

Photocatalytic treatment of 4-chlorophenol in aqueous ZnO suspensions : intermediates, influence of dosage and inorganic anions.

Abstract

The photocatalytically driven removal of eco-persistent 4-chlorophenol from water using ZnO is reported here. Kinetic dependence of transformation rate on operating variables such as initial 4-chlorophenol concentration and photocatalyst doses was investigated. A complete degradation of 4-chlorophenol at 50 mg L⁻¹ levels was realised in 3 h. Analytical profiles on 4-chlorophenol transformation were consistent with the best-line fit of the pseudo zero-order kinetics. The addition of small amounts of inorganic anions as SO₄²⁻, HPO₄⁻, S₂O₈²⁻ and Cl⁻ revealed two anion types: active site blockers and rate enhancers. Fortunately, Cl⁻ and SO₄²⁻ commonly encountered in contaminated waters enhanced the rate of 4-chlorophenol degradation. The reaction intermediates and route to 4-chlorophenol mineralisation were elucidated by combined RP-HPLC and GC-MS methods. In addition to previously reported pathway products of 4-chlorophenol photo-oxidation catechol was detected. A radical mechanism involving o-hydroxylation is proposed to account for the formation of catechol.

Keyword: 4-Chlorophenol; ZnO photocatalysis; Intermediate; Anion.