Possible control approaches of the Electro-Fenton process for textile wastewater treatment using on-line monitoring of DO and ORP

Ruey-Fang Yu a,⇑, Chuang-Hung Lin b, Ho-Wen Chen c, Wen-Po Cheng a, Ming-Chien Kao a

a Department of Safety, Health and Environmental Engineering, National United University, Miao-Li 360, Taiwan, ROC
b Department of Architecture, National United University, Miao-Li 360, Taiwan, ROC
c Department of Environmental Science and Engineering, Tunghai University, Taichung 407, Taiwan, ROC

HIGHLIGHTS

► The DO and ORP profiles have high correlations with the trends of H2O2, Fe²⁺ and Fe³⁺ variations.
► The DO and ORP profiles can help to identify the overdose of H2O2.
► The ANN models can precisely predict the COD removal efficiency and required Fe²⁺ doses.

GRAPHICAL ABSTRACT

Schematic diagram of the E-Fenton reactor and the correlating monitoring and control units in this study.

ABSTRACT

The Electro-Fenton (E-Fenton) process combines the advantages of electrochemical and Fenton processes, which is an effective and popular advanced oxidation process (AOP) for treating textile wastewater. Dynamically regulating the E-Fenton process is still difficult; however, it is critical for reducing operation costs and enhancing process performance. This paper presents the potentials of on-line monitoring of Oxidation Reduction Potential (ORP) and Dissolved Oxygen (DO) as key parameters to control the E-Fenton process for textile wastewater treatment. Experimental results have shown that the monitored DO and ORP profiles have high correlations with the trends of H2O2, Fe²⁺ and Fe³⁺ variations, which can help to identify over-dosing of H2O2. Both the multiple regression and the Artificial Neural Network (ANN) models were applied to predict the required Fe²⁺ doses using the monitoring ORP, DO, and COD removal targets. Very precise prediction results with the correlation coefficients (R²) of 0.95–0.99 were performed by the multiple regression models and the ANN models, respectively. As a result, the monitoring of DO and ORP have high potentials to effectively control the E-Fenton and contribute to the benefit of chemical cost savings.