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The Influence of Emerging Organic Pollutants on Bacteria Transport Behavior

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Emerging organic pollutants were widely reported to be present in aquatic environment due to the industrial-scale applications over the past few decades, which have inevitably released into the environment. Perfluoroalkyl acids (PFAAs), with surface activity and thermal and acid resistance, have been widely used as raw material for many products such as stain repellents, food packaging, and firefighting foams. Bisphenol A (BPA) is widely used in various products such as epoxy resins, polycarbonate plastics, food cans, and dental composites/sealants. Since it contains toxic effects, including endocrine disruption, cytotoxicity, genotoxicity, reproductive toxicity, and neurotoxicity, the presence of emerging organic pollutants in the environment may be harmful to humans and animals. Therefore, the fate of emerging organic pollutants in natural environments has drawn significant attention. The significance of perfluorooctanoic acid (PFOA) and BPA on the transport and deposition behaviors of bacteria (Gram-negative Escherichia coli and Gram-positive Bacillus subtilis) in quartz sand are examined in both NaCl and CaCl2 solutions at pH 5.6 by comparing both breakthrough curves and retained profiles with emerging organic pollutants in solutions versus those without emerging organic pollutants. All test conditions are found to be highly unfavorable for cell deposition regardless of the presence of emerging organic pollutants; however, 4.78%−55.48% cell deposition is observed depending on the conditions. The cell deposition may be attributed to micro- or nanoscale roughness and/or to chemical heterogeneity of the sand surface. The results show that, under all examined conditions, emerging organic pollutants in suspensions increases cell transport and decreases cell deposition in porous media regardless of cell type, presence or absence of extracellular polymeric substances, ionic strength, and ion valence. We find that the additional repulsion between bacteria and quartz sand caused by both acid−base interaction and steric repulsion as well as the competition for deposition sites on quartz sand surfaces by emerging organic pollutants are responsible for the enhanced transport and decreased deposition of bacteria with emerging organic pollutants in solutions.