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Influence of Nano- and Microplastic Particles on the Transport and Deposition Behaviors of Bacteria in Quartz Sand

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Plastic particles are world widely present in natural environment and are highly likely to interact with bacteria (the ubiquitous microbes in natural environment), which might affect the transport and deposition of bacteria in porous media. In this study, the significance of plastic particles from nano-scale to micron-scale (0.02-2 μm) on the transport and deposition behaviors of bacteria (Escherichia coli) in quartz sand was examined under environmentally relevant conditions in both NaCl and CaCl2 solutions at pH 6. The results showed that the presence of different-sized plastic particles did not affect bacterial transport behaviors at low ionic strength (10 mM NaCl and 1 mM CaCl2), whereas, at high ionic strength conditions (50 mM NaCl and 5 mM in CaCl2), plastic particles increased bacterial transport in quartz sand. At low ionic strength conditions, the mobility of both plastic particles and bacteria was high, which might drive to the negligible effects of plastic particles on bacterial transport behaviors. The mechanisms driving to the enhanced cell transport at high ionic strength were different for different-sized plastic particles. Specifically, for 0.02 μm nano-plastic particles, the adsorption of plastic particles onto cell surfaces and the repel effect induced by suspended plastic particles contributed to the increased cell transport. As for 0.2 μm MPs, the suspended plastic particles that induced repelling effect contributed to the increased cell transport. Whereas, for 2 μm MPs, the competition deposition sites by the plastic particles was the contributor to the increased cell transport.