ALUMINOSILICATE-COATED SILICA SAND FOR REACTIVE TRANSPORT EXPERIMENTS

Abstract

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Column experiments with pure minerals as porous medium are valuable tools to deduce mechanistic information on the fate and transport of reactive chemicals in the subsurface. Most commonly, silica sand is used as the model porous medium. Iron oxides have been used as well, mainly in form of iron-oxide-coated silica sand. Clay minerals, however, have only been recently used as model porous media, and the coating of aluminosilicate clay minerals on silica still needs investigation.

The objectives of this dissertation were (1) to develop a methodology to immobilize aluminosilicate clays (Georgia Kaolinite, Texas Smectite, and Morris Illite) on silica sand, (2) to study the hydrodynamic properties of the modified silica sand when packed into columns, and (3) to examine the fate and transport of humic acid in porous media dominated by different types of clay minerals.

We developed a method to immobilize the clay minerals on a silica support. Two

polymers were used as bridging agents between the clay minerals and the silica surface; polyacrylamide (PAM) and polyvinyl alcohol (PVA). More clay could be coated over the silica sand using PVA than PAM. The clay-coated sand obtained by the PVA method was stable against pH variations between 3 to 11, whereas with the coated-sand obtained with the PAM method the clay was not stable and detached above pH 9. These two polymers did not cause a significant change in the electrophoretic mobilities of the minerals, however the wettability of illite and smectite decreased when interacting with the PVA.

Iron oxide-, clay-, and humic acid-coated sand permits to produce a porous material with similar hydraulic conductivity but different surface chemistry. The clay-coated sand caused anion exclusion during transport experiments. The hydrodynamic properties of the coated sand was evaluated using the Peclet number for each porous media. The Peclet numbers for all the porous media were similar.

The interaction between humic acids and clay minerals was studied in dynamic transport experiments, using clay-coated sand. Smectite, illite, and kaolinite were coated on silica sand using the PVA method. Humic acid breakthrough curve reached a maximum of 40% of the initial concentration in the illite- and smectite-coated sands.