Different Surface Charged Plastic Particles Have Different Cotransport Behaviors with Kaolinite Particles in Porous Media

Meng Li, Lei He, Xiangwei Zhang, Haifeng Rong, and Meiping Tong

The wide utilization of plastic related products leads to the ubiquitous presence of plastic particles in natural environments. Plastic particles could interact with kaolinite (one type of typical clay particles abundant in environment) and form plastic-kaolinite heteroaggregates. The fate and transport of both plastic particles and kaolinite particles thus might be altered. The cotransport and deposition behaviors of micron-sized plastic particles (MPs) with different surface charge (both negative and positive surface charge) with kaolinite in porous media in both 5 and 25 mM NaCl solutions were investigated in present study. Both types of MPs (negatively charged carboxylate-modified MPs (CMPs) and positively charged amine-modified MPs (AMPs)) formed heteroaggregates with kaolinite particles under both solution conditions examined, however, CMPs and AMPs exhibited different cotransport behaviors with kaolinite. Specifically, the transport of both CMPs and kaolinite was increased under both ionic strength conditions when kaolinite and CMPs were copresent in suspensions. While, when kaolinite and positively charged AMPs were copresent in suspensions, negligible transport of both kaolinite and AMPs were observed under examined salt solution conditions. The competition deposition sites by kaolinite (the portion suspending in solution) with CMPs-kaolinite heteroaggregates led to the increased transport both CMPs and kaolinite when both types of colloids were copresent. In contrast, the formation of larger sized AMPs-kaolinite heteroaggregates with surface charge heterogeneity led to the negligible transport of both kaolinite and AMPs when they were copresent in suspensions. The results of this study show that when plastic particles and kaolinite particles are copresent in natural environments, their interaction with each other will affect their transport behaviors in porous media. The alteration in the transport of MPs or kaolinite (either increased or decreased transport) is highly correlated with the surface charge of MPs.