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A New Method For Accurate *In Situ* Concentration Measurements In Packed Columns

J.M. Thomas (1) and C.V. Chrysikopoulos (2)

(1) University of California, Irvine, Civil & Environmental Engineering, Irvine, United States (jmthomas@uci.edu), (2) University of Patras, Civil Engineering, Partras, Greece (gios@upatras.gr)

Columns packed with glass beads or quartz sand are commonly used in the laboratory as a model porous medium for groundwater hydrological experiments. In a typical experiment water flows through the packed column in one direction, a chemical, tracer, or colloidal suspension is injected at the influent, and the effluent is sampled at various times and analyzed to determine concentration. Column parameters (e.g., porosity and dispersivity), chemical reactions or dissolution, and hydrodynamic parameters (e.g., interstitial velocity and dispersion) can be determined from effluent concentrations (i.e., break-through curves). This method has two inherent weaknesses. First, for experiments involving seismic or acoustic wave vibration, the packing material can settle, leading to preferential flow paths that develop over time and lead to inconsistent and inaccurate results. Second, measurements of the concentration of a tracer as it flows through the column (*in situ*) cannot be determined. A new method for accurately measuring *in situ* conservative tracer and colloid concentrations in packed columns is presented. The method includes fabricating clear sintered glass-bead-packed columns, taking digital photographs of the column under black light, and determining concentrations by measurement of the fluorescence in the photographs using MATLAB's® Image Processing Toolbox™. The sintering prevents changes in the geometry of the porous medium making it particularly useful for seismic or acoustic vibration experiments. Since fluorescence is measured, the method is limited to fluorescent solute tracers and fluorescent polystyrene microspheres (colloidal suspensions). The method is shown to be as accurate as effluent sampling and allows for accurate *in situ* measurement of tracer concentrations at multiple times. However, the method is not useful for decaying chemical species since each time must be scaled to the known injected mass.