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Modeling and qualitative study of diesel biodegradation using biopile process in sandy soil

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The purpose of this study was to restore diesel-contaminated soil using biological process and then to study microbial metabolism followed by biodegradation of hydrocarbons. To reduce the processing time of soils biopile process, initially a part of the contaminated soil was enriched with nutrients. The determination of the optimal conditions for biodegradation of contaminants in soil after excavation (ex situ) was performed. Biopile technique was able to restore the diesel-contaminated soil. Indeed, after 76 days, the soil was decontaminated with total petroleum hydrocarbon (TPH) removal rate of about 85%. This performance was achieved during the first twenty days of treatment. The simple fractions (alkanes and aromatics) were firstly degraded followed by the complex fractions.

1. Introduction

The major problem encountered in soils polluted by petroleum products is reaching groundwater sources and affecting surface water quality. The devastating effects of the oil industry on the environment have been noted during the accidents (spill, leak etc.) and the discharges causing sometimes irreversible ecological disaster. Decontamination of polluted soils requires the physicochemical and biological processes involvement.

The fate of the petroleum products released into the environment is mainly governed by the biodegradation process. The existence of this phenomenon depends on the inherent biodegradability of the pollutant but also on the presence of appropriate microflora in soils and groundwater (Cunningham et al., 2004; Mrozik and Piotrowska-Seget, 2010; Bacosa et al., 2012; Chemlal et al., 2012).

Despite a frequent, multiple use of certain physicochemical methods in the restoration of polluted soil by petroleum products (such as: vitrification, washing, heat treatment etc). The bioremediation of soils remains the most efficient method. The main advantage of bioremediation is its reduced cost compared to conventional techniques. Moreover, it may lead to complete mineralization of the pollutant into inorganic minerals, H_2O, CO_2 (aerobic) or CH_4 (anaerobic). Bioremediation can deal with lower concentration of contaminants where the cleanup by physical or chemical methods would not be feasible (Haritash and Kaushik, 2009; Perelo, 2010; Partovinia et al., 2010).

The effectiveness of bioremediation depends on the physicochemical characteristics of the treated soil and the environmental conditions required by the microorganisms involved in hydrocarbons biodegradation (Costes and Druelle, 1997; De la Torre et al., 2006; Chemlal et al., 2012).

In our previous work (Chemlal et al., 2012), obtained results demonstrated that at laboratory scale, the ability of indigenous microorganisms to degrade the diesel. It was demonstrated that the biopile process was effective and applicable to Algerian soil and induce an increase in microbial activity, which results in a major decontamination.

Exhibiting removal efficiency of diesel of about 70% just after 40 days for the Biopile was obtained. In contrast, natural attenuation decontamination of the soil was too long and needed one year to reach considerable yield.

This work involves the implementation of bioremediation of a polluted soil with diesel using biopile process during 76 days. The kinetics of microbial growth and the diesel oil biodegradation were studied.

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