Fact Sheet

RHIZOSPHERE-ENHANCED BIOREMEDIATION

PROBLEM

Natural attenuation is often the most cost-effective treatment for remote contaminated sites. In cold regions, however, natural attenuation is often inhibited by lack of nutrients coupled with a short growing season. To cost-effectively treat hundreds of petroleum-contaminated sites in remote, cold regions, we need to identify means to enhance natural attenuation processes.

SOLUTION

Rhizosphere enhancement of natural bioremediation can provide a low-cost and effective treatment for petroleum-contaminated soils. Rhizosphere-enhanced remediation capitalizes on naturally occurring soil processes that are enhanced in the rhizosphere (the zone of soil adjacent to plant roots). The roots exude excess carbon compounds produced by plants; those carbon compounds then stimulate the soil microbial population near root surfaces, which in turn stimulates bioremediation.

For remediating petroleum-contaminated soils, the mechanism is not increased plant uptake, but increased microbial numbers and activity and exploitation of that increased microbial activity to enhance biotreatment. The technology requires minimal equipment and costs for mobilization, operation and maintenance, and demobilization.

A main constraint to date is collecting defensible field data for use in developing easy-to-apply guidelines. Because of treatment rates and spatial variability of contaminants in the soil, appropriate field sampling techniques and analytical strategies are the keys to successful representation of the situation in the field.

RESULTS

In laboratory experiments at CRREL and field studies in Fairbanks, Alaska, we have demonstrated successful plant germination, plant growth, and root intrusion in both crude-oil- and diesel-contaminated soil. Cold-tolerant grasses, especially annual ryegrass and Alpine bluegrass, appear to germinate and grow relatively well in petroleum-contaminated soils.

We also found greater bacterial numbers in the rhizosphere soil compared to unvegetated bulk soil, as well as an increase in the percentage of soil microorganisms that can degrade model organic contaminants. Most significantly, vegetated soil treated with nutrients increased remediation rates and reached a lower endpoint concentration than did unvegetated or untreated soils.

We are now extending our demonstrations to other locations, to test appropriate plants species, and to develop more widely applicable guidelines for use. We have seeded and fertilized cold-tolerant grasses in POL-contaminated soils at three geographically diverse sites in Alaska: Annette Island (southern), Galena-Campion (interior), and Barrow (north slope). The technology will be evaluated in terms of its overall cost, regulatory acceptance, and practicality of implementation. We will also be comparing different sampling procedures to evaluate sampling methods for measuring rhizosphere and nutrient effects.

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