Influence of humic acid on the dispersion and transport of $nTiO_2$ particles in quartz sand and ferric oxyhydroxide-coated sand media

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The increasing applications of synthetic nano-materials and our very limited knowledge on their potential environmental and health effects have caused increasing public concerns. Many engineered nanoparticles such as $nTiO_2$ are highly reactive and may cause extensive damage to eco-systems and people's health. To evaluate the scope of nanoparticle contamination in soil and groundwater, information on how nanoparticles are dispersed and transported in subsurface environment is essential.

Natural organic matter such as humic acid (HA) are ubiquitous in soil and groundwater and are frequently reported for effectively stabilizing nanoparticle suspensions by steric repulsion and electrostatic effects. However, the knowledge of how HA influences the behaviors of nanoparticles is not clear. Besides, as most of studies on nanoparticle transport were conducted in well-defined porous media, they do not accurately represent the variety of mineral surface types and surface charge heterogeneities encountered in real soil systems. The objective of this study is to investigate the influence of HA on the stability and transport of $nTiO_2$ particles in ferric oxyhydroxide-coated quartz sands media. Batch experiments indicated $nTiO_2$ adsorption to sands (clean sands and Fe-coated sands) were generally lower with the presence of HA at pH 5 and pH 9. Stability tests showed that $nTiO_2$ suspensions were susceptible to aggregation at intermediate HA concentrations ranging from 0 to 1ppm, which can also be reflected by the changes of zeta potential and hydrodynamic diameters. Transport experiments showed that in the absence of HA, mobility of $nTiO_2$ was lower at acidic pH than that at alkaline pH. A low concentration of HA substantially enhanced $nTiO_2$ transport in an Fe-coated sand column due to increased electrostatic repulsion and steric effects between $nTiO_2$ and the sand grains.

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