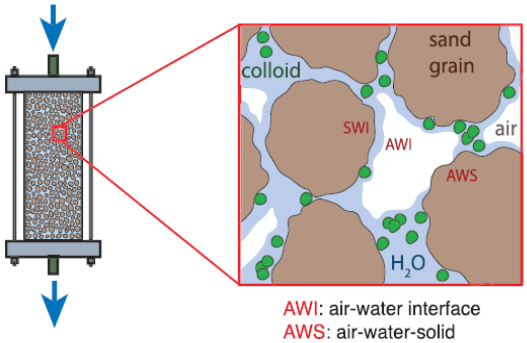
GRAPHICAL ABSTRACT



AWI: air-water interface
AWS: air-water-solid
SWI: solid-water interface

ABSTRACT

The main objective of this study was to better understand the combined effects of ionic strength, and sand grain size on colloid fate and transport in unsaturated porous media. Spherical fluorescent polymer microspheres with three different sizes (0.075, 0.30 and 2.1 μm), and laboratory columns packed with two size fractions of clean quartz sand (0.513 and 0.181 mm) were used. The saturation level of the packed columns was set to 83–95% with solutions having a wide range of ionic strength (0.1–1000 mM). The electrophoretic mobility of colloids and sand grains were evaluated for various ionic strength conditions. The single collector removal and collision efficiencies were quantified using the classical colloid filtration theory. Furthermore, theoretical collision efficiencies were estimated with appropriate DLVO energies using a Maxwell model. The experimental results suggested that the retention of the bigger colloids (2.1 μm) was slightly higher compared to the conservative tracer and smaller colloids (0.3 and 0.075 μm) in deionized-distilled-water, indicating attachment at air–water interfaces or straining. Moreover, relatively smaller attachment was observed onto fine than medium quartz sand. The mass recovery of the 0.3 μm microspheres in NaCl solution was shown to significantly decrease with increasing ionic strength. Both the experimental and theoretical collision efficiencies based on colloid interactions with solid–water interfaces, were increased with increasing ionic strength.