Treatment of methyl t-butyl ether contaminated water using a dense medium plasma reactor, a mechanistic and kinetic investigation

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Abstract

Plasma treatment of contaminated water appears to be a promising alternative for the oxidation of aqueous organic pollutants. This study examines the kinetic and oxidation mechanisms of methyl t-butyl ether (MTBE) in a dense medium plasma (DMP) reactor utilizing gas chromatography-mass spectrometry and gas chromatography-thermal conductivity techniques. A rate law is developed for the removal of MTBE from an aqueous solution in the DMP reactor. Rate constants are also derived for three reactor configurations and two pin array spin rates. The oxidation products from the treatment of MTBE contaminated water in the DMP reactor were found to be predominately carbon dioxide, with smaller amounts of acetone, t-butyl formate, and formaldehyde. The lack of stable intermediate products suggests that the MTBE is, to some extent, oxidized directly to carbon dioxide, making the DMP reactor a promising tool in the future remediation of water. Chemical and physical mechanisms, together with carbon balances, are used to describe the formation of the oxidation products and the important aspects of the plasma discharge.