Catalyzed Electrolytic Degradation of 1,4-Dioxane in Contaminated Water

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Abstract. 1,4-dioxane, a probable human carcinogen, is an important emerging water contaminant. It is resistant to many of the traditional water treatment technologies such as biological degradation, sorption to activated carbon, and air stripping. Dioxane is miscible in water and thus capable of rapid migration in groundwater, often ahead of other contaminants. We have developed titanium mesh electrode-based flow-through reactors for the treatment of water contaminated with dioxane. Electrolytic degradation processes do not only proceed through direct electron transfer at the electrode surface, but also in the bulk water by reactive radical species formed from the oxidation and reduction of water, leading to the hypothesis that catalytic materials placed in between the electrodes may enhance degradation kinetics. Thus, novel titanium dioxide-based inter-electrode catalysts were developed, characterized, and tested for degradation performance using lab-scale reactors. Investigations were performed to determine the degradation efficiencies of the different catalysts, while also identifying relevant properties of the catalyst and flow-through reactor variables that impact performance. Results indicate the novel TiO_2 catalyst greatly enhances oxidation kinetics of dioxane. At concentrations as high as 4.4 mg/L and flow velocities up to 6ft/day, > 90 % degradation was achieved. Although further optimization is ongoing, the results of these investigations show that electrolytic treatment, when used in combination with a catalytically active inter-electrode material, can efficiently degrade organic contaminants, even persistent ones such as 1,4-dioxane.