Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07857, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07857
EGU General Assembly 2008


# Dynamics of dehydrogenase and catalase activities in oil-polluted soil, as studied with two bioremediation techniques

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Two bioremediation techniques were used for cleanup of southern chernozemic soil from recent and long-term oil pollution: introduction of oil-oxidizing *Dietzia maris* strain ÀÌ3 and stimulation of natural microbial communities. The dynamics of the number of oil-oxidizing and heterotrophic microorganisms, decrease in the pollutant content, and dehydrogenase and catalase activities were estimated when comparing the efficiencies of these bioremediation technologies.

It was shown that the recent oil pollution promoted a 1.5-fold decrease in dehydrogenase activity in the soil. This parameter, in the treatment using the introduced strain, corresponded to the norm after 30 days and was a little lower than the initial value in the treatment with stimulation. Maximal development of the introduced strain was observed in the same period (from $10^7$ to $3.73\times10^9$ cells $g^{-1}$ of soil). The decrease in petroleum hydrocarbons in this soil was twofold higher than was that after stimulation of the natural microflora.

Both cleanup techniques achieved identical decreases in the content of petroleum hydrocarbons after 90 days; however, dehydrogenase activity was 2.49 $\mu$l Í$_2$ $g^{-1}$ of soil·day$^{-1}$ in the treatment with the introduced strain, this being fourfold greater than the activity in soil under stimulation conditions and twofold greater than the activity in uncontaminated soil. Catalase activity was not observed at any point in the treatment

with stimulation, and after the strain had been introduced, low catalase activity values were found at the end of the experiment.

The dynamics of dehydrogenase activity in the long-term polluted soil showed similar trends in both treatments, increasing 1.7-fold after 7 days and decreasing toward the end of the experiment. In this soil, *D. maris* ÀÌ3 developed less effectively, its numbers being increased only 10-fold at 7 days after introduction into the soil. Catalase activity after 7 days was 6.3 and 4.9 $\mu$l of 0.1 N $KMnO_4$ 2.5 $h^{-1}$ in the soil with and without the strain, respectively. The growth of catalase activity continued for an additional week in the case of stimulation of the native microflora, and when *D. maris* ÀÌ3 was introduced, the increased values were retained until the end of the first month. Subsequently, catalase activities were similar in both treatments. Similar results for the decrease in the content of the petroleum hydrocarbons were observed throughout the experiment.

Thus, the change in dehydrogenase activity in remediated soil, along with the basic criteria, is a significant parameter of bioremediation efficiency. This parameter can be used as an indicator of the soil cleanup process.