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Effect of various inorganic anions on the degradation of Congo Red, a di azo dye, by the photo-assisted Fenton process using zero-valent metallic iron as a catalyst

L. Gomathi Devi*, S. Girish Kumar, K. Mohan Reddy, C. Munikrishnappa

Department of Post Graduate Studies in Chemistry, Central College City Campus, Dr. B.R. Ambedkar Veedi, Bangalore University, Bangalore 560 001, India
Tel. +91 80 2296 1336; email: gomatidevi_naik@yahoo.co.in

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ABSTRACT

The present research focuses on the heterogeneous advanced photo-Fenton processes of the type $Fe^0/H_2O_2/UV$ and Fe^0/ammonium persulfate (APS)/UV as a potential technique to degrade Congo Red (di azo dye). Both the oxidants H_2O_2 and APS showed comparable efficiencies on the iron surface for the mineralization of Congo Red (CR) under UV light. The influence of various reaction parameters like pH of the solution, catalyst loading, concentration of the oxidants (H_2O_2/APS), influence of hydroxyl radical scavenger and the concentration of the substrate dye molecules are investigated and the optimum conditions are reported. The influences of various inorganic anions that are commonly present in the industrial effluents are studied using the above processes. All the inorganic anions used shows inhibitive effect on the degradation rate. Inorganic anions like chloride (Cl^-) and sulfate (SO_4^{2-}) inhibit the degradation rate by forming complexes with Fe^{2+}/Fe^{3+} ions in the solution and they also quench the generated hydroxyl radicals. Anions like nitrate (NO_3^-), carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) suppress the degradation rate mainly by scavenging the generated hydroxyl radicals. Quinol, hydroquinone and naphthalene derivative were the major intermediates obtained during the mineralization process. The experiments were extended successfully to treat the industrial effluent containing CR dye. APS proved to be a better oxidant than H_2O_2 for treating the effluent. The present method is advantageous as it is a simple and cost-effective technique for the mineralization of non-biodegradable di azo dye.

Keywords: Advanced oxidation process (AOP); Photo-Fenton type reaction; Zero-valent metallic iron surface; Inorganic anions; Congo Red

* Corresponding author.