World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:12, 2017

Degradation of Commercial Polychlorinated Biphenyl Mixture by Naturally Occurring Facultative Microorganisms via Anaerobic Dechlorination and Aerobic Oxidation

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Abstract : The production and use of Polychlorinated biphenyls (PCBs), a group of synthetic halogenated hydrocarbons have been restricted worldwide due to its toxicity and categorized as one of the twelve priority persistent organic pollutants (POP) by the Stockholm Convention. Low reactivity and high chemical stability of PCBs have made them highly persistent in the environment and bio-concentration and bio-magnification along the food chain contribute to multiple health impacts in humans and animals. Remediating environments contaminated with PCBs is a challenging task for decades. Use of microorganisms for remediation of PCB contaminated soils and sediments have been widely investigated due to the potential of breakdown these complex contaminants with minimum environmental impacts. To achieve an effective bioremediation of polychlorinated biphenyls (PCBs) contaminated environments, microbes were sourced from environmental samples and tested for their ability to hydrolyze PCBs under different conditions. Comparison of PCB degradation efficiencies of four naturally occurring facultative bacterial cultures isolated through selective enrichment under aerobic and anaerobic conditions were simultaneously investigated in minimal salt medium using 50 mg/L Aroclor 1260, a commonly used commercial PCB mixture as the sole source of carbon. The results of a six-week study demonstrated that all the tested facultative Achromobacter, Ochrobactrum, Lysinibacillus and Pseudomonas strains are capable of degrading PCBs under both anaerobic and aerobic conditions while assisting hydrophobic PCBs to make solubilize in the aqueous minimal medium. Overall, the results suggest that some facultative bacteria are capable of effective in degrading PCBs under anaerobic conditions through reductive dechlorination and under aerobic conditions through oxidation. Therefore, use of suitable facultative microorganisms under combined anaerobic-aerobic conditions and combination of such strains capable of solubilization and breakdown of PCBs has high potential in achieving higher PCB removal rates.

Keywords : bioremediation, combined anaerobic-aerobic degradation, facultative microorganisms, polychlorinated biphenyls
Conference Title : ICEBR 2017 : International Conference on Environmental Biodegradation Rates
Conference Location : Sydney, Australia
Conference Dates : December 04-05, 2017