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ABSTRACT

Bioremediation of Water Contaminated with BTEX, TPH, and TCE

by

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As the industrialization expands, the energy consumption and the use and disposal of chemicals maintain a rapid growth in both Macau and mainland China. Since those industrial products are used widespread, they have become a great potential source of contaminants in the water and soil environments. This contamination results from spills, leaking from transfer lines and storage tanks, and poor environmental awareness. Their toxicities have caused a serious deterioration in the environmental quality and created threats to the human health. This study aims to investigate the bioremediation technology for some major environmental contaminants such as petroleum and chlorinated compounds and to evaluate the degradation capability of indigenous microbial isolates towards those compounds under various conditions, using suspended cultures. Four pure cultures were isolated from soil samples potentially contaminated with gasoline compounds at a construction site near a gas station in Fai Chi Kei, Macau SAR and in the northern part of China (Beijing, and Hebei and Shandong provinces). The effects of different factors, including concentrations, on the removal efficiencies for representative contaminants, like BTEX (benzene, toluene, ethylbenzene, and three isomers of xylene), TPH (total petroleum hydrocarbons), and TCE (trichloroethylene) were investigated. Microbial isolates were first investigated for their removal efficiencies toward BTEX mixture as substrates. Results showed that almost all the combinations tested (BTE*o*X, BTE*m*X, and BTE*p*X mistures) were shown with simultaneous and satisfactory total removal efficiencies up to 98%. In case of TPH provided as substrates, 2,000 mg/L was generally shown with the highest

bio-removal efficiency, while the bio-removal efficiencies decreased with further increased substrate concentrations. When BTEX and TPH were mixed together, BTE*o*X in BTE*o*X/TPH mixture was shown with higher bio-removal efficiencies, while BTE*m*X in BTE*m*X/TPH mixture was shown with the lowest, regardless of isolates. TPH in BTE*m*X/TPH mixture, on the other hand, were generally shown with higher bio-removal efficiencies compared to when mixed with BTE*o*X and BTE*p*X. When these BTEX mixtures present with TCE, the stimulatory effect of TCE toward BTE*o*X bio-removal was observed for BTE*o*X/TCE mixture, while the inhibitory effect of TCE toward BTE*m*X observed for BTE*m*X/TCE mixture. The bio-removal efficiency for TPH was shown lower in TPH/TCE mixtures compared to TPH present alone, implying the inhibitory effect of TCE toward TPH bio-removal. For the mixture of BTEX (at 417 mg/L), TPH (at 2,000 mg/L) along with TCE (at 5, 15, and 50 mg/L), TCE was shown better co-metabolically removed at 15 mg/L, probably utilizing BTEX and/or TPH as primary substrates.