

Bioremediation of hydrocarbon polluted soil - Improvement of in situ bioremediation by bioaugmentation with endogenous and exogenous strains

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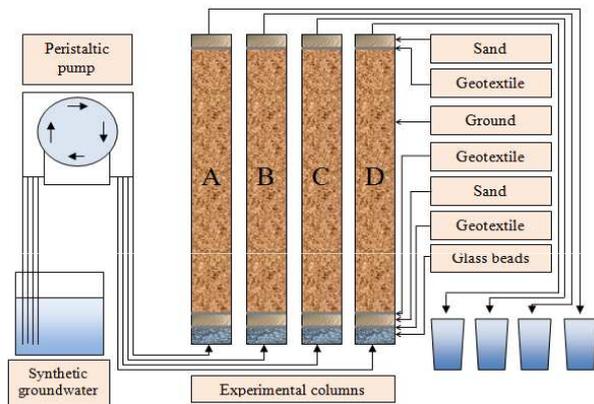
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INTRODUCTION

Petroleum pollution has now become a real problem because hydrocarbons are persistent contaminants in soils and water. Contamination problems increase when ages of relevant facilities, such as oil storage tanks and pipelines, increase over time. The evolution of Legislation concerning soil pollution has led to the need of efficient techniques able to restore the polluted ground. Unfortunately, these techniques are expensive. Bioremediation of hydrocarbon polluted soils has been recognized as an efficient, economic and environmentally sound treatment. Particularly biostimulation and bioaugmentation are being studied in labs. A lot of studies tried to determine which method is the most efficient, but the conclusions diverge. Moreover, conditions are different in labs and contaminated sites.

MATERIAL AND METHODS

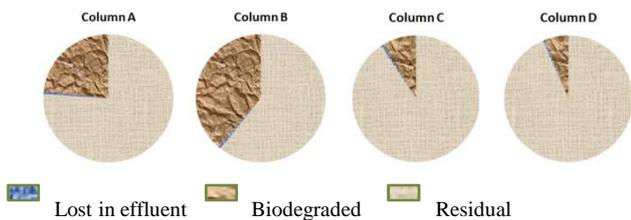
This study simulated in situ bioremediation for diesel-contaminated soil by a column operation. The contaminated soil from La Louvière was packed in the columns with small amounts of sand and glass beads.



Column A simulated biostimulation. An exogenous consortium was added to Column B. Column C was inoculated with an indigenous consortium and an artificial consortium composed of two isolated strains was added to Column D. Consortia are associations of microorganisms.

Hydrocarbon elimination

Hydrocarbons can be eliminated by biodegradation or lost in effluent. The hydrocarbon concentrations were determined by gas chromatography.

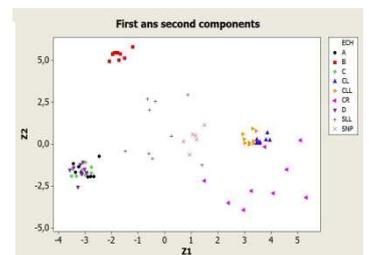


The amounts of hydrocarbons lost in effluent are negligible for each column. However, the exogenous consortium inoculated in Column B leads to the best biodegradation rate. Consequently, the efficiency of bioaugmentation has been demonstrated.

Metabolic profiles

Biolog ECO Micro Plates™ were used to estimate the evolution of metabolic profiles in the experimental columns. The results were analysed through similarity rates and principal component analysis (see the picture below).

The metabolic profile of the exogenous consortium (CL) is isolated from the other consortia. Its evolution (B) is different from the final metabolic profiles of Columns A, C and D, which show a similar evolution. The initial profile of soil microflora (SLL) seems to change during the experience.

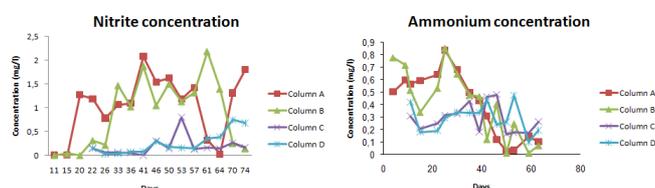


Similarity rates were also calculated between the consortia. The similarity evaluated between the initial consortium and the consortium extracted from Column A is only 61 %. This value means that the metabolic profile of microflora evolved during the experience, as previously said. The similarity between the microflora extracted from the 4 columns was also determined. Columns A, C and D are comparable. Column B shows a low similarity rate with the other columns (39 % with Column A).

RESULTS AND DISCUSSION

Aerobic biodegradation of hydrocarbons

Aerobic biodegradation of hydrocarbons must be encouraged. Anaerobic biodegradation is slower than aerobic degradation and leads to undesired substances. O₂ concentration was measured daily in water getting out of the columns. It was always more than 0,5 mg/l, which is the limit of risk of anaerobiose. Nitrite and ammonium concentrations were also measured two days a week. Nitrites come from nitrate reduction when oxygen is lacking. Ammonium results from a different way of metabolism (ammonification) when oxygen is lacking too. Nitrite and ammonium concentrations were always less than 2,5 and 1 mg/l, respectively.



CONCLUSION

Bioaugmentation seems to be a good way to treat hydrocarbon pollutions and could be applied on a large scale.