

Synergistic Coupling Between Electrochemical and Ultrasound Treatments for Organic Pollutant Degradation as a Function of the Electrode Material (IrO₂ and BDD) and the Ultrasonic frequency (20 and 800 kHz)

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Solutions of the organic pollutant model, Crystal Violet (CV), were subjected to ultrasonic, electrochemical treatment and its combination. Ultrasound was tested at two frequencies (20 kHz or 800 kHz) and 80 W in deionized water. After 120 min, 20 kHz conducted to 6% CV degradation, while 50% elimination was observed at 800 kHz. No mineralization of the organic matter was detected in either case. Electrochemistry, using sulfate (0.35 mol L⁻¹) with IrO₂ or Boron Doped Diamond (BDD) electrodes at 20 mA cm⁻², was also evaluated. After 45 min the IrO₂ and the BDD electrodes conducted to 8% and 95% degradation of the initial substrate; while 15% and 43% mineralization, respectively, was removed after 120 min. The impact of anions was as follows: 3 mM bicarbonate enhanced 800 kHz ultrasonic yields, presence of chloride and sulfate benefit electro-oxidation with IrO₂ and BDD electrodes respectively. CV oxidation at an electrode surface can be synergistically improved by ultrasound action at 20 kHz and 800 kHz. In the best combination tested (BDD electrode and 800 kHz ultrasonic wave), CV was removed in 45 min, while 80% of the initial organic carbon was eliminate using BDD electrode and 800 kHz ultrasonic wave.

Keywords: Sonolysis; Electrolysis; Sonoelectrolysis; Crystal violet dye

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