



The behaviour, fate and effects of TiO₂ nanoparticles in river streams - a microcosm experiment

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Engineered Nanoparticles (ENPs) provide special and unique properties which are related to their size and surface characteristics. Due to these special properties ENPs have a large range of industrial, commercial and environmental applications. However, these characteristics may appear undesirable as soon as they are active in the wrong place. The most likely aquatic pathway for the environment is expected to be via surface waters. For natural waters the homo- and heteroaggregation of ENPs plays a major role that determines the appearance and fate in the aquatic system. Also the emergence of biofilm in river streams has a positive effect on the fate of ENP in the environment. Possible adverse effects on the biofilm by e.g. photoreactive nanoparticulate TiO₂ are assumed. Hence, the objectives of this study are to test the aggregation behaviour in natural waters and to identify transport mechanisms in river streams and effects of ENPs on target microorganisms.

The presented study has (1) developed and applied a multidimensional test matrix to deduce the colloidal stability and particle/aggregate size of ENPs in the regime of typical environmental parameters (i.e. pH, natural organic matter, main cations and anions). (2) the ENPs were tested at lab scale transport experiments in microcosm flumes under different bed coverage with natural biofilms, (3) transport parameters were determined and (4) effects on the microorganisms within the biofilm recorded.

Under conditions of elevated calcium concentrations (alpine spring water) we could

show that the sediment is the final sink of investigated ENPs. Microcosm flume experiments revealed a direct link between the degree of biofilm coverage and particle retention therein. The magnitude of adverse effects on the microbial community was different for particles with identical particle size (aggregates) but different specific surface area and primary particle size.