LATEST DEVELOPMENTS IN THE PHYTOREMEDIATION OF METAL CONTAMINATED SOIL AND GROUND WATER

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ABSTRACT

Numerous industrial, construction, and military practices have contaminated soil and water with heavy metals. High concentrations of metals are dangerous to human health as they disrupt the metabolic process and produce toxic effects in the lungs and central nervous systems (Iskandar, 2001). Remediation of heavy metal contaminated sites is particularly difficult as metals cannot be degraded easily like organic compounds and the cleanup generally requires their removal. Current remediation methods applicable to metal contaminated soils are expensive, environmentally invasive and labor intensive. Phytoremediation is a low cost, environmentally safe, human health and environment protective technology and thus has been proposed as alternative to the expensive conventional methods. Phytoremediation takes advantage of the fact that living plants can be compared to a solar driven pump, which can extract and concentrate particular elements from the environment (Raskin and Ensley, 2000). Many experiments performed to date in laboratories demonstrated the efficiency of phytoremediation technology and its advantages over the conventional methods for remediating metal contamination. The successful transfer of phytoremediation from the laboratory to the field is a crucial step in the development of this technology. Different strategies such as using chelators to enhance metal solubility, combining phytoremediation with other technologies and genetically transforming plants are being used to enhance the performance of the technology.

KEYWORDS

Phytoremediation, heavy metals, phytoextraction, rhizofiltration, hyperaccumulators

INTRODUCTION

The industrial revolution has resulted in the release of large amounts of potentially toxic heavy metals like arsenic, cadmium, lead, mercury and nickel into the atmosphere posing a threat to human health. Many metals are essential trace elements for cells, but are toxic to humans and plants at higher concentrations. The conventional methods for remediation of metal-contaminants includes pump and treat systems for water and soil washing, excavation, and reburial for soil. These methods are very expensive methods and also disturb the soil structure during the remediation process. About 35% of $7 to 8 billion spent per year by United States for remediation is being spent for metals remediation (Pilon-smits and Pilon, 2002). Many sites around the world still remain polluted with toxic levels of trace elements with no remediation in sight because it is too expensive to remediate them with the available conventional methods. In the United States alone, more than 50,000 metal-contaminated sites need to be remediated (Pilon-smits and Pilon, 2002) and the list of toxic metal contaminated sites is growing larger every year. A new technology that uses the plants' natural processes to remove, degrade or sequester metal contamination, called phytoremediation, is gaining worldwide attention as an alternative to the expensive conventional methods (Suthersen, 2002). Compared to conventional methods, phytoremediation is a potentially cost effective method and as it does not involve excavation of soil in the contaminated site, it may preserve the soil fertility and structure. Phytoremediation takes advantage of uptake capabilities of root system of plant, along with