

Reactor design for electrolytic treatment of the persistent organic pollutant 1,4-dioxane in groundwater

P. Maxine Cottrell, Tom C. Sale, and Jens Blotevogel

Department of Civil and Environmental Engineering, Colorado State University

Abstract. The common industrial solvent stabilizer and wetting agent 1,4-dioxane (1,4-D) is one of the most widely occurring organic groundwater contaminants in United States today. It is a probable human carcinogen, highly mobile in groundwater, and resistant to anaerobic biodegradation. The ineffectiveness of conventional treatment approaches such as stripping and sorption to activated carbon results in a critical need of advanced technologies for the treatment of 1,4-D in groundwater. Our previous bench-scale research has shown that electrochemical oxidation is able to fully mineralize 1,4-D. This study addresses the design of a mobile pilot-scale reactor that can be used to test electrolytic degradation performance under site-specific conditions. Assessment of critical design parameters showed that batch operation improved 1,4-D degradation rates by about 60% compared to flow-through operation, with a 90% degradation rate improvement when the batch reactor was operated with regular polarity reversals. This mode of operation reduces scale build-up on the electrodes, with the added benefit of prolonging electrode life. Furthermore, 1,4-D degradation rates were increased by an additional 60% by using novel doped tin oxide-coated electrodes, which have been reported to fully mineralize highly resistant perfluorinated compounds. Future testing at contaminated field sites will reveal the efficacy of our newly designed reactor, and thus electrolytic treatment, for the remediation of groundwater contaminated with 1,4-D and other persistent organic pollutants.