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Improvement of electrocoagulation process on hexavalent chromium removal with the use of polyaluminum chloride as coagulant

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ABSTRACT

In the first phase of this study, effects of different parameters, including initial pH, applied current density, reaction time and initial chromium concentrations on the chromium removal efficiency, were investigated in electrocoagulation process. The results showed that the maximum removal efficiency of 78.8% was achieved at pH 3, current density of 12.5 mA/cm^2, and initial concentration of 50 mg/L. In the next phase, effect of adding polyaluminum chloride—as a conventional coagulant—to electrocoagulation process in order to have higher chromium removal efficiency and lower energy and electrode consumption was assessed. According to the results of this phase, the increase in polyaluminum chloride dosage to 1250 mg/L was beneficial for enhancing hexavalent chromium removal efficiency from 60.2 to 96.4% at pH 7, current density of 8.33 mA/cm^2 and initial concentration of 50 mg/L. Furthermore, adding PACl to the process led to reduction of considerable amount of energy and electrode mass depletion in comparison with the electrocoagulation process. In the last phase, response surface methodology (RSM) was employed to optimize five operating variables. According to the analysis of variance results, the R^2 values of 99.3% for chromium removal efficiency indicating that the accuracy of the polynomial model is acceptable. The optimum value of initial pH, current density, initial chromium concentration, reaction time and dosage of polyaluminum chloride were 5, 8.33 mA/cm^2, 50 mg/L, 40 min and 1000 mg/L, respectively. Chromium removal of 93% was observed in the experiment at optimum conditions, which was close to the model predicted result of 87.27%.

Keywords: Chromium removal; Electrocoagulation process; Synthetic wastewater; Aluminum electrodes; Polyaluminum chloride; Response surface methodology

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