BIOREMEDIATION OF CONTAMINATED SOIL

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ABSTRACT

The release of contaminants into the environment is inevitable. Contaminants are released through manufacture and use of products and as a result of treatment and disposal of wastes. Upon release to the environment, contaminants move and respond to a number of interrelated natural and man made factors.

Penta-chloro-phenol (PCP) is one such contaminant that has been released into the environment and is known to have serious long term environmental effects. The objective of this study was to determine the effectiveness of biological processes to remediate soil contaminated with Penta-chloro-phenol (PCP). This thesis reviews mechanisms by which soil is contaminated, processes available to remediate soils, and in particular, process requirements for successful bioremediation.

The abilities of bacteria to degrade PCP from soil contaminated with PCP was evaluated. Solid phase and slurry phase experiments were examined for their effect on PCP concentration over a four month period at the Department of Technology, Massey University. The objectives of this study were (1) To determine if aeration and inoculation of soil in-situ could produce significant removal of PCP. (2) Determine the effect of concentration on bioremediation rates. (3) Compare in-situ treatment with bio-slurry treatments.

The experiments showed that it is possible to remove up to 95 % of PCP from contaminated soil by inoculation with bacteria. Inoculum size and aeration were shown to be critical factors in affecting the rate of degradation. The larger the initial inoculum the greater the rate of degradation. Without aeration the inoculum was unable to significantly degrade PCP. The bio-slurry confirmed that PCP could be removed readily from soil to an aqueous state. In an aqueous state PCP is degraded at a faster rate than when it is incorporated into the soil matrix.

The results of this work is to show that soil rehabilitation by way of biodegradation is a feasible and attractive process.

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1. INTRODUCTION

The total land area on Earth is approximately 14500 million hectares of which 13250 million hectares is ice free. Land use patterns are mainly determined by interactions between climate, geography, geology, human and economic processes. Land can be categorised into four categories: arable and permanent cropland, permanent pasture, forests and land for general use including land unused in urban areas, and waste and barren land. The latter encompasses a third of the earths surface, of which more than 3,000 million hectares is suspected to be exposed to chemicals[1].

All categories of land are open to pollution and consequently are hazardous to the environment, attention has been focussed on land categorised under general use because this represents a more direct risk to human health and thus receives the greater publicity in the case of incidents.

Contaminated land results from a wide range of human activities including industrial discharge processes and the disposal of waste. New Zealand has an advantage over old world countries such as the United Kingdom and United States of America in that there is not a legacy of nearly two centuries of industrial operation. Despite this New Zealand has sites which are as heavily contaminated as some overseas industrial sites. Remedial technique experience with respect to contaminated land is brief, dating back only to the 1970's. Its is important in the long term to develop new and effective means of soil decontamination.

Bioremediation of soils is a novel technique that is slowly gaining acceptance despite having significant cost advantages over other remediation technologies. The main reason for this lack of acceptance being a reluctance on the part of engineers to utilise a treatment option that was generated outside their field.

The aim of this thesis is to add to this body of knowledge