Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2014.937761

56 (2015) 388–398
October

Taylor & Francis
Taylor & Francis Group

Development of a four-layered ANN for simulation of an electrochemical water treatment process

Hadi Rezaei Vahidian[a,*], Ali Reza Soleymani[b,*], Jalal Basiri Parsa[c]

[a]*Department of Chemistry and Chemical Engineering, Malek Ashtar University of Technology, Tehran, Iran, Tel. +98 851 3339843; email: hrvahidian_1984@yahoo.com*
[b]*Faculty of Science, Department of Applied Chemistry, Malayer University, Malayer 65719, Iran, Tel. +98 851 3339843; email: a.r.soleymani@malayeru.ac.ir*
[c]*Department of Applied Chemistry, Bu-Ali Sina University, Hamadan, Iran, Tel. +98 811 8282807; email: parssa@basu.ac.ir*

Received 28 January 2014; Accepted 16 June 2014

ABSTRACT

This work is dealing with the performance and modeling of an electrochemical water treatment process. A bench-scale electrochemical reactor with working volume of 0.5 L was applied to treat an azo dye, acid brown 14, as a typical pollutant in aqueous media. For the dye initial concentration of 50 mg/L, the experimental data showed the optimum conditions of the process as: [NaCl] = 5 g/L, pH 6.4, and $V = 4$ V. Under the conditions, after 18 min and consuming of low energy amount of 0.24 Wh/L, 92% of decolorization efficiency (DE) was obtained. To model the process and simulate the obtained results, artificial neural network (ANN) method was used. Five effective operational parameters, i.e. reaction time, initial pH, applied voltage, supporting electrolyte, and the dye initial concentrations were considered as the network inputs; meanwhile, both of the DE and energy consumption (EC) criteria, were considered as the relevant network outputs. A four-layered feed-forward ANN, consisting of "trainbfg" learning algorithm and "tansig" as the transfer function in both hidden and output layers, was constructed. The neuron number structure of 5:4:6:2 and the iteration number of 600, showed best model-calibration ability. The K-fold cross-validation method showed high correlation coefficients (R^2) of 0.988 and 0.983 for the simulation of the DE and EC criteria, respectively.

Keywords: Modeling; Four-layered ANN; Electrochemical oxidation; K-fold cross validation

*Corresponding authors.