Electrochemical oxidation of Hydrolyzed Polyacrylamide (HPAM) at Ti/SnO₂-Sb₂O₃/β-PbO₂ Anode. Degradation Kinetics and Mechanisms

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Polymer flooding produced water is a taxonomic group of refractory wastewaters with a high viscosity and molecular weight. The discharge of water that contains hydrolyzed polyacrylamide (HPAM) into the environment will result in many environmental problems. The use of the electro-oxidation (EO) method for the degradation of wastewater is characterized by many advantages, including high efficiency, wide applicability, simplicity, and easy operation. In this study, HPAM was degraded using Ti/SnO₂+Sb₂O₃/β-PbO₂ anodes. The physicochemical properties of the electrodes were characterized via scanning electron microscopy (SEM) and X-ray diffraction (XRD). HPAM degradation experiments were carried out at current densities of 10-40 mA/cm², electrode distances of 1-5 cm, initial solution pH values of 3-7, and electrolyte concentrations of 2000-10000 mg/L. The degradation kinetics studies showed that the HPAM degraded by the EO process followed a pseudo-first-order kinetic model under various conditions. Under the optimal conditions, namely a current density of 20 mA/cm², electrode distance of 1 cm, initial pH of 5, and electrolyte concentration of 6000 mg/L, the efficiency of the electrochemical degradation of HPAM attained 100%. Finally, the degradation mechanism and products of HPAM were determined via monitoring ion chromatography (IC), three-dimensional excitation emission matrix (3D EEM) fluorescence spectra, Fourier transform infrared spectroscopy (FT-IR), the total organic carbon (TOC), and gas chromatography/mass spectrometry (GC/MS).

Keywords: Electro-oxidation, HPAM, kinetics, mechanism.

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