

Electrokinetic Soil Processing as a Supplement to Bank Filtration for Removing Persistent Organic Contaminants

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Abstract. The occurrence of pharmaceutical, personal health care products (PPCPs), and bioactive chemicals in the nation's wastewater effluents and drinking water supplies continues to be an area of great concern to water treatment professionals. Researchers have identified several of these compounds as persistent and have proven that these compounds remain essentially unaltered in conventionally treated drinking water and wastewater effluents. A water treatment method that has not been examined for use in the breakdown of these emerging, persistent compounds is electrokinetic soil processing (ESP). ESP uses subsurface electrodes to induce a low-level direct current which results in physiochemical and hydrological changes in the soil mass, leading to species transport by coupled mechanisms such as electromigration, electroosmosis, diffusion and electrolysis of water.

This research examines the use of electrokinetic remediation as a supplement to river bank filtration for the breakdown of carbamazepine (CBZ), sulfamethoxazole (SMX), tris-(2-chloroethyl)-phosphate (TCEP), tris-(2-chloro-, 1-methylethyl)-phosphate (TCPP), and tris-(2-chloro-, 1-chloromethyl-ethylphosphate (TDCP). Soil column studies using media from an existing bank filtration site on the South Platte River in Colorado were conducted on native groundwater with known concentrations of CBZ, SMX, TCEP, TCPP, and TDCP. Column tests were run using both groundwater and an organic acid as the electrolyte in the electrode well under a current density of approximately 5 A/m². The use of an organic acid as the electrolyte assists in maintaining an optimal pH range over the soil column and isolates the effect of the column's redox conditions on contaminant concentration. Parameters such as pH, ORP, and conductivity were monitored throughout the soil column experiments. Additionally, contaminant concentrations were examined and compared under both electrolyte scenarios. Changes in the water quality bulk parameters were compared to changes in contaminant concentrations in the electrode compartments and throughout the column for both electrolyte solution scenarios.