Investigation of water decolorization by Fenton oxidation process in batch and continuous systems

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ABSTRACT

Nowadays, advanced oxidation methods such as Fenton and modified Fenton processes draw considerable attention to dye removal in textile wastewater. In Fenton process, low concentrations of Fe$^{2+}$ and H$_2$O$_2$ solutions are used and these Fenton reagents generate OH$^*$ radicals including high oxidation potential. The Fenton process, in which non-toxic and harmless reagents are applied at low concentrations, is very useful for decolorization of wastewater since it is very effective and less polluting. In this study, decolorization of the water samples containing azo dyes like Acid Red 88 (AR 88) was performed by Fenton oxidation process on a laboratory-scale setup. The aqueous solutions prepared by AR 88 dye were used for effective decolorization by Fenton oxidation method in batch process under various reaction conditions. By this method, the effects of solution temperature, pH, stirring speed, and concentration on the decolorization of the samples were investigated. The decolorization reaction kinetics of AR 88 dye was also determined in the batch system. Then, the Fenton oxidation experiments were carried out in the continuous system under the optimum conditions of stirring rate = 250 rpm; pH 2; [H$_2$O$_2$] = 1.0 mM; [Fe$^{2+}$] = 0.1 mM; azo dye concentration [AR 88] = 0.12 mM; and $T$ = 30$^\circ$C. These optimum conditions were determined in the batch system studies. The efficiency of decolorization for both systems was about 99% and the decolorization kinetics of the water samples containing AR 88 dye was found as the second-order. The experimental results also showed that the Fenton’s reagent was effective for the degradation of AR 88 dye using H$_2$O$_2$ and Fe$^{2+}$ solutions at low concentrations.

Keywords: Fenton process; Oxidation; Textile dyes; Wastewater; Decolorization

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