Factors affecting the Success of Bioremediation of Petroleum Hydrocarbons in Contaminated Soils

By Brent Perz

ABSTRACT

Bioremediation is a relatively new technology that is being used is being used today to clean up soils that are contaminated with petroleum hydrocarbons as well as many other hazardous chemicals. Bioremediation is the use of microorganisms or substrate to stimulate microorganism activity to reduce the concentration, toxicity and mobility. The first step of bioremediation is to predict if the hydrocarbons in the contaminated soil can successfully be biodegraded and reduced. Various experiments of soils from field sites are used to determine if a specific soil will benefit from bioremediation. Nutrient availability has a large impact on the effectiveness of bioremediation. To increase the nutrient availability nitrogen and phosphorus can be added to a soil. The temperature also has a large effect on the extent of degradation that can occur. Different types of petroleum hydrocarbons are degraded easier than others. Also bioremediation of a soil contaminated by hydrocarbon mixtures will be discussed because of the similarity to an actual situation in nature. Indirect bioremediation and the bioremediation of hydrocarbons on a commercial sorbent will also be discussed. Three different soils form Eureka, Nunavut will be assessed for their bioremediation treatability.

KEYWORDS

Bioremediation, biotreatability, petroleum hydrocarbons, microorganisms, bioavailability

INTRODUCTION

Today petroleum hydrocarbon spills and pollution are an environmental concern for the entire world. Bioremediation is a cost a cost effective clean-up technology that is able to treat soils containing oil, degradable hydrocarbons and indigenous microorganisms able to breakdown these chemicals (Nocentini et al., 2000). The biotreatability of a soil must be assessed to determine if the soil is eligible for bioremediation. Success of bioremediation depends on the time the pollutant has been in the soil, the weathering, hydrocarbon structure and availability of the chemical in the soil.

Another aspect of bioremediation that is important is the nutrient and temperature requirements. First of all nutrients must be available for a microorganism to be active and degrade petroleum hydrocarbons. The temperature if low enough can also limit the rate of degradation. This becomes an issue in areas that are relatively cold all year round.

The effectiveness of bioremediation also depends on the type of petroleum hydrocarbons in the contaminated soil. The Hierarchy of Biodegradability ranges from n-alkanes which are degraded very easily to aromatic steranes which are very difficult to degrade (Moldowan et al., 1992). Crude oil as well as many other petroleum liquids contains mixtures of hydrocarbons. These mixtures contain alkanes, alkenes, aromatics and polar compounds that can be easily biodegraded. The effectiveness of bioremediation depends on soil and hydrocarbon source type, concentration of total hydrocarbons and oxygen and nutrient availability (Huesmann, 1997).