234d Development and Characterization of a Tubular High-Density Plasma Reactor for Water Treatment

Derek C. Johnson and David S. Dandy

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Experiments have yielded a number of important insights into the sparging and oxidation of methyl *tert*-butyl ether (MTBE), benzene, ethylbenzene, toluene, *m*- and *p*-xylene, and *o*-xylene (BTEX) in a dense medium plasma reactor (DMPR). Rate constants associated with plasma initiated oxidation, interphase mass transfer and photolysis were determined using a combination of nonlinear least squares analysis and Matlab® optimization for each species. The rate constants developed for the DMPR, in conjunction with a species mass balance on a prototype tubular high-density plasma reactor, have been applied to determine the removal rates of MTBE and the BTEXs when operating in batch and continuous flow configurations. The dependence of contaminant concentration on parameters such as treatment time, the number of pin electrodes, electrode gap and volumetric flow rate has been determined. It was found that, under various design specifications and operating conditions, the tubular high-density plasma reactor may be an effective tool for the removal of volatile organic compounds from aqueous solutions. Based on these promising results, a prototype tubular high-density plasma reactor has been fabricated. Characterization of the aqueous plasma discharge has been performed as an initial step in determining the feasibility of the new reactor to oxidize aqueous organic compounds. Current and voltage measurements are presented for varying operating conditions such as electrode gap, solution conductivity, number of pin electrodes and feed gas. The sputtering rate of the cathodes has also been examined to determine the time for which the plasma discharge can be sustained without electrode maintenance.