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USING BIOSURFACTANTS IN PHYTOREMEDIATION OF SOIL POLLUTED WITH PETROLEUM HYDROCARBONS

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Abstract

Phytoremediation ecotechnologies based on joint application of ecological potential of plants and microorganisms are actively used for remediation of chemically contaminated environment. However, the efficiency of phytoremediation is sufficiently decreased due to the low mobility of pollutant molecules. The similar cases appear while dealing with long-term contamination of soil with crude oil, when light hydrocarbons of oil have volatilized and the remaining components with long chains form resin mass are hardly removable.

The problem could be solved via improvement of phytoremedition technologies by application of surface-active substances, capable to emulsifying resin mass, and improving its penetration to plants. The biosurfactants produced by specially selected microorganisms fit this purpose. The advantages of biogenic surfactants if compared with their synthetic analogues are their higher surface activity, efficiency at extreme temperatures and pH, biodegradability, and positive influence on plants growth.

In the presented work the results of using microbial surfactants rhamnolipids, rhamnolipid biocomplex PS and trehalose lipids) in model phytoremediation experiment targeted to clean the soil artificially contaminated with crude oil (the level of initial contamination by total petroleum hydrocarbons (TPH) equals 27 500 ppm) have been shown.

Preliminary selected according to oil degradation ability bacterial consortium (consisting of oil-destructor strains of *Pseudomonas* and *Bacillus*) and alfalfa (*Medicago sativa*) were applied in the experiment.

Mass of the contaminated soil samples was equal to 7.5 kg. Suspension of bacteria (1.2 l) and solutions of biosurfactants (100 mg/500 ml) were introduced to each soil sample at the beginning of the experiment. On 14th day after inoculation plants were sowed in soil samples. The experiment was continued during 3 months at greenhouse conditions. The chromatographic analysis of contaminated soil samples after remediation process have shown that as a result of abiotic and biotic processes (volatilization of hydrocarbons and their assimilation by aboriginal microflora) TPH content in contaminated soil was decreased by 45% during the three months. The use of plants without bacterial consortium and biosurfactants resulted in soil decontamination by 63%. Plants and bacteria jointly were capable to assimilate 82% of oil hydrocarbons. The application of biosurfactants resulted in further intensification of bioremediation process: in cases of trehalose lipids and rhamnolipids the maximum cleaning effects by 96 and 98%, correspondingly are achieved. The results clearly indicate the efficiency of using biosurfactant preparations for the enhancement of phytoremediation process.