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Bioremediation of an industrial soil contaminated by hydrocarbons in microcosm system, involving bioprocesses utilizing co-products and agro-industrial wastes

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Abstract

The present study describes practical implication of bioaugmentation and biostimulation processes for bioremediation of an industrial soil chronically contaminated by hydrocarbons. For this purpose, biomass production of six autochthonous hydrocarbon-degrading bacteria were evaluated as inoculum of bioaugmentation strategy, by testing carbon and nitrogen sources included co-products and agro-industrial waste as sustainable and low-cost components of the growth medium. Otherwise, biostimulation was approached by the addition of optimized concentration of nitrogen and phosphorus. Microcosm assays showed that total hydrocarbons (TH) were significantly removed from chronically contaminated soil undergoing bioremediation treatment. Systems Mix (bioaugmentation); N,P (biostimulation) and Mix + N,P (bioaugmentation and biostimulation) reached higher TH removal, being 89.85%, 91.00%, 93.04%, respectively, comparing to 77.83% of system C (natural attenuation) at 90 days. The increased heterotrophic aerobic bacteria and hydrocarbon degrading bacteria counts were according to TH biodegrading process during the experiments. Our results showed that biostimulation with nutrients represent a valuable alternative tool to treat a chronically hydrocarbon-contaminated industrial soil, while bioaugmentation with a consortium of hydrocarbon degrading bacteria would be justified when the soil has a low amount of endogenous degrading microorganisms. Furthermore, the production of inoculum for application in bioaugmentation using low-cost substrates, such as industrial waste, would lead to the development of an environmentally friendly and attractive process in terms of cost–benefit.