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ABSTRACTS

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Bioremediation of Soils and Waste Dump Sites Contaminated with Chloroorganics and Other Pollutants

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Public concern over the harmful effects of man-made chemicals on humans and their environment has largely focussed on a few classes of compounds. Of these, chlorinated aromatic compounds, pesticides, nitroaromatics, dyes, petroleum wastes, etc. are most spectacular. These compounds enter the soil environment via various industrial and agricultural activities.

It is highly imperative to eliminate or detoxify these chemical residues from the environment. Elimination through microbial degradation is considered to be very efficient and economical due to the biochemical versatility of microbes (Bartha, 1986). However, often translation of laboratory processes into field conditions fails due to several reasons. The major factors responsible for this are the heterogeneity of both natural microflora and the contaminating chemicals. Nevertheless bioremediation technologies have been proved to be effective in the destruction of a wide range of environmental contaminants. Effective degradatin of polycylclic aromatic hydrocarbons (PAHs) in contaminated land from industrial sites by autochthonous microorganisms have been demonstrated by Weissenfels *et al.* (1992), but in the absence of high soil organic matter. The biodegradation in different soils was found to differ significantly even under similar conditions of temperature, nutrients, O_2 supply and occurrence of PAH-degrading bacteria. Polychlorinated biphenyls (PCB) biodegradation has been shown to occur under both aerobic and anaerobic conditios (Abramowicz, 1990). Two complementary PCB-degrading bacterial strains ENC 307 and ENV 360 have demonstrated up to 80% destruction of PCB in site soils containing 300 ppm Arolor 1248. These organisms have been shown to degrade higher-chlorinated PCB cogeners by using two distinct and complementary dioxygenase enzyme systems (Abramowicz, 1990). An enhanced aerobic biodegradability by increasing survivability of PCB-degrading bacteria and using co-cultures has also been demonstrated (Adriaens and Focht, 1990). The biodegradation of chlorophenols, common environmental contaminants originating mainly from their use as wide-spectrum biocides in industry and agriculture has been demonstrated. The microbial consortium was able to degrade PCP and PAH in a contaminated soil from wood preserving facility (Otte *et al.*, 1994). Degrading of PCP in soi by *Phanerochaete chrysosporium* and *Lentinula edodes* was found to be optimal at soil moisture content of 47% at 25°C and pH 4.0 (Okeke *et al.*, 1996). Microbial decontamination of technical chlorophenol containing soil by composting has been studied (Valo and Salonen, 1986). Pertsova *et al.* (1984) have shown the degradation of 3-CBA in soil, inoculated with *Ps. putida*. Focht and Shelton (1987) have reported the mineralization of 3-CBA in a sandy-loam soil upon the addition of *Ps. alcaligens* C-O. All isomers of monochlorobenzoate, 3, 4-dichlorobenzoate, have been shown to be degraded in a soil slurry with high organic matter conent (Brunsbach and Reineke 1993). The sensitivity of germination of seeds of tomato and tobacco to 3-CBA and 4-CBA was overcome by inoculating *Ps. aeruginosa* strain 3m T into 3-CBA and 4-CBA contaminated soil (Ajithkumar *et al.*, 1998).

Among pesticides, studies have been made on the microbial degradation of hexachlorocylohexane (HCH) in paddy fields under flooded and upland conditions (Sethunathan *et al.*, 1998). Soil submergence, coupled with amendments with organic sources such as green manure and rice straw was an effective option for bioremediation of HCH. Similarly, DDT was readily degraded in flooded soil amended with green manure or rice straw (Sethunathan *et al.*, 1998). However, the presence of rice straw or peanut meal retarded the degradation of DDT in soil by *Pseudomonas* sp. DT-ct2 (Manonmani and Kunhi, unpublished data). Chattejee *et al.* (1982) reported 90% degradation of 1000 ppm of 2, 4, 5-T in soil by inoculating a laboratory evolved strain *P. capacia* AC 1100 (now *Burkholderia capacia* AC 1100) within one week. Weekly application of this strain could remove over 90% of concentration as high as 20,000 υg 2, 4, 5-T g^{-1} soil within 6 weeks (Kilbane *et al.*, 1983). Elimination of inhibition of crop seed germination by 2, 4, 5-T through bioremediation of contaminated soil has also been demonstrated (Gangadhara and Kunhi, unpublished data). Thus, bioremediation is gaining importance and is being practiced now throughout the world. However, it is imperative to have a clear understanding of the biotic and abiotic characteristics of the soil before any bioremediation process is started. Though native microorganisms or natural isolates are used in bioremediatin processes, ecological impact of the introduced organisms has to be assessed.

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