

INSIGNIFICANT ROLE OF HYDRODYNAMIC DISPERSION ON BACTERIAL TRANSPORT

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ABSTRACT: Dispersion in porous media has been postulated as a mechanism that can increase particle transport, but the magnitude of increased transport predicted using analytical models of column experiments is a function of the boundary conditions chosen for the models. To date, insufficient attention has been paid to the implications of these boundary conditions for column or field simulations of particle transport. In order to assess the potential effect of particle dispersion on bacterial transport during bioremediation using bioaugmentation, we review the most frequently applied boundary conditions and models used in particle transport modeling. Using a finite-difference model written in MATLAB to simulate a column experiment, we demonstrate that for boundary conditions typically employed in short (~10 cm) laboratory columns, hydrodynamic dispersion in such systems does not appreciably alter the calculation of bacterial stickiness or overall transport. However, dispersion is known to increase with distance, resulting in dispersivities on the order of one to several hundred meters over distances of 100 m. Using boundary conditions appropriate for field tests (a semi-infinite domain), and increasing dispersivity in proportion to transport distance, it was similarly demonstrated that dispersion would not appreciably increase the distance of particle travel (defined as the distance prior to a 2-log reduction in bacteria concentration) in field situations. Thus, it is concluded that dispersion can be neglected in calculating particle collision efficiencies in both laboratory and field experiments.