Optimizing electrochemical H_2O_2 generation in a concentric cube reactor for the degradation of water contaminated with the herbicide Atrazine

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The study aimed to optimize the operational conditions of a concentric cube electrochemical reactor for the *in situ* production of hydrogen peroxide (H_2O_2) and to apply this system to the treatment of water contaminated with the herbicide atrazine. H_2O_2 generation was carried out using gas diffusion electrodes (GDE) based on Printex L6 carbon, developed according to a standard method established by the research group (1). Optimization was performed using a Central Composite Rotatable Design (CCRD) with a 2^4 factorial design, varying the K_2SO_4 concentration, current density, oxygen flow rate, and pH. The response variable was the H_2O_2 concentration after 30 minutes of electrolysis, and statistical analysis yielded a regression model with $R^2 = 0.96$, identifying current density and pH as the most influential factors. After optimization, the system was applied to the degradation of atrazine through different oxidative processes: (i) anodic oxidation with H_2O_2 (AO/H_2O_2), (ii) AO/H_2O_2 combined with UV-C irradiation (AO/H_2O_2/UV-C), (iii) AO with UV-C (AO/UV-C), (iv) anodic oxidation alone (AO), and (v) UV-C alone. In processes without H_2O_2, nitrogen (N_2) was used instead of oxygen (O_2). Among the tested processes, AO/H_2O_2/UV-C showed the highest degradation and mineralization efficiency, mainly due to the generation of highly reactive hydroxyl radicals (•OH) through UV-C activation of H_2O_2. These results demonstrate that the concentric cube electrochemical reactor, under optimized conditions for H_2O_2 production, is a promising alternative for advanced treatment technologies targeting water contaminated with recalcitrant organic compounds.

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