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Electrocoagulation Process for the Removal of Reactive Orange 16 Dye using an Aluminium Electrode

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Structured Abstract

Background: Industrial wastewater, especially from the textile industry, contains synthetic dyes like Reactive Orange 16 (RO16), an azo dye with strong, persistent coloration that poses serious ecological and health risks. Conventional wastewater treatment methods, such as chemical coagulation, generate toxic sludge and residual chemicals, while biocoagulation lacks efficiency due to longer retention times. Electrocoagulation (EC) offers a promising alternative for RO16 removal, with the potential to reduce pollutant levels without additional chemical inputs. The objective of this study is to determine the effectiveness of electrocoagulation (EC) for RO16 dye removal by analyzing contaminant parameters dye concentration and NaCl dosage and operational parameters voltage and time treatment.

Methods: Electrocoagulation experiments were conducted using aluminium electrodes as both anode and cathode. Electric current induced electrode oxidation, to remove dye removal. Parameters studied included contaminant factors dye concentration and NaCl dosage and operational factors voltage and time treatment. Dye removal efficiency was measured using UV-Vis spectrophotometry.

Results: This study shows that RO16 removal efficiency decreased with increasing dye concentration, with maximum removal rates of 81.75% at 25 ppm, 66.24% at 50 ppm and 51.25% at 100 ppm. Higher NaCl dosages improved efficiency, reaching 75.29% at 0.6 g/L, 65.29% for 0.3 g/L compared to 53.82% at 0.1 g/L. Voltage significantly affected removal, with maximum efficiencies of 81.39% at 30 V, 65.36% at 20 V, and 47.27% at 10 V. Removal efficiency increased with time across all conditions. The maximum efficiency achieved within 60 minutes for 25 ppm and 70–90 minutes for 50 ppm and 100ppm. Similarly, higher voltages (30 V) and NaCl dosages (0.6 g/L) resulted in faster removal, achieving maximum efficiencies within 50–60 minutes.

Conclusion: In conclusion, this study successfully evaluated the effectiveness of Reactive Orange 16 (RO16) dye removal using electrocoagulation based on contaminant parameters dye concentration and NaCl dosage and operational parameters voltage and time treatment. This study highlights the potential of electrocoagulation as an efficient method for removing RO16 dye from wastewater, minimizing the need for additional chemicals and reducing pollutant levels effectively.

Keywords: Aluminium Electrode, Electrocoagulation, Reactive Orange 16

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