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Bioaugmentation essay on polycyclic aromatic hydrocarbons spiked microcosms with mixture of soil bacteria

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The remediation of polycyclic aromatic hydrocarbons (PAH) in soil is a difficult process due to their high hydrophobicity [1]. Increase of PAH mineralization can be achieved through bioaugmentation, a process based on the input of specialized micro-organisms. Three bacterial strains (Sp-5, Sp-8 and Ac-14) isolated from polluted material and one strain (Sp-C8) isolated from creosote were selected for their ability to degrade phenanthrene or to form a stable emulsification. The aim of the study was to test in microcosms (laboratory soil incubations) the ability of strains mixtures to depollute loam-sandy material spiked with a total of 50 $mg.kg^{-1}$ of PAH (fluorene, phenanthrene, fluoranthene and pyrene) and bioavailable nitrogen, with a factorial plan of 2^4 optimized in 8 modalities. The PAH concentration was determined at 0, 7, 21 and 35 days after 3 days drying prior to HAP extraction procedure. At $t0_{+3}$ the amount in soil of analysed PAH was found in the average ranges of 1.8-0% for fluorene, 31.6-1.6% for phenanthrene, 100-59% for fluoranthene and 100-70% for pyrene. The fluorene degradation rate wasn't further analysed cause of the very low concentration found à $t0_{+3}$. The addition of the strains Ac-14/Sp-5 increased phenanthrene degradation rates compared to the non bioaugmented microcosms with the respective values of 107.6±8.9 and 21.6±50.7 $\mu g.kg^{-1}.day^{-1}$ between 0 and 35 days. The mixture of strain Ac-14/Sp-C8 significatively decrease the fluoranthene degradation rate compared to the non bioaugmented microcosms with the respective values of 552.5±15 and 910,7±51,8 $\mu g.kg^{-1}.day^{-1}$ between 0 and 35 days. The pyrene degradation rate was 348.5±31.2 $\mu g.kg^{-1}.day^{-1}$ without any strain input and significatively increased in the presence of three communities: Sp-C8/Sp-5, Sp-C8/Ac.14 and Sp-5/Ac.14 between 7 and 21 days with the respective degradation rate of 705.2±236.1, 553.5±14.3 and 422.9±10.7 $\mu g.kg^{-1}.day^{-1}$. The microcosms shows that fluorene is degraded rapidly regardless of the modalities tested. The factorial design allowed us to show de bioaugmentation interest of Sp-C8, Sp-5 and Ac.14 on phenanthrene and pyrene degradation. These results show that the factorial designs can be used for the selection of community bacterial composition for PAH biodegradation.

[1] Laor, Farmer, Aochi, & Strom (1998), *Water Res.* 32(6), 1923–1931.