REMEDIATION OF SOIL CONTAMINATED WITH PETROLEUM HYDROCARBONS

Submitted By

Amr Hamed Gouda Abd El Rahman

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Ain Shams University, 2008

A thesis submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Science

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معالجة التربة الملوثة بالهيدروكربونات النفطية

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Content

List of Tables

List of Figures

List of Figures

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ABSTRACT

Soil mineral oil contamination causes many problems for the surrounding environment. Many methods are carried out to treat oil contaminated soil however ex-situ or in-situ. Phytoremediation and bioremediation are in-situ remediation methods that are less expensive and less disruptive than ex-situ approaches.

In this work, phytoremediation using alfalfa, bioremediation using *Pseudomonase putida* and a combination were investigated as in-situ remediation options for sandy soil contamination with petroleum hydrocarbons. Sandy soil samples and hydrocarbon contaminants were collected from a gas production plant located in Port-said city. The levels of hydrocarbon contamination in soil were 2.5%, 5% and 10%. All experiments were carried out in pots. The remediation efficiency was evaluated with time by the quantitative analysis of total petroleum hydrocarbons (TPH) concentration in soil throughout the experiments after 15, 30, 60, and 90 days from the start of the experiments.

Results showed that the ability of the used methods to reduce hydrocarbon concentrations from soil for all concentrations of contamination compared to control samples during 90 days or less of the remediation processes. The different treatments were able to reduce the level of contamination in the sandy soil with efficiencies up to a maximum of 99.9% for phytoremediation, 98.7% for bioremediation, and 99.0% of combination method, for TPH initial contamination of 5%, 10%, and 2.5% (w/w) respectively.

1) Introduction

Petroleum hydrocarbons are naturally occurring chemicals used by humans for a variety of activities.

Natural gas, crude oil, tars and asphalts are types of petroleum hydrocarbons ultimately composed of various proportions of alkanes, aromatics, and polycyclic aromatic hydrocarbons.

Petroleum hydrocarbons comprise a diverse group of chemicals with variable physical and chemical characteristics. They are often divided into two main categories: gasoline range organics (GRO) and diesel range organics (DRO). The characteristics of petroleum range from moderately hydrophobic low-molecular weight to hydrophobic high-molecular-weight compounds.

Soil hydrocarbons contamination has become a global environmental problem, with a wide variety of contributing sources, and it takes place from many sources such as production, transportation pipelines, tankers, refineries, storage tanks, and accidents. **U.S. EPA (1988)** reported that 75% of 2 millions underground storage tanks are leaking significantly.

Many oil spill disasters all over the world result in contamination of soil with petroleum hydrocarbons over long areas that caused dangerous effect on the ecological system such as the oil spill during Iraqi-Kuwait war in 1991, **UNEP (1993)** reported that about 16 km^2 of Kuwait desert were contaminated with 25-50 million barrels.

Exposure of organisms to various concentrations of hydrocarbons contaminated soilresponses results in bad effects ranged from simple bioaccumulation up to death of biota. Hydrocarbon contaminated soil causes hazard and physiological damage in exposed animals.

It is now widely recognized that soil contamination with petroleum hydrocarbons is a potential threat to human health that forced the efforts in the last centuries to find efficient, low cost and environment friendly techniques for soil remediation.

Phytoremediation and bioremediation are promising in-situ methods for the degradation of hydrocarbons in soil that are efficient, cost-effective, and environment friendly technologies.

Although phytoremediation requires longer time than other technologies, it is considered a cost effective strategy with many positive environmental effects for remediation of hydrocarbons contaminated soils if imminent pathways for human exposure and risk are not an issue.

The current research aims at studying the performance of different in-situ remediation methodsfor the removal of total petroleum hydrocarbons (TPH) from sandy soil at different levels of contamination. These methods include remediation using plant, bacteria or plant and bacteria.