International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations
IASET

ENHANCED BIOREMEDIATION OF SOIL CONTAMINATED WITH ANTHRACENE: OPTIMIZATION OF BIOSTIMULANT LEVELS USING RESPONSE SURFACE METHODOLOGY

AJANI AYOBAMI OLU[1], OGUNLEYEOLADIPUPO OLAOSEBIKAN[2] & HAMED JIMOH OLUGBENGA[3]

[1,2]Department of Chemical Engineering, Ladokeakintola University of Technology, Ogbomoso, Nigeria

[3]Center for Space, Transport and Propulsion, National Space Research and Development Agency, Epe, Lagos, Nigeria

ABSTRACT

Response Surface Methodology (RSM) with Box Behnken Design (BBD) was used to study the effects of time, organic fertilizer (composted from 25% cattle dung, 25% goat dung, 25% pig dung and 25% poultry manure), palm kernel oil (PKO) and commercial activated carbon (CAC) as independent biostimulating agents on the enhanced bioremediation of soil contaminated with anthracene, a polycyclic aromatic hydrocarbon (PAH) consisting of three fused benzene rings. The BBD consisted of three levels and four factors with anthracene reduction and total hydrocarbon utilizing bacteria (THUB) count as dependent variables (responses) in a six week remediation period. The results indicated that the rate of anthracene removal and THUB count generally increased as time progressed and with increase in the level of organic fertilizer, PKO and CAC amended. A statistically significant (P < 0.0001) second-order quadratic regression model for anthracene removal (using design-expert statistical program (v. 6.0.8) with coefficient of determination, R^2 (0.9818 and 0.9866) for anthracene reduction and THUB count were obtained respectively. A multi objective numerical optimization technique based on desirability function was carried out to optimize the bioremediation process. The predicted optimum values of time, organic fertilizer, PKO and CAC were correspondingly found to be 5 weeks and 6 days, 25.87 g, 29.63 g and 29.83 g to achieve 91.04% and 19.57×10^5 cfu/g maximum anthracene reduction and THUB count. In the optimized condition, 90.85% anthracene reduction and 19.49×10^5 cfu/g THUB were obtained respectively. The statistical analyses and the closeness of the experimental results and model predictions show the reliability of the regression model. Thus, biostimulation of indigenous microbial community can enhance remediation of PAH contaminated environment.

KEYWORDS: Anthracene, BBD, Bioremediation, Biostimulating Agents, PAH, RSM, Second-Order Quadratic Regression Model