A Generalized Model for Transport of Contaminants in Soil by Electric Fields

A generalized model applicable to soils contaminated with multiple species under enhanced boundary conditions during treatment by electric fields is presented. The partial differential equations describing species transport are developed by applying the law of mass conservation to their fluxes. Transport, due to migration, advection and diffusion, of each aqueous component and complex species are combined to produce one partial differential equation that describes transport of the total analytical concentrations of component species which are the primary dependent variables. This transport couples with geochemical reactions such as aqueous equilibrium, sorption, precipitation and dissolution. The enhanced model is used to simulate electrokinetic cleanup of lead and copper contaminants at an Army Firing Range. Acid enhancement is achieved by the use of adipic acid to neutralize the basic front produced for the cathode electrochemical reaction. The model is able to simulate enhanced application of the process by modifying the boundary conditions. The model showed that kinetics of geochemical reactions, such as metals dissolution/leaching and redox reactions might be significant for realistic prediction of enhanced electrokinetic extraction of metals in real world applications.

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