A computation fluid dynamics investigation of fluid flow in a dense medium plasma reactor

Derek C. Johnson and David S. Dandy[1]

Colorado State University, Dept. of Chemical & Biological Engineering, Fort Collins, CO 80523 USA

[1]To whom the correspondence should be addressed:
Telephone: (970) 491-7437
Fax: (970) 491-7369
Email: dandy@colostate.edu

Abstract

Computational fluid dynamics are applied to the study of three-dimensional fluid flow in a dense medium plasma reactor under different operating conditions. Reaction mechanisms and rates for the removal of methyl *t*-butyl ether (MTBE) in a dense medium plasma reactor are developed from experimental data to determine the plasma volume, the rate of interphase mass transfer and the photolysis rate of MTBE via UV emission from the plasma. The simulations show that the volume of fluid in contact with the plasma in the dense medium plasma reactor only constitutes a maximum of approximately 10% of the fluid cycled through the plasma zones. The simulations also predict appreciable pressure gradients on the surface of the pin electrodes, resulting in a small discharge area located away from the region in which the electric field strength is maximum. This result has been confirmed indirectly through observation that pin electrodes sputter metal from an area of similar size and location to the low-pressure region predicted by the simulations. The pressure gradients are shown to be a function of operating conditions as well as pin location, indicating that the plasma discharge conditions are not consistent throughout the reactor.