2． 項目簡介

(*項目所屬科學技術領域、主要研究內容、發現點、科學價值、同行引用及評價等內容。*)

This project is divided into two main areas; the first one is the development of biological technologies for the removal of gasoline compounds (BTEX, a mixture of benzene, toluene, ethylbenzene, and xylenes) and chlorinated aliphatic hydrocarbons (CAHs) in contaminated soil and groundwater. The second part is related to the application of biological technologies using fungus, yeast, and microalga, under non-sterile conditions, to remove organics and nutrients while generating renewable energy (biodiesel). In both areas, many procedures have been developed so far using physicochemical technologies, which are expensive to implement at full scale, not environmentally friendly, presents high complexity, and do not result in complete mineralization of the contaminants. Biological technologies have been reported as alternatives due to their cost effectiveness, environmental friendliness, and simplicity. Chlorinated aliphatic and petroleum hydrocarbons are among the most widespread contaminants in subsurface, due to their increased use and accidental spillage. The perception/concept of wastewater treatment plants as waste disposal facilities have been substantially changed nowadays. Instead, it has been considered a resource recovery facility that produces clean water, recover nutrients (nitrogen and phosphorus), and has the potential to reduce the dependence on fossil fuel by the generation of renewable energy. The discoveries obtained so far by the development of biological technologies in this project are very promising for future application on site. A BTEX-adapted bacterium, Pseudomonas plecoglossicida, was isolated from heavily petroleum-contaminated soil and showed its ability to simultaneously remove two representative CAHs (cis-DCE and TCE) and BTEX mixture from soil under aerobic conditions.The current project also demonstrated that scrap tyre is a good candidate to remove BTEX, cis-DCE, and TCE, due to its remarkable sorption property as well as the capability to immobilize microorganisms. Scrap tyres showed high sorption capacities towards BTEX compounds. When microorganisms and tyres were used together, the removal efficiencies for each contaminant in a mixture were higher compared to the treatments where microorganisms and tyres are separately used, suggesting a promising reutilization of waste tyres as sorbents and immobilization matrices for the contaminant removal from mixed waste contaminated environments. Related to the generation of biodiesel while treating industrial wastewater, the current process has two distinct cost advantages comparing to the previous studies due to the no addition of external nutrients to the cultivation medium and the applicability in real wastewater under non-sterile condition. The addition of microalga to the yeast culture and harvesting part of biomass at 72 h further increased lipid yield and lipid content as well as removal of nutrients, compared to the yeast and microalgal pure cultures. The removal of carbamazepine (anticonvulsant) and naproxen (antiflamatory) from synthetic wastewater was successfully obtained in a bioreactor, which was stably operated for almost half a year under non-sterile conditions, immobilized with P. chrysosporium. Especially for the carbamazepine, which is known to its recalcitrant nature, the removal efficiency obtained by this project was very high (around 80%) comparing to the previous studies, where the removal efficiency varied from 0-40%. The results obtained by this project resulted in the publication of articles in international journals (35, cited 505 times) with decent impact factors as well as in the participation in international conferences (75).

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