Optimization of a site-specific biostimulation strategy using response-surface methodology to remediate a chronically hydrocarbon-contaminated industrial soil.

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In present times, contamination with petroleum compounds is one of the most important environmental problems, mainly in industrial areas. The Zárate-Campana petrochemical pole, Buenos Aires, Argentina, has a history of hydrocarbon contamination of more than 100 years, so it is relevant to recover these contaminated areas through the development of site-specific bioremediation technologies that are compatible with the environment. In this work, biostimulation strategy to remediate chronically hydrocarbon-contaminated soil was approached by the addition of nutrients such as nitrogen (N) and phosphorus (P) in order to evaluate the influence of these on the growth of the autochthonous microflora. Therefore, the response-surface methodology as a statistical tool was used to predict the optimum values of N and P concentration with the aim of obtaining the maximum total hydrocarbon removal in the soil. Microcosm systems were carried out into flasks containing contaminated samples belonging to RHASA refinery areas. Different N ($NaNO_3$) and P (Na_2HPO4) concentrations were added to each system according to central composite design, and incubated at 20-25°C for 90 days. Hydrocarbon concentration content was measured by gas chromatography as the response of the model. Results showed that the addition of 0.589 g N/kg and 0.304 g P/kg leads to the highest hydrocarbon removal efficiency, decreasing from 6881 ppm to 728 ppm. In addition biostimulation strategy was compared with natural attenuation and 89.71% of total hydrocarbons were removed when the biostimulation was applied, while in natural attenuation was 72.06%. In both treatments, total aerobic heterotrophic bacteria increased during 90 days, whereas the count of hydrocarbon degrading bacteria remained stable. The biostimulation strategy approached in this work showed to be a promising alternative to remediate the soils of the study site.