

BIOREMEDIATION OF SOIL CONTAMINATED BY PETROLEUM BYPRODUCTS: EVOLUTION OF ORGANIC CONTAMINANTS AND EFFICIENCY OF THE TREATMENT

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Bioremediation of soils contaminated by petroleum byproducts was carried out in a field experiment during one year. The experiment was carried out on an experimental set-up consisting of three concrete basement plots (3.2x3 m) covered by a black tent to avoid meteoric water infiltration. 30 m³ of the polluted soil (24 tons) were engineered on this platform. In order to optimize bioremediation effects, water, oxygen, fertilizers and carbone source were controlled during the treatment period. A 20-25% humidity was maintained by regular watering. Oxygen was brought by periodic turnings of the pile. Fertilization was carried out, consisting of supplying agricultural fertilizers (2.1 g N kg⁻¹, 225 mg P kg⁻¹, 291 mg P₂O₅ kg⁻¹) to obtain a C/N/P ratio of 100/9/1. Fertilization was applied in three times on day 0 and months 1 and 3. Moreover, soil was mixed with straw (15% v/v) in order to increase air diffusion, stimulate micro-organisms growth and improve the soil structure (Chaîneau et al., 2002).

The organic extract was studied in the initial soil and after 1, 2, 3, 4.5, 6, 9 and 12 months of experiment. For each soil, organic extract and asphaltene yields were determined. After maltene fractionation by liquid chromatography, saturated and aromatic hydrocarbons as well as resins were analyzed by GC-MS and IRTF. Asphaltenes were characterized by flash pyrolysis GC-MS. Moreover, each fraction was analyzed by HPLC-GPC in order to follow the molecular weight evolution during the bioremediation.

The characterization of the initial soil reveals that the organic contamination is inherited from petroleum byproducts with an organic extract concentration (OEC) equal to 14

900 mg.kg⁻¹ dry soil. Molecular and spectroscopic analyses show that this pollution corresponds to mono-aromatic polymers close to polystyrene.

During the remediation experiment, OEC decrease progressively until 9 800 mg.kg⁻¹ (Figure 1) and especially hydrocarbons content (~50% of hydrocarbons degraded after 1 years of experiment). However, the efficiency of the degradation is less and less intense with the duration of the experiment as already observed in previous experiment on soils polluted by crude oil (Chaîneau et al, 2002). These authors explain this decrease in efficiency by the production of secondary products (metabolites) affecting the micro-organisms activities. However, the molecular mass distribution deduced by HPLC-GPC and GC-MS reveals a preferential disappearance of low molecular mass hydrocarbons. As a matter of fact, the decrease in efficiency of remediation is rather due to a relative enrichment in macromolecules more difficult to biodegrade.

REFERENCE

Chaîneau C.H., Yepremian C., Vidalie J.F., Ducreux J. and Ballerini D. (2003) Bioremediation of a crude oil-polluted soil: biodegradation, leaching and toxicity assessments. *Water, air and soil pollution*, **144**, 1-4, 419-440.

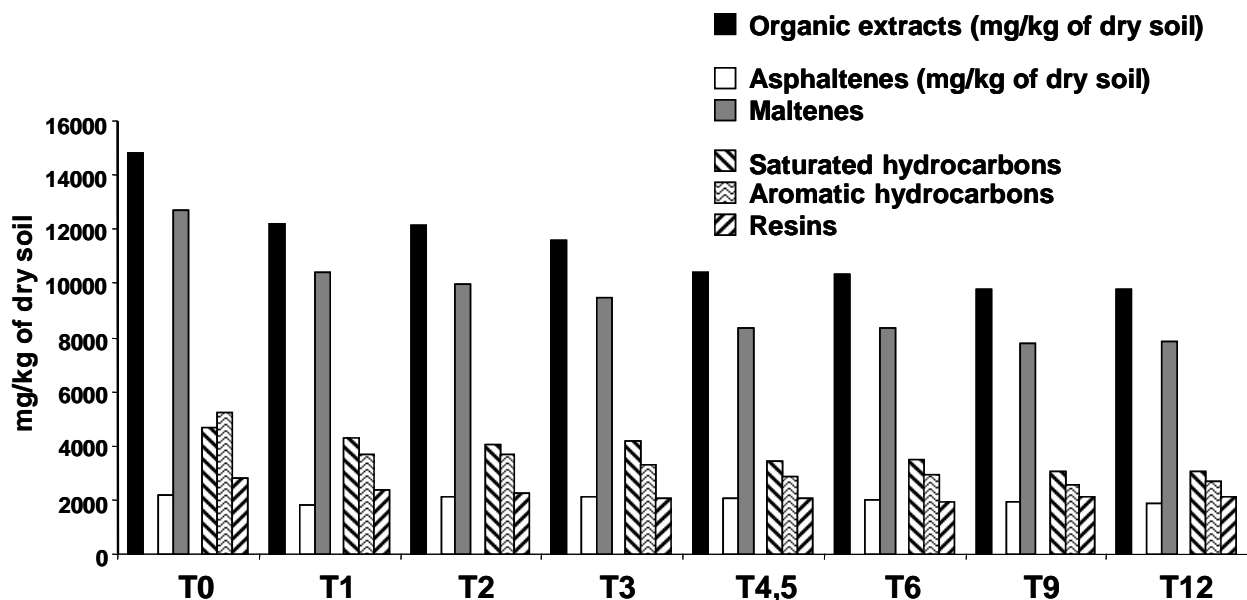


Figure 1. Evolution of organic extracts, asphaltenes, maltenes, resins, saturated and aromatic hydrocarbons yields (in mg/kg of dry soil) during the bioremediation experiment (in month).