

Reaction Mechanisms Associated with Oxidative Chlorophenol Degradation by Modified Fenton Process using Pyrite as the Catalyst

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Electrophoretic mobility measurements, in conjunction with spectroscopic analysis, were performed to better understand the reaction mechanisms associated with oxidative chlorophenol (CP) degradation by modified Fenton process with pyrite as the catalyst. The electromobility measurements suggest that the pyrite surface is negatively charged in the absence of CP and H_2O_2 at $pH > 2$. However, in systems containing H_2O_2 and CPs, the surface becomes positively charged, indicating the formation of oxidized Fe (III)-surface species (e.g., Fe-oxides). Batch dissolution experiments indicated that most of Fe released from pyrite surface was mainly in the form of Fe(III) species with very little Fe^{2+} in solution. The X-ray photoelectron spectroscopy (XPS) analysis further proved the accumulation of Fe(III)-surface precipitates on pyrite surface during oxidative CP degradation. Scanning electron microscopy (SEM)-coupled with energy dispersive system (EDS) indicated presence of O, Fe, S and C on pyrite surface, implying accumulation of Fe-oxides as well as binding of CP with pyrite. In addition, the X-Ray Diffraction (XRD) measurements show that while un-reacted samples were pyrite with very little impurities, the pyrite samples reacted in systems containing H_2O_2 and CP contained Fe-oxides, mainly in the form of goethite and hematite. Overall, these results support the claim that the oxidative CP degradation occurred on both pyrite surface and in solution with Fe^{2+} released from pyrite.