

Reclamation of oil polluted soil

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More than 200 thousands km of main oil pipelines and 350 thousands km field pipelines are used on Russian territory. These field pipelines see about 40 thousands of emergencies happening every year, most of them involve some oil spill. Oil losses constitute 25 million ton every year. Biota are depressed, food chains, physical, chemical and biological properties are disturbed in the polluted soil. Spilt oil is adsorbed into the ground and stays in its top level. Volatile oil fractions leave the soil through vaporization while heavy fractions, tars, and asphaltens are not weathered out and slowly trickle deep down under the topsoil level and may reach ground water table. Hence there is a demand to develop new high effective technologies of cleaning, environment recovery and recultivation of oil-polluted lands and water bodies. [1] Scientists are continuing to develop new methods trying to find the most feasible solution for different conditions.

In case of an oil spill toxic substances will trickle deep down the earth, potentially reaching ground water reservoirs and polluting surface waters. They cannot accumulate because they are reprocessed by different microorganisms in the soil. But if oil reached the ground waters or to the open air, oil cannot be reprocessed in a natural way because number of microorganisms is not high enough there. When soil is polluted, oil covers pieces of ground and oxygen cannot come in. Without enough oxygen aerobic bacterial population is triggering. [2], [3]

Soil reclamation is a process to revive the soil capacity lost due to human activity. One method of fast and effective transformation of toxic substances into non-toxic ones is biological detoxification by microorganisms. Below we consider two such methods.

Patent by I. Arhipchenko and others [4] pertains to biotechnology and microorganisms industry. It is linked to a new culture of microorganisms that destroy oil and petroleum products. *Rhodococcus globerulus* strain H-42 was obtained from *Rhodococcus globerulus* strain TCH-OK which was subjected to cosmic radiation. This newly-discovered mutant variety allows speeding up of oil elimination. Culture liquid after the growing phase was consolidated by separation to concentration 10^9 – 10^{10} cells/ml.

For bio treatment of water surfaces the culture liquid was diluted to concentration 10^6 cells/ml with freshwater and then 0,2 % of ammonium nitrate phosphate was added as a fertilizer. The prepared solution was distributed over the soil, 10 lit/m². In 10–15 days there is a second bio treatment of the polluted soil. In case high level of pollution, in 10–15 days after second there is a third bio treatment. In case of overdrying, soil is watered and pronged, if it is possible. Pilot testing was assayed on the surface of 1–2 m² of the extremely polluted soil, where the level of pollution was determined.

Method of biological reclamation oil polluted soil in natural settings of high north, that is in patent A. Ukrainev and others [5], is based upon chalking and application of mineral fertilizers. Then the polluted areas are treated with biological preparation that destroys oil, it includes microbial fertilizer-carrier in terms of the fermented agricultural wastes and bacterial culture, immobilized inside the carrier. After that the plot is seeded and harrowed. Treatment by dry culture preparation is done once in a season during warm period on the basis of 100 g of culture per meter squared. Bacterial culture of *Bacillus cereus* strain 3K is used in concentration of 10^{12} cells/g of carrier. The culture is scattered during seeding or before it. The harrowing depth is 5–10 cm. Mineral fertilizer “Bamil” or “Omug” are used as microbial fertilizer-carriers. “Bamil” is produced from dried biomass of active silt microorganisms or from pig farming waste and contains native microorganisms: *Bacillus pumilus*, *Bacillus sphaericus*, *Micrococcus hylae*, *Arthrobacter viscosus*,

Bacillus licheniformis. “Omug” fertilizer is produced from dried poultry excreta and also contains native microorganisms: *Clavibacter michiganese*, *Bacillus amyloliquefaciens*, *Micrococcus varians*.

The comparison of these different methods of reclamation of oil polluted soils shows that the most success variant is patent by A. Ukrancev and others [5], which use chalking and application of mineral fertilizers. This method exploits the natural peculiarities of high north soils which is a good factor even if it used in another region because the user may not fear sudden change of weather. In the same time the *Rhodococcus globerulus* H-42 strain needes special storage conditions to keep the strain active. That strain was obtained by selection from another strain which was subjected to cosmic radiation and has narrow temperature window for activity, thus this method has inherent climatic limitations.

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