Desalination and Water Treatment
www.deswater.com

32 (2011) 42–48
August

1944-3994 / 1944-3986 © 2011 Desalination Publications. All rights reserved.
doi: 10.5004/dwt.2011.2676

Removal of 2,4-dichlorophenol as herbicide's by-product by Fenton's reagent combined with an electrochemical system

Thanakorn Methatham[a], Ming-Chun Lu[b], Chavalit Ratanatamskul[a]*

[a]*Department of Environmental Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand*
Tel. +66 (81) 614-8623; Fax +66 (2) 218-6678; email: dr_chawalit@yahoo.com
[b]*Department of Environmental Resources Management, Chia Nan University of Pharmacy and Science, Tainan 717, Taiwan*

Received 29 August 2010; Accepted in revised form 30 December 2010

ABSTRACT

2,4-dichlorophenol (2,4-DCP), which is known as a by-product from herbicide utilization, is a priority toxic organic pollutant listed by U.S. EPA. The application of electrochemical system combined with Fenton process has been investigated here in order to know the feasibility of continuous electro-regeneration of ferrous ion for enhancement of 2,4-DCP degradation in the Fenton's reagent solution. The operating parameters such as pH, current density, H_2O_2 to Fe^{2+} (H/F) mole ratio and H_2O_2 feeding mode of operation were also investigated to determine the optimum operating condition. From the experimental data, it was found that current density of 0.05 mA/cm^2 with the H_2O_2 to Fe^{2+} (H/F) mole ratio at 30 and operating pH of 3 could completely remove 1 mM 2,4-DCP up to 70%. Improvement in efficiency and stability of process could be achieved by modification of H_2O_2 feeding mode from one-time initial feeding mode to the step feeding mode of operation that could reduce toxicity possibility and mineralization rather than only one-time initial feeding. Additionally initial degradation rate was investigated by the first-order model for using in the process optimization indicator. HPLC and IC data were applied to identify the intermediates occurred among the reaction. For this experiment, 2-chlorophenol, phenol, hydroquinone, p-benzoquinone, maleic, acetic, oxalic, and formic acids were found as the main oxidation intermediates. Moreover, a degradation pathway for 2,4-DCP oxidation was proposed on the basis of intermediate compounds that were detected.

Keywords: 2,4-dichlorophenol(2,4-DCP); Electrochemical system; Fenton process; Hydroxyl radicals; Operating parameters; Feeding mode of operation

* Corresponding author.