

Chapter 9

Role of Rhizoremediation in Decontaminating Some Hazardous Pollutants

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ABSTRACT

Rhizoremediation is a natural biological base, multifactorial operation treatment method which highly depends to environmental factors especially in terrestrial environment as operation of remediation process. Interaction and relationship between microbial community and plant roots is specific attraction and advantages of this advanced treatment method. Decontamination efficiency and time could be highly manageable by operation and rhizoaugmentation. Rhizoremediation is advanced compact combination of phytoextraction, phytovolatilization, phytotransformation and phytostabilization. High efficiency of pollutants removal, adaptive and wide range of operation and augmentation factors cause of emerging application of this for biodegradable organic compounds and heavy metals. Selection of suitable plant and joining them with comfortable microbial couples is a function which can plane simultaneously removal system. This chapter will present an overview on PAH, TPH, PCB and heavy metal removal and mechanism of decontamination, plant selection and augmentation process.

INTRODUCTION

Sustainable development requires the serious national and international development and wide promotion of environmental care and management as well as a constant search for eco-friendly techniques to treat terrestrial and aquatic habitats contaminated by rapid increasing anthropogenic activities. Traditional methods for waste management are switching a problem to another side or aspect of environmental

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footprint. Microorganisms are the baseline of bioremediation of pollutants and plants can be considered as a leader in phytoremediation process. Interdisciplinary cooperation between microorganisms, plants, augmentation factors and operational factor are essential to earning higher efficiency in a shorter time. More than one century ago a German scientist Prof Hiltner in 1904 coined the term “Rhizosphere” for distinctive plant root’s environment.

Good success in rhizoremediation has been attempted to suitable organism selected for this process. Survival of selected bacteria in contaminated soil and concentration on a specific generation of degrading bacteria to converting them to commercial application. Plant root colonization can be inoculated by selecting degrading bacteria. Host plants with effective, supplying rhizosphere in one hand and concentration of contamination in other hand, are the main aspects of rhizoremediation. Genetically modified microorganisms can be applied after application of wild types of microorganism. Some of the well-known organic compounds such as polycyclic aromatic hydrocarbons (PAH) (Maila et al., 2005; Techer et al., 2012), total petroleum hydrocarbon (TPH), (Wojtera-Kwiczor et al., 2014), polychlorinated biphenyls (PCBs) (Mackova et al., 2009; Slater et al., 2011), trichloroethylene (TCE), (Schöftner et al., 2015; Yee et al., 1998) have been degraded and removal of high toxic heavy metal (Masood & Malik, 2013) in extremely high concentration, have been associated by rhizoremediation. Environmental impacts of hydrocarbons could be managed by this treatment method. Improving fertilization of soils with nitrogen fixing is traditional application of this green technology.

Finding a couple partners contain plant and bacteria in order to form a combined degradation society is the fundamental step to effective pollutant removal from contaminated soils. Interaction between plant and microbial community will present decontamination process as well as environmental condition for growth and development. Because of a high correlation between organic pollutants degradation and volume of carbon dioxide evolved, CO_2 as a mineralization production through the rhizoremediation can be used for collecting efficiency of organic compounds degradation furthermore, the positive correlation between pollutants degradation and CO_2 evolving recognized as dehydrogenase activity index (Namkoong et al., 2002).

CONCEPTUAL OVERVIEW OF RHIZOREMEDIATION

Rhizoremediation is a specific phytoremediation which rhizosphere of plants drive main action on remediation of contaminations by preparing suitable condition for especial microorganisms. Knowledge triangle of bioremediation could be arranged by efficiency of removal as: natural attenuation < phytoremediation < rhizoremediation (Prasad, M. N. V., & Prasad, R., 2012). Figure 1 illustrate rhizoremediation as microbial augmented phytoremediation and phytoremediation. Soil is the media that rhizoremediation carried out there and the main contaminants which degraded through the rhizoremediation are organic compound. High hydrophobicity of organic compounds is the major limitation that prohibits their entrance to plants. The main mode of the remediation body in rhizoremediation are not plants, meanwhile, bacteria are the practical, active organs which do the remediation process. Plants are solar-powered pump for microorganisms to arranging contaminant degradation. These cooperation cause to production of suitable substrates for microorganisms and performing pollutants. In fact, microbial community in symbiotic life with root of plant species could be considered as effective combination of living organisms for enhancing the process of contaminated media. Amino acid, sugar and organic acid supplied by plants

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