Engineered Bioremediation - Technology of Choice for Treatment of Aquifer Contaminated with Oil Pollutants

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Introduction

Aquifers contaminated by petroleum hydrocarbons is a major problem worldwide. During the exploitation, processing, accidental spills, transport, distribution, storage and use of crude oil and its products, these may be released into the hydrosphere in an uncontrolled manner. Bioremediation is a method of reducing petroleum pollution from environment which has been widely used in the last years. It is a process which is based on the natural capacity of microorganisms to decompose toxic waste from the environment into harmless products. Engineered bioremediation is a preferable approach because it involves modification of polluted sites at desirable time intervals to accelerate the degradation of contaminants. This modification is achieved by biostimulation (providing nutrients, electron acceptors, biosurfactants, biopolymers, and slow-release fertilizers for increasing the microbial activity), and bioaugmentation (addition of microbial biomass, preferably a consortium, for its greater degradation capacity, synergistic performance, and co-metabolic events).

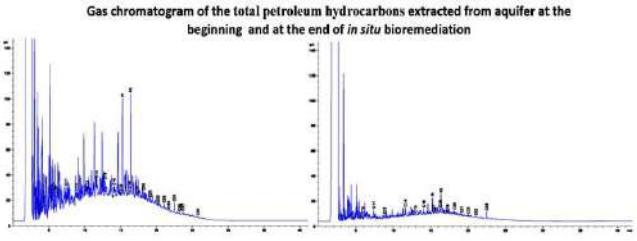
Material and Methods

This paper presents the engineered bioremediation of aquifers contaminated by petroleum hydrocarbons, in the process which lasted for 12 months. The contaminated area was located near the city of Belgrade (Serbia), on the terrace sediments of the Sava River. This remediation treatment was performed within the closed bipolar system (one extraction and two injection wells), with adsorption in the external unit.

In situ engineered bioremediation was started with addition of nutrients from the reservoir through the injection well into the aquifer. Together with nutrients, in order to stimulate chemical oxidation and increase oxygenation of the aquifer, H_2O_2 was added. Finally, zymogenous hydrocarbon-degrading microbial consortia was added via the same injection well. The zymogenous consortium of hydrocarbon-degrading microorganisms initially contained $7x10^9$ CFU dm^{-3} microorganisms. Reinoculation with the prepared microbial consortium was performed at 30-day intervals. Recirculation was achieved by extraction of contaminated groundwater using the extraction well followed by filtration through the filtration/adsorption column filled with natural inorganic hydrophobic adsorbents and finally injection to the subsurface through the injection well. During water filtration, a biofilm of zymogenous microorganisms was formed on the material of the adsorption column.

Conclusion

During the engineered bioremediation, the content of petroleum hydrocarbon in aquifer decreased by 88% of the initial level. This indicates that the process was performed successfully.



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