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Review Article

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Keywords: Phytoremediation; Contaminated soils and sediments; Polychlorinated Biphenyls (PCBs); Remediation technologies; ; ; Rhizoremediation

Introduction

Polychlorinated Biphenyls (PCB) are common chemical contaminants used from the 1930s to the 1980s globally. PCBs may be found in polluted soils and sediments, although their use has been strictly controlled. e

the surface of the soil and regularly transformed to aerate a combination.

ermal techniques for treatment: ermal desorption is an environmental cleanup technique which uses heat to improve the mobility of pollutants from the sample substratum (typically dirt, sludge, or lter cake) and extract it. As low heat thermal desorption at around 400 °C is used to treat moderate and high organic distillate pollutants such as solvents, diesel, gasoline, and greasing oils [10]. Polluted material is continuously pumped into a rotary kiln heating it

Technology	Develop-ment stage	Field testing	Cost indica-tion	Clean up time	E ectiveness	Social Ac-ceptability	Major Ad-vantages	Possible dis-advantages
Biological treatment Land farming	Practical stage	Limited	Moderate	Fast	Variable	Moderate	Biologi-cal process Amendments can be added to speed the degradation of the con-taminants	Need to control soil condi-tions to optimize the rate of contaminant degradation.
ermal treatment ermal desorption	Practical stage	Substantial	High	Fast	High	Moderate	e e ciency of desorp-tion can be greater than 99%. It is insensitive to contaminant concentration levels in the soil	Special equipment and condi-tions can be necessary to prevent formation of dioxins and furans

Table 2: - Remediation Technologies.

Under anaerobic environments strongly chlorinated PCB can be de chlorinated to form lower chlorinated congeners that are more vulnerable to degradation and o en recognized as the Pathway to Biphenyl Degradation. is involves insertion of O2 into the less chlorinated structure at adjoining unsubstituted carbons, accompanied by ring to create chlorinated benzoate [11].

Phytoremediation: Phytoremediation is based on plant use for the extraction, sequestration and/or detoxi cation of toxins from polluted site. Also in context of PCB there are three major processes involved: soil ingestion and aggregation in tissues of leaves and stems, phytodegradation i.e. enzymatic transition and rhizoremediation crop improvement of microbial function in the root region, increase of bioremediation, development of secondary metabolites such as carbohydrates, proteins, organic acids, di erent exudates and microbial vegetation [12]. Table 3 brie y summarizes these techniques.

Rhizosphere degradation

A root in the rhizosphere activates a multitude of microbial processes.

Technology	Develop-ment stage	Field testing	Cost indica-tion	Clean up time	E ectiveness	Social Ac-ceptability	Major Ad-vantages	Possible dis-advantages
methods								
Biological treatment Bio remediation	Initial stage	Limited	Low to Mod-erate	Long	Variable	High	Natural process. Im-proves the overall qual-ity and tex-ture of soils. Di erent technologies are available and enhance-ments can be made to improve ef- ciency of nutrients phosphorus, chloride etc.	e rate of PCB re-moval may be orders of magnitude slower in nature than as established in laboratory because of mass transfer limitations

e use of this stimulating action to improve the deterioration of various pollutants has been described as "rhizodegradation", "phytostimulation", "rhizoremediation" or "plant-supported bioaugmentation". Multiple plant species will thrive on PCB-contaminated soils and some species adjust the bacterial community composition in favor of PCB deteriorating indigenous communities with high degradation capacity (Figure 4).

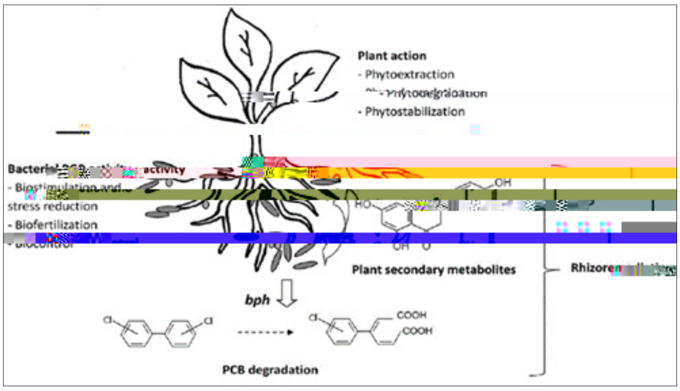

Figure 4: Interaction of Bacterial Species in PCB Contaminated Soil.

Implementation of Remediation Technologies

Since the technologies mentioned aim to kill or transform PCBs, function in somewhat speci c ways and therefore have varying clean up periods, prices, product breakdowns and the climates trikes. ey also have site-speci c e cacy, since each technique focuses on the pollutants (mostly a mixture of them green and inorganic contaminants, particularly though they are polluted just because of speci c congener mixtures of PCBs), age of the waste, soil type and geomorphological conditions, and other polluting variables.

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Biological therapies typically, such as bioremediation; phytoremediation and natural attenuation are long-term techniques that have lower

atmospheric costs and less invasive consequences

More recently, the use of multiple technologies has brought remarkable results in reducing PCBs. Accordingly, the active management of PCBs recognized not only by the introduction of appropriate remediation methods, but also by the general recognition that endorses the impacts of the respective remediation technology on human and environmental safety, which have not yet been achieved. Hence nding e ective