Blocking and ripening of colloids in porous media and their implications for bacterial transport

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Abstract

A model accounting for the dynamics of colloid deposition in porous media was developed and applied to systems containing similarly charged particles and collectors. Colloid breakthrough and intracolumn retention data confirmed that blocking reduced overall colloidal adhesion to soil. The surface coverage at which blocking occurred varied for the type of colloid, as shown by changes in the clean-bed collision efficiency, a0, and the excluded area parameter, b. Excluded area parameters were relatively high due to unfavorable interactions between particles and collectors, and ranged from 11.5 for one bacterium (*Pseudomonas putida* KT2442) to 13.7 and 24.1 for carboxylated latex microspheres with differing degrees of charged groups on their surfaces. Differences in b values for the three colloids were correlated with electrophoretic mobility, with the most negatively charged colloid (carboxylated latex; CL microspheres) having the highest b. No correlation between hydrophobicity and a0 or b was found. Besides using colloidal particles capable of blocking, the addition of chemical additives to the soil has been suggested as a means for reducing attachment of colloids to porous media. Dextran addition caused an order-of-magnitude reduction in the overall a (for carboxylated-modified latex; CMLs). This reduction was not attributed to blocking, but to the sorption of dextran to the soil which lowered a0. The filtration-based numerical model used to fit the a0 and b parameters was used to demonstrate that blocking could result in significantly enhanced bacterial transport in field situations.