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NEW TECHNOLOGIES IN OIL AND DRILLING WASTE DISPOSAL

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Due to the increase of oil production volumes, oil and petrochemicals are recognized as the planet's priority pollutants. With the expansion of oil-contaminated soil areas, conditions of soil cover deteriorate and the balance of the ecosystem is disturbed. New biotechnologies for petroleum industry waste disposal represent a new ecological method of restoration of the natural balance.

At the present moment, greening is a developing trend in the petroleum industry. The increase in well drilling and the sophistication of drilling fluids bring about new combinations of chemical agents that can interact or react with earth materials in downhole conditions, which can result in formation of toxic compounds. This is why development of toxicity test techniques for oil and drilling fluids and petroleum industry waste disposal are the tasks of vital importance [1].

One of the priority areas in restoration of oil-contaminated ecosystems is the use of biotechnology. Use of these technologies for waste disposal is the friendliest towards natural environment.

Mechanical and physical techniques cannot ensure the complete removal of oil and petrochemicals from the soil, while the natural process of waste degradation in the soil is extremely time-consuming [4].

Remediation of oil-contaminated soil is currently carried out using techniques that are, as a rule, inadequate and lack sufficient scientific justification. Current procedures of response to oil spills in soils frequently lead to irreversible destruction of the topsoil, for example, during oil burning, covering contaminated areas with earth, and disposal of contaminated soil in landfills.

In order to facilitate bioremediation of ecosystems with various degree of contamination in different climatic zones, microbial bio-products are introduced into ecosystems, and technologies of producing these bio-products and using them to remediate water and soil resources contaminated by petrochemicals and other waste are being developed.

Eco-biotechnology is represented by bio-products for environmental protection and remediation: *biosorbents*, *biocatalysts*, *bioremediation agents*, and technologies for bioremediation of contaminated environments and processing of waste and byproducts in industry and agriculture [3].

There are two types of *bioremediation* agents: universal (suitable for specific tasks and specific contaminations) and authentic (highly efficient, especially composed of native microbial strains of particular epitope, and bioengineered if required) [2].

In general, it is possible to accelerate the remediation of oil-contaminated soil by microorganisms in two ways: increasing the metabolic activity of the soil's natural microflora by changing the relevant physical and chemical parameters of the environment (some well-known agricultural practices are used for this purpose), or introducing active oil-degrading bacteria that are specially selected from the natural microflora into the contaminated soil.

According to their purpose, bioremediation agents are divided into biostimulants (native microorganisms), bio-additives (decomposer organisms), and photostimulators (rhizospheric bacteria).

Biological treatment (bioremediation) of contaminated terrestrial and aquatic ecosystems can be performed using biological products and biosorbents produced both in Russia and abroad.

Biosorbents are active substances used for removing oil spills.

Their main parameters are oil biosorption capacity (oil, kg./sorbent, kg.), flotability per month, and propensity for reduction of interfacial tension.

Biosorbents allow to completely remediating soils and bodies of water of oil pollution without any harm to the environment while ensuring active decomposition of petroleum hydrocarbons by microorganisms both on the surface of water and below it, as well as in bottom deposits and coastal zones.

When biosorbents are introduced to a petrochemical spill, it initially maintains its shape and then proceeds to break into separate patches as oil gets absorbed by the sorbent granules and forms into separate fragments. The fragments are removed mechanically or are left afloat. After a couple of weeks, depending on the temperature of water, the oil-degrading bacteria of the sorbent oxidize oil's hydrocarbon into carbon dioxide and water.

During oil spill response operations, use of biotechnologies is considered the best way of accident recovery and oil collection. The issue of their efficiency remains open due to the abundance of factors that influence the use of biosorbents in the open sea. The mechanism of the "water-oil-ice" interaction is currently not understood and studied well enough, as is the "ice-oil-water-biosorbent" interaction.

There exists a large number of microorganisms that are able to process hydrocarbons of various classes.

Among the decomposers there are 45 strains of bacteria belonging to Pseudomonas, Bacillus, Mycobacterium, Micrococcus, Achrobacter, and 4 strains of Candida and Cryptococcus yeasts. A technique has been developed to select the most active strains that are able to decompose different fractions of oil.

These are the microorganisms that serve as a basis for producing various bio-products and developing new techniques for selecting the most active strains that are able to decompose different fractions of oil and petrochemicals in order to remediate contaminated soils, natural bodies of water, aquatic areas, industrial wastewater, and rehabilitate contaminated territories. The best known products are Lenoil and Devoroil.

During biotechnological remediation of oil-contaminated soil, the decomposer organisms selected from the natural biocenosis exclude the unpredictable ecological effects that are possible when using foreign microorganisms. Other advantages include the low cost of decomposer bacteria cultures and the ability to use them for cleaning up pollution with oil and petrochemicals (petrol, kerosene, diesel fuel, etc.) in all parts of the Earth [2].

This way, development of technologies for reclamation of soil and water contaminated by oil and petrochemicals using decomposer microorganism cultures derived from native microflora becomes a priority trend in petrochemical waste disposal.

In order to select the correct method of using biotechnology and oil-contaminated waste disposal technique, it is necessary to carry out preliminary biological assessment and chemical analysis of the waste.

The advantage of biotechnologies over conventional methods of petroleum industry waste disposal lies in their mild effect on the natural environment. Biological processing of toxic oil compounds and their byproducts can not only cause the transition of waste from one class into another, but also result in non-hazardous substances and recyclable materials. Zero waste production is a new step in environmental education, and many countries all over the world already understand the importance of this trend for preservation of our planet and well-being of the population.

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RHEOLOGICAL PROPERTIES OF CRUDE OILS IN YAREGSKOYE AND YARAKTINSKOYE OIL FIELDS

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For the extraction and the pipeline transport of oil with anomalous properties, detailed information about the features of its rheological behavior at different shear stresses in a predetermined temperature range is required. Non-Newtonian properties are typically discovered in high-viscosity oils with a high content of asphaltene, resin and paraffin. As study objects, oil with a high content of resin and asphaltene (Yaregskoye oil field) and oil with high paraffin content (Yaraktinskoye oil field) were used.

After carrying out experimental researches on a rotary viscometer and producing typical rheology curves of shear stress (τ) versus shear rate (γ), it was found that oil with a high content of resin and asphaltene has pseudoplastic properties and can analytically be described by Ostwald De Waele equation: $\tau = K \cdot \gamma^{n}$, and its effective viscosity