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Combination of UV-Fenton oxidation process with biological technique for treatment of polycyclic aromatic hydrocarbons using *Pseudomonas pseudoalcaligenes* NRSS3 isolated from petroleum-contaminated site

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Polycyclic aromatic hydrocarbons (PAHs), often from petroleum oil spill, by-product of petroleum refining, incomplete combustion of fossil fuel, leakage in pipeline and underground storage, apart from the effluents of pesticide, dye, pigment, and drug industries, are considered carcinogenic and mutagenic. As the abundance of PAHs in the environment cause adverse effects on humans and ecosystem, the PAHs contamination needs to be monitored and such polluted sites require remediation. Conventional methods available for remediation of PAHs are adsorption, advance oxidation process, electrochemical remediation, solvent extraction, use of synthetic surfactants and photocatalytic remediation. These methods including the alternative Fenton oxidation technology are not only expensive but also produce secondary pollutants. In this study we evaluated the performance of UV-Fenton-PBBR (Packed bed bioreactor) hybrid system for the treatment of polycyclic aromatic hydrocarbons (naphthalene and fluorene). *Pseudomonas pseudoalcaligenes* NRSS3 was isolated from petroleum-contaminated site and immobilized on *Sterculia alata* was used as packing media in the PBBR. The naphthalene and fluorene were taken as model polycyclic aromatic hydrocarbon (PAHs) with initial concentration of 400 mg/L. The optimum conditions for UV-Fenton oxidation were (pH: 3, Fe^{2+}: 2.5 g/L, H_2O_2: 1000 mg/L) for naphthalene and (pH: 3, Fe^{2+}: 3.0 g/L, H_2O_2: 1200 mg/L) for fluorene. The overall maximum removal efficiency of the combined system was found to be 96 and 94.7% for naphthalene and fluorene, respectively. GC-MS analysis confirms the formation of catechol, 1-napthol, salicylic acid and phthalic anhydride as metabolites during degradation process. Biodegradation kinetics of naphthalene and fluorene were studied using Monod model and kinetics constants were found to be μ_{max}: 0.3057 per day; Ks: 112.87 mg/L for naphthalene and μ_{max}: 0.2921 per day; Ks: 114.75 mg/L for fluorene.

Keywords: Biodegradation, Fluorene, GC-MS, Kinetics, Naphthalene, Oil spill, PBBR, Pollution, Remediation, SEM, UV-Fenton