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Abstract

Remediation techniques for toxic/persistant contaminants in groundwater are often technologically difficult. Nanoparticles (NP) like nZVI (Zero-Valent Iron) applicable as *in-situ* reduction or oxidation agents for groundwater treatment give promising results. However, they may also represent an additional contamination. This study aims to evaluate the mobility and the reactivity of NP in the presence or absence of biofilm by column transport assays mimicking aquifer conditions, and to evaluate the impact of NP on planktonic nitrate-reducing bacteria.

Biofilms were grown on sand using environmental groundwater samples as inoculum in nitrate reducing conditions. Suspensions of nZVI were then injected into the columns and the outlet Fe concentrations monitored. Biofilm-NP interactions were characterized using SEM/STEM observations of sand after the NP breakthrough. Biofilms were further characterized using molecular approaches.

The predicted travel distances of nZVI are found to be 1.5 to 25 m for a 10 m d^{-1} flow. The presence of biofilm in the column decreased the total porosity of column from 35% to 25%. Though the recoveries of nZVI at the column outlet in the presence or absence of biofilm were similar, the analysis of the sand suggested NP-biofilm interactions (correlation TOC vs Fe concentrations). These interactions are confirmed by the SEM/STEM observations. Results also show a toxicity of NP on planktonic bacteria.

It appears therefore that reactive NP, very useful for *in situ* groundwater treatment, can represent a source of emerging contamination. Indeed, a toxicity of manufactured NPs toward bacteria could be highlighted and interactions between bacterial biofilm and NPs could be observed.

Keywords : Reactive Nanoparticles, Bacterial biofilm, Toxicity, Nanoremediation