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The role of dissolved organic matter (DOM) from compost in the removal of PAH from contaminated soil: a Fluorescence approach

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As already recognized, the fate of hydrophobic organic pollutants in aqueous environments is strongly affected by organic matter content, and especially by dissolved organic matter (DOM) which can interact with these compounds as a function of their affinity. Therefore, the equilibrium constants of association of compounds with high fluorescence efficiencies, such as polycyclic aromatic hydrocarbon (PAH), with DOM can be measured by means of the fluorescence quenching method, based on the assumption that free PAHs fluoresce in aqueous solution but not if associated with DOM.

The goal of the present study was to determine the partition coefficient of pyrene to dissolved organic matter (DOM) from compost and to evaluate the role of compost DOM in the pyrene removal from contaminated soil.

DOM sample was isolated from the mature compost using a saline solution, and was analyzed by chemical and spectroscopic techniques, in order to evaluate its nature, which resulted closely resembling that of "native" soil humic substances. Aliquots of aqueous solution of pyrene were added to five DOM extracts to give final concentrations of pyrene and DOM of 10 μg L^{-1} and 5-25 mg L^{-1},respectively. The solutions were thoroughly mixed for 5 min, and then allowed to stand for 10 min. Fluorescence intensity (FI) values were collected at 368-370 nm (excitation wavelength, 271 nm), by setting operating parameters previously optimized. Fluorescence measurements were carried out in triplicate both in each DOM solution in the absence of pyrene and in pyrene solutions in the absence of DOM.

The Stern-Volmer equation was used to evaluate the FI values of pyrene in the presence of DOM (FI_{DOM}) and in the absence of DOM (FI_0). A linear plot (r^2 = 0.9957) was obtained by correlating FI_0/FI_{DOM} values versus DOM concentration, with a corresponding partition coefficient of 2.08 x 105 (L kg^{-1}).

The greater value of K_{DOM} with respect to those usually obtained for soil humic components and the strong correlation measured between pyrene dissipation and DOM molar absorptivities underlines a high affinity of pyrene towards the compost DOM, which can be reasonably ascribed to its tertiary structure very rich in hydrophobic cavities and/or pseudo-micelles. Such property appears extremely important in indicating that compost could be used, besides for its amendment capacity, also as a potential tool in contaminated soils remediation.