Desalination and Water Treatment
www.deswater.com
doi: 10.1080/19443994.2013.852484

(2013) 1–15

Taylor & Francis
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Removal of Cu^{2+} and Cd^{2+}, and humic acid and phenol by electrocoagulation using iron electrodes

Djamel Ghernaout*, Sara Irki, Ahmed Boucherit

Chemical Engineering Department, University Saad Dahlab of Blida, P.O. Box 270, Blida 09000, Algeria
Tel./Fax: +213 25 43 36 31; email: djamel_andalus@yahoo.fr

Received 2 October 2013; Accepted 3 October 2013

ABSTRACT

This work concerns the plotting current intensity I (A) *vs.* applied voltage E (V) curves of electrocoagulation (EC) of some organic (humic acid (HA) and phenol) and inorganic (copper sulphate and cadmium chloride) compounds which are often found in water/wastewaters. The study is conducted in batch mode using Fe electrodes at laboratory scale. The device is constituted with two ordinary steel electrodes with active area S = 19.95 cm^2 and 4 cm as separation from each other in a 500 mL beaker which is filled with 500 mL solution to treat. The applied voltage is 12 V for 45 min as EC time and an optimal pH which is determined from current intensity I (A) as a function of applied voltage E (V) curves. Depending on the pollutant type, different EC process mechanisms are proposed and less or more important reduction levels are achieved in these experiments.

Keywords: Electrocoagulation (EC); Humic acid (HA); Phenol; Copper; Cadmium; Iron

1. Introduction

In Algeria, the water resources are limited and unevenly distributed. These resources have been, over the last two decades, found to have negative effects like drought and pollution. The absolutely pure water rarely exists in nature. The raw waters still contain many organic and inorganic pollutants from natural or human activity [1]. One of the goals sought in water treatment is to reduce or even eliminate these pollutants [2–4]. This is performed by physicochemical processes (coagulation/flocculation, sedimentation, filtration and disinfection) [5–11]. Currently, there is a tendency to use electrochemical techniques (electrocoagulation (EC), electroflotation, electrooxidation, electrodisinfection, etc.) [12–18] as promising methods for water/wastewater treatment [19–23].

This work aims to contribute in the comprehension of EC process by studying the reduction of some representative pollutants, such as organic (humic acid (HA) and phenol) and inorganic (copper and cadmium) compounds contained in wastewater. Synthetic solutions of these substances are prepared and electrocoagulated at a laboratory scale.

The tests consisted in carrying out electrolysis experiments in an EC reactor. In order to distinguish between the different mechanisms of EC process, first of all, the pH of distilled water is adjusted at three representative values of the pH range: pH 2 (acidic), 7 (neutral) and 12 (alkaline). Then, the solutions are electrolysed as control tests during which the evolution of the current intensity I (A) as a function of the

*Corresponding author.