xenobiotics, i.e. substances foreign to natural environment which do not belong to the natural biotic cycle has been steadily growing over the past decades. They include: chemical pollutants such as herbicides, pesticides, chemical production wastes; oil and oil products; heavy metals; harmful products of human daily living activity, etc. In fact the composition and origin of this pollution are quite variable. Pollution and excessive use of pesticides has led to sustained poor performance and poor quality of agricultural products. Accumulation of pesticides after their functional application leads to the death of soil organisms adversely affects the soil-forming process and degrades soil fertility. Therefore, in recent years, scientists raised the issue of improving the ecological health and productivity of land through the use of various types of sorbents, including composite materials with microbiological and microelement additives [1].

Natural remediation of ecosystems from pollutants is carried out with the help of complex processes in biocenosis containing associations of microorganisms. Interest to the existing microorganisms in the soil associations operating in natural substrates, and their use in biotechnology appeared relatively recently. In nature, microorganisms exist in the composition of consortium, associations with each other and other organisms, showing intrinsic functional activity. However, the high level of pollution reduces self-cleaning function. Therefore of particular importance to address environmental issues have gained biotechnological methods using microorganisms useful qualities. To expedite the processofcleaningecosystems fromtoxicantsappropriate to useofmicrobialpreparations - artificially createdbased onmonoculturesof bacteria andmicrobial communitiesthatare able to oxidizepollutant.microbial.

Institute of Sorption and Problems of Endoecology NAS has significant achievements in the development of biotechnological methods using sorption technologies for cleaning soil and water pollution from toxic chemicals (pesticides). Reclamation of soil contaminated of pesticides by method of detoxification of pesticides with using microorganisms - destructors, immobilized on the surface of specialized composite sorbents has several features. Sorption technologies are promising for isolation and use of useful natural microflora consisting of bacterial cultures of individual microorganisms or their communities in creating effective sorption and biological systems for pollutant detoxification.

To obtain sorption biocomplex which is in its own way a catalyst in biotechnological processes requires a thorough study of the effect of the sorbent surface nature – MO carrier: on the pattern of the microbiological component sorption: on preservation of its catalytic activity. This allows to predict the future use of this material.

For a sorption biocomplex to be competitive in natural conditions an appropriately targeted sorbent carrier and bacterial component need to be properly selected.

As for the bacterial component, in nature bacteria are extremely numerous and have flexible metabolism allowing them to live in any biosphere.

Whether xenobiotic destructive strains, when used, still survive in soil and preserve their destructive activity in natural conditions is the question yet to be answered. Destructive microorganisms of various ecotoxicants are widely spread in nature. In soils repeatedly exposed to pollutants the population composition of their microflora changes.

Natural microflora has a broad stable biodestructive potential and is environmentally safe. Microorganisms capable of decomposing a number of xenobiotics were obtained by isolation and enrichment of microbiota using inoculum taken from the environment. Natural populationis well adaptedto the environmental conditions, being highly stable and synergetic it allows more efficient use of a target substance as the only source of nutrition and re-entry of the microorganism into its original environment ensures its selective advantage.

Sorption methods are broadly used to isolate and concentrate bacterial cells. The use of sorbents that adsorb biomolecules well and easily precipitate out of the solution speeds up the process of isolation of promising natural bacterial cultures capable of using one or another pollutant. Sorbent is a matrix carrier for bacterial cultures immobilization mimicking their natural existence since in nature MO attaches to the particles of soil, sludge or dust. An effective sorbent carrier should have targeted adsorption capacity, be non-toxic, technologically advanced, easy to mix, economically efficient, and, most importantly, biocompatible. Each case requires perspective sorption matrix to be selected to immobilize MO of a certain type. Biomolecule (ligand) immobilization is carried out either by adsorption due to hydrophobic interactions or by a covalent bond formation.

Carbon materials and composites with mineral and vegetable certain materials are promising for use as a carrier for microbial cells. Suchsorbents, carriershave a high chemicalresistance, mechanical strength, ion exchange propertyessufficientpermeability towater and othersubstrates, biocompatibility andprocessability. Unlikethe mainsorbentscarriersis thattheywas based oncheap and affordableproducts of pyrolysisplant wasteagriculture andwood processingproduction, andenriched with microelementszeolitesand someother examples ofnatural aluminum silicatesand oxides.

We have conducted research on the allocation of natural microbiota, its adaptation to the assimilation of pesticides. Studied the use of pollutant derived microbial complex task orientation in the culture medium and immobilization to the sorption matrix. Sole carbon and energy source is a pollutant. The capacity to destroy the contaminant microorganisms immobilized on the sorbent and in the free state, was considered as an example chlorine and phosphorus pesticides.

Theoretical and experimental studies and obtained generalized depending on the accumulation of biomass during the decomposition of a pesticide under the action of MO- destructors as culture fluid and immobilized on the sorbent. The reproduction character of microorganisms destructors differs for free bacterial groups and those immobilized on the sorbent.

Adaptation phase and the beginning of reproduction last much longer when a primary culture fluid is used for biotreatment of a pollutant compared with a fixed culture on a sorbent surface. Experimental conditions, namely temperature, initial pH and initial number of microorganisms are identical. The same relationship is observed at the exponential growth phase characterized by a constant cell division, as well as at the stationary phase characterized by the product accumulation and the concentration reduction of the substrate pollutant consumed by MO. Die off phase is characterized by MO viability loss. On a bioactivated sorbent die-off phase occurs at much greater accumulation of sorbent [2].

Research results allowed us to offer the sorptive drug based on the composition of carbon, mineral and vegetable sorption materials with immobilized microorganisms - destructors natural association with a wide range of destructive actions regarding pesticides of different chemical composition [3]. This makes it possible to achieve the end result of clearing natural environments from pesticides to MACs. In addition, natural mycobiota combined with composite by sorbent ensures in soils nitrogen fixation (nitrogen-fixing bacteria) and increase the availability and digestibility of trace elements.

Field tests biosorption material ("AGRODETOKS") in the experimental field showed that the use of the composite sorbents with immobilized microorganisms on its surface of microorganisms - destructors pesticides isolated from natural ecosystems can achieve the amount of degradation of pesticides up to 90% during the growing season. In plants grown qualitative parameters above 1.5-2 times, which confirms the possibility to get organic food, which in developed countries qualify as "organic".

The sorption technology are perspective for the allocation and use of natural microflora, consisting of associations of microorganisms-destructors directed action, while creating of biosorption complexes for cleaning and remediation of soils contaminated by toxicants. Using composite sorbent based on carbon, mineral and plant material as a carrier for immobilization of microorganisms allows the creation of effective sorption- biological systems for detoxication of pesticides. Important, that the biocomplex had advantages in natural conditions. Natural population is well adapted to the environmental conditions, being highly stable and synergetic it allows more efficient use of a target substance as the only source of nutrition. Re-entry of the microorganism into its original environment ensures its selective advantage. Such sorptive biocomplex is competitiveness in vivo. Immobilization of microorganisms - destructors sorption on the surface of the matrix increases the destructive action of microorganisms.

BIBLIOGRAPHY

1.Gusev M.V.Microbiology: the textbook / 4th ed.Moscow: Publishing Center"Academy", 2003. 464p.

2.Khokhlov A.V. Biocarbonsorbent of complex action / LAB "LAMBERT":Academic Publishing. 2014.108 p.

3.Khokhlov A.V., Strelko V.V.,Khokhlova L.I. Biosorption material of destructivetypefor the purificationof waterand soilenvironmentsfrompesticides / Patentof Ukraine

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