

## Removal of heavy metal ions from aqueous solution by electrocoagulation using a horizontal expanded Al anode

E.-S.Z. El-Ashtoukhy, T.M. Zewail\*, N.K. Amin

*Chemical Engineering Department, Faculty of Engineering, Alexandria University, P.O. Box 21544, Alexandria, Egypt  
Tel. +20 35914475; Fax +20 35921853; email: tagchem04@yahoo.com*

Received 21 December 2008; Accepted in revised form 11 January 2010

---

### ABSTRACT

The performance of a batch cell with a horizontal expanded Al-anode in removing  $\text{Cu}^{2+}$  and Cr from a hexavalent chromium solution by electrocoagulation from separate solutions was examined. The effect of electrolysis time, current density, pH, initial pollutant concentration and NaCl concentration on the removal efficiency of  $\text{Cu}^{2+}$  and Cr has been investigated. The results revealed that as current density increases the removal efficiency of  $\text{Cu}^{2+}$  increases, while in the case of Cr it increases up to a certain limit, then remains approximately constant. The optimum pH is from 4 to 6 and 3.5 for  $\text{Cu}^{2+}$  and Cr removal, respectively. The removal efficiency of  $\text{Cu}^{2+}$  increases as NaCl increases, but in the case of Cr it decreases. COD measurements showed that a 66.67% reduction of COD has been obtained at the optimum conditions of  $\text{Cu}^{2+}$  removal. Energy consumption was calculated for both heavy metals at different current density and NaCl concentration. At the optimum condition an energy consumption of 43 kWh is required for the removal of one kg of  $\text{Cu}^{2+}$  ions; a value of 145 kWh is required for the removal of one kg of Cr. The difference in behavior between  $\text{Cu}^{2+}$  removal and Cr removal was explained on the basis that cathodic reduction of  $\text{Cr}^{6+}$  to  $\text{Cr}^{3+}$  which controls the rate of Cr removal.

*Keywords:* Electrocoagulation; Heavy metals removal; Expanded horizontal anode; Aluminum electrode; COD

---

\* Corresponding author.