KINETICS MODELING OF PARTIAL DEGRADATION OF CARBOFURAN BY PYRITE

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Abstract

The zeta potential of pyrite and pyrite-carbofuran suspensions was examined as a function of pH and the chemical kinetics of carbofuran was examined in the presence of pyrite as a function of pH and adsorbent loading. The pH_{IEP} of pyrite was around 1.70 when inert environmental conditions were maintained. In the presence of carbofuran, the pH_{IEP} shifted from 1.70 to ~3 and the zeta potential has increased indicating direct surface interactions. The carbofuran degradation was also evidenced by time resolved IR spectroscopic measurements. Conventional kinetic experiments showed that the degradation is pseudo-first order with respect to carbofuran concentration. When the initial pyrite loading is increased by about 10 fold, the reaction order of carbofuran degradation has transformed from 0^{th} to pseudo 1^{st} order indicating a surface mediated mechanism. This mechanism of carbofuran degradation is largely ascribed to a Fenton like process. In the presence of pyrite at acidic pH, the carbofuran degrades via two routes: cleavage of the C-N bond forming carbamate and 2,3-dihydro-2,2-dimethyl benzofuran-7-al formate, and cleavage of the C-O bond forming methylamine and 2,3-dihydro-2,2-dimethylbenzofuran-7-ol. The resulted carbamic acid is unstable and, therefore rapidly degraded to methylamine and CO_2. In agreement with mass spectroscopic data, a simple kinetic model was proposed as required for design of a unit process in drinking water treatment.