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Percent recovery of low influent concentrations of microorganism surrogates in small sand columns

M.E. Stevenson (1) and A.P. Blaschke (1,2,3)

(1) Centre for Water Resource Systems, Vienna University of Technology, Vienna, Austria (stevenson@waterresources.at), (2) Institute of Hydraulic Engineering and Water Resources Managment, Vienna University of Technology, Vienna, Austria (blaschke@hydro.tuwien.ac.at), (3) Interuniversity Cooperation Centre Water & Health, Vienna, Austria

In order to develop a dependable method to calculate the setback distance of a drinking water well from a potential point of microbiological contamination, surrogates are used to perform field tests to avoid using pathogenic microorganisms. One such surrogate used to model the potential travel time of microbial contamination is synthetic microspheres.

The goal of this study is to examine the effect of differing influent colloid concentrations on the percent recovery of microbial surrogates after passing through a soil column. Similar studies have been done to investigate blocking of ideal attachment sites using concentrations between 10^6 and 10^{10} particles ml^{-1}. These high concentrations were necessary due to the detection limit of the measuring technique used; however, our measuring technique allows us to test input concentrations ranging from 10^1 to 10^6 particles ml^{-1}. These low concentrations are more similar to the concentrations of pathogenic microorganisms present in nature. We have tested the enumeration of 0.5 μm microspheres using a solid-phase cytometer and evaluated their transport in small sand columns.

Fluorescent microspheres were purchased for this study with carboxylated surfaces. The soil columns consist of Plexiglas tubes, 30 cm long and 7 cm in diameter, both filled with the same coarse sand. Bromide was used as a conservative tracer, to estimate pore-water velocity and dispersivity, and bromide concentrations were analysed using ion chromatography and bromide probes. Numerical modelling was done using CXTFIT and HYDRUS-1D software programs.

The 0.5 μm beads were enumerated in different environmental waters using solid-phase cytometry and compared to counts in sterile water in order to confirm the accuracy of the method. The solid-phase cytometer was able to differentiate the 0.5 μm beads from naturally present autofluorescent particles and bacteria, and therefore, is an appropriate method to enumerate this surrogate.