



Cadmium removal using a spiral-wound woven wire meshes packed bed rotating cylinder electrode

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HIGHLIGHTS

- A spiral-wound woven wire mesh rotating cylinder electrode was used for cadmium removal.
- The rotation speed has the highest impact on the removal efficiency.
- A more economic current efficiency and energy consumption (41% and 3.12 kWh kg⁻¹) were obtained.
- RMS proved to be an accurate methodology for optimizing the cadmium removal.

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ABSTRACT

The effect of electrolysis operating parameters on the removal efficiency of cadmium from a simulated wastewater was studied by adopting response surface methodology combined with Box–Behnken Design. As a new electrode design, spiral-wound woven wire mesh rotating cylinder electrode was used for cadmium removal. Current (240–400 mA), rotation speed (200–1000 rpm), initial cadmium concentration (200–600 ppm), and cathode mesh number (30–60) were chosen as independent variables while the removal efficiency of cadmium was considered as a response function. The results revealed that the rotation speed has the major effect on the removal efficiency of cadmium. Regression analysis showed good fit of the experimental data to the second-order polynomial model with a coefficient of determination (R^2) value of 0.9931 and Fisher F-value of 89.82. The optimal conditions within the experimental ranges of the independent variables were a current of 345 mA, a rotation speed of 800 rpm, an initial cadmium concentration of 500 ppm, and a mesh number of 30, where concentration of cadmium was diminished from 500 to 8 ppm after 60 min of electrolysis with a specific energy consumption of 3.12 kWh kg⁻¹ and a current efficiency of 41%.

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1. Introduction

Cadmium has many uses in wide sectors of industry like devices of solar energy capture, rechargeable batteries, pigments, corrosion inhibiting coatings of surfaces, alloys, and stabilizers for plastics (Grau and Bisang, 2007). However, the toxicity of cadmium has a major effect on these uses and leading to severe problems for the environment. The legal limitations relating to cadmium discharge in effluents are very rigorous and treatment of these effluents is mandatory before discharging them into the sewer to hold the cadmium concentration at low level (Barnes et al., 1987). Many traditional treatment methods

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