12.45 Influence of Soil Properties on TiO_2 Nanoparticles Mobility

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Nanotechnology is a new and fast emerging field that involves the design, production and use of structures at the nanoscale. Despite the widespread application of nanotechnology in agricultural, environmental and industrial sectors, a growing concern is about the effects of nanoproducts within different environmental compartments and their likely impacts on human health. In particular, the identification of factors that influence the behavior of nanomaterials in the environment and especially in soil, is decisive in evaluating health and safety issue [1].

Manufactured TiO_2-nanoparticles (TiO_2-NPs) are a good example of a nanomaterial that has been accepted as having many properties useful for a wide range of applications, from 'self-cleaning' surfaces to cosmetics [2]. Several studies have been published on the ecotoxicological effects of nanoscale TiO_2, and in this context the fate and behavior of nanoparticles in soils and groundwater should be investigated in order to assess possible routes of exposure to ecosystems and humans. [3] .

This study aims to provide the baseline information on the processes and phenomena involved in the potential soils' contamination with 'nanowaste'. Thus, to better understand the transport through soils of TiO_2-NPs, laboratory batch and columns experiments were performed using TiO_2-NPs (Sigma-Aldrich, anatase, 25 nm) respectively suspended and loaded in three different types of Italian soils. Aliquots of soil suspensions with and without TiO_2-NPs were periodically collected, and monitored for aggregate size distribution (Mastersizer2000_Malvern) and Ti concentration (ICP-OES_Varian). Ti concentration was measured before and after TiO_2-NPs percolation through the different soils' columns.

Soils analyses showed huge differences in particle size distribution and organic matter content; the cationic exchange capacity was higher in soils richer in clay and in organic carbon, while the values of electrical conductivity show ionic strength higher in the sandy soil suspension and lower in the clayey one.

Experimental results suggest that soil properties affect the behavior of TiO_2-NPs, that could be specially influenced by the organic matter content and the ionic strength. A high presence of TiO_2-NP in both soil suspensions and columns flowthrough was found in the soil richer in organic matter. These results suggest a transport through the circulating soil solution as a consequence of the higher presence of dissolved organic carbon which probably induces a sterically stabilized system of TiO_2-NPs aggregates. Contrarily, a lower concentration of TiO_2-NPs was observed in both soil suspensions and columns flowthrough of clayey soil due to the higher adsorption sites on the clay mineral. The elevated ionic strength of the sandy soil can facilitate the aggregation and the consequent precipitation of TiO_2-NPs confirmed by the lower content of nanoparticles in the soil suspension.

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