Sugarcane Bagasse-Derived Electrodes for Scalable H_2O_2 Generation in Flow-Based Pollutants Degradation

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This study investigates the utilization of sugarcane bagasse (SCB), a abundant agro-industrial residue, as a sustainable carbon source for fabricating gas diffusion electrodes (GDEs) that enable the in situ generation of hydrogen peroxide (H_2O_2)[1] through electrochemical advanced oxidation processes (EAOPs). The SCB-based GDE was compared with a commercial carbon-based GDE (PL6C), showing similar efficiency, with 1.995 mg L^{-1} after 60 minutes at 150 mA cm^{-2} for the SCB-GDE. To assess its practical application, the SCB-GDE was employed in an electrochemical flow reactor to treat simulated wastewater containing 20 mg L^{-1} of amoxicillin (AMX). Among the methods tested, the photo-electro-Fenton (PEF) process achieved the highest total organic carbon (TOC) removal (82.7%) in 90 minutes, with low energy consumption (2.3 kWh g^{-1} TOC). Liquid chromatography-mass spectrometry identified several degradation byproducts of AMX, and Ecological Structure Activity Relationships (ECOSAR) ecotoxicity analysis showed that some intermediates were more toxic than the parent compound. These findings emphasize the importance of monitoring degradation products in wastewater treated by electrochemical methods. Overall, this work provides a compelling proof of concept for GDEs made from solid waste (sugarcane bagasse) as efficient, low-cost, and scalable alternatives to traditional materials for decentralized water treatment. The approach combines renewable carbon valorization with high-efficiency pollutant degradation, contributing to the development of sustainable electrochemical technologies for environmental cleanup.

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