

In Situ Generation of Hydrogen Peroxide and Percarbonates in a 3D Printed Reactor for Environmental Remediation

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Atrazine (ATZ) and oxyfluorfen (OXY) are herbicides widely used in agriculture, but the high persistence of these compounds in soil and groundwater poses a significant risk to human health and aquatic ecosystems. In contrast to traditional treatment methods, the use of inorganic oxidants offers advantages such as less waste generation, greater efficiency in the degradation of complex compounds and less environmental impact [1]. This work aims to investigate the oxidizing potential of hydrogen peroxide (H_2O_2) and percarbonate ($\text{C}_2\text{O}_6^{2-}$) as promising alternatives for the degradation of polluting organic compounds, in soil and water. The work used a double-compartment reactor, in which H_2O_2 was produced in the cathode compartment and $\text{C}_2\text{O}_6^{2-}$ in the anode compartment. A gas diffusion electrode (GDE) made of Printex L6 carbon (PL6C) was used as the cathode, and a boron-doped diamond (BDD) as the anode. The electrogeneration experiments were carried out at current densities ranging from 5 to 50 mA cm^{-2} , in a 0.5 mol L^{-1} sodium bicarbonate (NaHCO_3) support electrolyte, in a discontinuous and continuous flow system. The degradation was carried out through advanced oxidation processes (AOPs), using the electro-generated oxidizers. The best conditions for H_2O_2 production were achieved at 5 mA cm^{-2} in discontinuous flow, with a faradaic efficiency of 66.8% (846.9 mg L^{-1}), and 10 mA cm^{-2} in continuous flow, with 84.6% (111.8 mg min^{-1}). Under these same conditions, the efficiencies obtained for $\text{C}_2\text{O}_6^{2-}$ were 37.3% (4.9 mmol) and 16.8% (3.9 mmol min^{-1}), respectively. Greater removal of contaminants was achieved with the use of H_2O_2 (> 50%), with greater selectivity for ATZ, both in liquid media and in soil.

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References:

[1] Trench, A. B. *et al.*; Chemosphere (2024).