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Remediation of Soil from Oil Refinery by Combination of Abiotic Oxidation and Biodegradation

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Extended Abstract

Petroleum compounds are the most abundant environmental pollutants. Despite their fair biodegrability, their biological elimination from soil can face many problems such as low bioavailability, high toxicity and nutrient lack inhibiting microbial metabolism, or insufficient counts of degrading microorganism. The aim of this work was to eliminate high concentration of old petroleum pollution (up to 60 000 mg/kg dry weight) from a soil originating from oil-refinery by combination of advanced oxidation processes and biodegradation using augmented degrading microorganisms. The process was monitored using determination of C_{10}-C_{40} aliphatic hydrocarbon concentration, determination of phospholipid fatty acids, determination of activities of extracellular enzymes and genetic analyses.

Preliminary biodegradation tests were focused on the simple treatments (single initial bioaugmentation, nutrient addition etc.). A 3-month initial lag of C_{10}-C_{40} aliphatic hydrocarbon elimination and following predominant zero-order kinetics indicated the lack of degrading microorganisms. Freshly added diesel fuel was biodegraded significantly faster as compared to original pollution. Together with lower yield by non-exhaustive extraction using n-butanol and 1-propanol:water (1:1 v/v) this indicated expected low bioavailability of old pollution.

To overcome these problems pre-oxidation of soil using Fenton reagent or peroxodisulphate was carried out prior to biodegradation and bioaugmentation was carried out regularly using higher inoculum concentrations. Results of this experiment in several variants are presented.