Treatment of raw tannery wastewater by electrocoagulation technique: optimization of effective parameters using Taguchi method

Abdalhadi Deghles*, Ugur Kurt

Department of Environmental Engineering, Yildiz Technical University, 34349 Istanbul, Turkey, Tel. +90 212 383 53 92; Fax: +90 212 383 53 58; emails: daghlas2014@gmail.com (A. Deghles), ugurkurt28@gmail.com (U. Kurt)

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ABSTRACT

In this study, the electrocoagulation (EC) technique for tannery wastewater treatment was examined using iron and aluminum electrodes. The effects of operating parameters that include current density, initial pH, and electrolysis time on EC performance were accomplished. In addition, Taguchi method was carried out in order to design the experiments and to optimize the experimental results. L25 orthogonal array (OA, three factors in five levels), signal-to-noise (S/N) ratio (the larger-the-better), and analysis of variance were applied to find the optimum levels and relative magnitude of the effects of parameters. The removal efficiency of chemical oxygen demand (COD), total chrome, and color are considered as the response parameters. In the case of iron electrodes, the optimum conditions of COD were found to be at the fifth level of current density (50 mA/cm²), the fourth level of initial pH (7), and fifth level of electrolysis time (25 min). According to total chrome, they were found at the third level of current density (30 mA/cm²), the fifth level of initial pH (8), and the fifth level of electrolysis time (25 min). In addition, with regard to color removal efficiency, they were determined to be at the fifth level of current density (50 mA/cm²), the fourth level of initial pH (7), and the fifth level of electrolysis time (25 min). At the optimum conditions of COD, total chrome, and color removal efficiencies were achieved as 63.3, 99.7, and 82%, respectively. Also, operating costs for both COD and color removals were evaluated as 0.88 $/m³; but for chrome removal, they were 0.70 $/m³. In the case of aluminum electrode, the optimum conditions of COD, total chrome, and color removal were found to be at the fifth level for each operating parameter corresponding to current density (50 mA/cm²), initial pH (7), and electrolysis time (25 min). As a result, the observed removal efficiencies of COD, total chrome, and color under these optimum conditions were 64.4, 99, and 88%, respectively. In addition, operating costs for COD, chrome, and color removals were 0.94 $/m³.

Keywords: Taguchi method; Electrocoagulation; Aluminum electrodes; Iron electrodes; Total chrome; Tannery wastewater

*Corresponding author.

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