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Effect of sodium and nitrates salts on TiO_2 nanoparticles transport in porous media

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Titanium dioxide (TiO_2) is one of the most widely used nanomaterials, which is introduced into the environment from different activities. The scope of this study was to investigate the effect of solution chemistry on the transport and retention of TiO_2 nanoparticles (NPs) in water saturated porous media, under varying flow rate and initial NPs concentration. More specifically, TiO_2 anatase NPs solutions were prepared at concentrations of 5 and 50 mg/L. The ionic strength (IS) of TiO_2 NPs solution was adjusted to 0, 0.1, 1, 10, 100 and 1000 mM with NaCl or $NaNO_3$. More than 70 flowthrough experiments were conducted in glass columns with diameter of 2.5 cm and length of 30 cm, packed with 2-mm diameter glass beads. The flow rate was adjusted at 1 and 2 mL/min. The TiO_2 NPs solution concentrations were measured by fluorescence spectroscopy at 625 nm.
The breakthrough curves of multiple experiments under the same operating conditions presented significant variation. Generally, the retention of NPs in the column was increased with increasing initial concentration. Furthermore, the retention of NPs was affected by the IS, and was shown to be greater at very high IS values (i.e 100 mM and 1000 mM). As expected, more NPs were retained near the inlet of the column. The retention of NPs was enhanced as the initial concentration increased.