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ARTICLE

Electrochemical degradation of diazinon from aqueous media using graphite anode: Effect of parameters, mineralization, reaction kinetic, degradation pathway and optimization using central composite design

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ABSTRACT

In this study, the experimental data were collected in a laboratory-scale batch reactor equipped with a graphite electrode as anode and an SS316 electrode as a cathode. The central composite design (CCD) was selected for evaluation of the effect of different parameters (j = 1–8 mA/cm^2, initial diazinon concentration = 30–90 mg/L, pH = 3–11, and electrolysis time = 30–90 min) and their interactions on the electrochemical degradation of the diazinon. The results showed that the degradation of diazinon and removal of COD reached 87.6% and 77.81%, respectively. The kinetic studies were indicative of the suitability of the pseudo-first-order kinetic ($R^2 > 0.98$) for the explanation of data obtained from the degradation of diazinon and removal of COD on the graphite electrode. The AOS parameters in the outlet effluent of the electrochemical process with graphite anode were increased from −0.73 to +0.58, indicating the biodegradability of the diazinon by the electrochemical system. The intermediate produced during the electro-oxidation process were diazinon, O,O-diethyl O-(4-ethylpyrimidin-2-yl) phosphorothioate, O,O-diethyl O-(pyrimidin-2-yl) phosphorothioate, O-methyl O-(pyrimidin-2-yl) O-hydrogen phosphorothioate, O-(pyrimidin-2-yl) O-hydrogen phosphonothioate, pyrimidin-2-yl hydrogen phosphonate, 1,3-dioxan-2-ol, 1λ3,3 λ3-dioxine, and ethane-1,2-diol. Finally, diazinon was completely degraded using hydroxyl radicals produced by the electrochemical process and converted into CO_2 and H_2O products.

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KEYWORDS
Electrochemical degradation; diazinon; kinetic study; intermediate products; central composite design

1. Introduction

In recent decades, rivers have been heavily polluted by industries, mines, municipal sewage, and agricultural runoff. The surface agricultural runoffs are the primary source of pesticides [1]. One of the important groups of pesticides is Organophosphorus

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