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Bioremediation of Soils of the Kola Peninsula (Murmansk Region) Polluted with Oil Products

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This report presents the results of applying various bioremediation methods of soils contaminated with oil products in the northern regions on the example of the Murmansk region. We investigated the effectiveness of plants, fertilizers, sorbents and microorganisms to purify oil contaminated soil in the field model experiment and under condition of real long-term contamination.

The upper limit of potential self-purification of mineral soils in the region is determined: 15 g/kg for light oil, 5 g/kg for dark oil with a contamination depth of no more than 10 cm. Mineral and organic fertilizers enhanced the activity of native hydrocarbon-oxidizing microorganisms and the efficiency of purification of contaminated soil has increased by 20-50%.

A group of plants with high resistance to oil pollution in the Arctic was selected for the phytoremediation of soils: reed canary grass (Phalaroides arundinacea), meadow fescue (Festuca pratensis), timothy grass (Phleum pratense), and blue-lyme grass (Leymus arenarius). The possibility of using rolled lawns (phytomats) on the basis of a soil-substitute vermiculite substrate for the bioremediation of oil-contaminated soils was studied. At the initial stages of growth, when plants are most vulnerable to environmental toxicity, the development of the root system occurs in the substrate. Subsequently, the plants roots penetrate deeper, and the phytomate is fixed on the surface of the contaminated soil.

Microbial associations based on native microbes accelerate the decomposition of oil products in soil by 10–20% in the Albic Podzols of the Kola Peninsula. The fungi Penicillium canescens st. 1, P. commune, P. ochrochloron, P. restrictum, and P. simplicissimum st. 1 isolated from contaminated soils were selected for this study as the active destructors of oil hydrocarbons. The efficiency of microbial associations (bacteria Pseudomonas fluorescens, P. putida, P. baetica, and Microbacterium paraoxydans and fungi Penicillium commune, P. canescens st. 1, and P. simplicissimum st. 1) for soil purification from oil products was evaluated. The bacterial–fungi association was more effective; the content of oil product has reduced by 82% over 120 days.

Five strains of hydrocarbon oxidizing microscopic fungi (Tolypocladiun inflatum st. 49, T. inflatum st. 30, Meyerozyma guilliermondii, st. KA17, st. KA22-4) and two strains of hydrocarbon oxidizing bacteria (st. 7, st. 3) were selected to purify coastal zones of the Barents Sea. The strains showed a high ability to destroy oil products by 60-78% in a laboratory experiment.