Desalination and Water Treatment
www.deswater.com
doi: 10.1080/19443994.2015.1025437

57 (2016) 8815–8825
April

Taylor & Francis
Taylor & Francis Group

Electrochemical oxidation of C.I. Acid Red 73 wastewater using Ti/SnO_2-Sb electrodes modified by carbon nanotube

Li Xu[a,b,*], Yukuan Sun[a,b], Lichao Zhang[c], Jiejing Zhang[d], Fan Wang[e]

[a]*School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, P.R. China, Tel. +86 22 27409839; Fax: +86 22 27890515; emails: xuli620@163.com (L. Xu), qdsunyukuan@163.com (Y. Sun)*
[b]*Tianjin Key Laboratory of Membrane Science and Desalination Technology, Tianjin 300072, P.R. China*
[c]*Sinopec Engineering Incorporation, Beijing 100101, P.R. China, Tel. +86 22 27409839; email: hbkjdxzlc@163.com*
[d]*School of Life Sciences, Jilin Agricultural University, Changchun 130118, P.R. China, Tel. +86 431 84533360; email: zjjx124@163.com*
[e]*School of Chemical Engineering, China University of Petroleum, Beijing 102249, P.R. China, Tel. +86 10 89733288; email: tjuwangfan@gmail.com*

Received 13 September 2014; Accepted 24 February 2015

ABSTRACT

Electrochemical oxidation of C.I. Acid Red 73 (AR 73) in aqueous solution is performed in an undivided cell using Ti/SnO_2-Sb-CNT as anode. Cyclic voltammetric experiments suggest that electrochemical oxidation of AR 73 is totally irreversible and direct electron transfer does not occur on anode surface. The influence of operating parameters on the degradation efficiency is investigated systematically, including current density (25–100 mA cm^{-2}), initial dye concentration (0.5–1.5 g L^{-1}), initial pH (3–11), and different kinds of supporting electrolyte. The electrochemical degradation of AR 73 follows pseudo-first-order kinetics. The removal efficiency of AR 73 degradation increases from 78.3 to 95.7% with increased current density from 25 to 100 mA cm^{-2}. The initial AR 73 concentration has a negative effect on degradation rates at higher value, and pH has no obvious effect on the dye removal rate. The comparative experiments using Na_2SO_4, NaCl, and Na_3PO_4 as supporting electrolyte indicate that NaCl has the most significant effect on AR 73 degradation, but shows poor mineralization ability with only 51.5% removal rate of total organic carbon. The electrogenerated oxidant $S_2O_8^{2-}$ using Na_2SO_4 supporting electrolyte also contributes the dye degradation and mineralization compared with Na_3PO_4. Samples during the electrochemical oxidation process are characterized with UV–vis spectra and high performance liquid chromatography. The results show that the AR 73 and intermediates formed during the degradation are both completely removed after 3 h electrochemical oxidation. The electrochemical technique is expected to be an interesting alternative for the treatment of azo dye in wastewater.

Keywords: Electrochemical oxidation; Azo dye; SnO_2-Sb-CNT electrodes; C.I. Acid Red 73

*Corresponding author.