

Reductive Electrochemical Treatment Systems for Decentralized Treatment of Contaminated Groundwater, Stormwater and Drinking Water

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Decentralized treatment systems include: 1) pump and treat systems for contaminated groundwater, 2) systems to treat stormwater runoff, and 3) systems at apartment buildings in developing countries to re-treat drinking waters contaminated during transit from the drinking water treatment plant.

Decentralized treatment systems should be modular, simple to operate, and should minimize the supply of treatment chemicals. Electrochemical treatment systems feature these desirable characteristics, but have rarely moved beyond laboratory experiments. Challenges have resulted from the focus on oxidative electrochemical treatment systems and include the use of expensive electrode materials (e.g., diamond), slow kinetics to degrade contaminants (e.g., hours), and the production of toxic halogenated products from oxidation of halides. This presentation describes the development of electrochemical reduction systems that can overcome these challenges. Using cathodes fashioned from activated carbon, organic contaminants in groundwater or stormwater are captured and sequestered on the carbon, permitting degradation to occur over much longer timescales while treating high flowrates of contaminated waters. Passing electrons through conductive carbons permits dehalogenation of contaminants sorbed to the carbon without oxidation of halides to toxic byproducts. The degradation of sorbed contaminants permits on-site regeneration of the carbon, thereby avoiding the need for off-site transport and disposal of the carbon. Passing electrons through a stainless steel mesh permits conversion of low concentrations of hydrogen peroxide to hydroxyl radical for use in apartment-level systems in developing countries to re-treat drinking water where there are fears of re-contamination between the drinking water treatment plant and the apartments.