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Degradation of imidacloprid pesticide in aqueous solution using an eco-friendly electrochemical process

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ABSTRACT

The aim of this study was to evaluate the efficiency of electrochemical degradation process in the removal of imidacloprid (IM), a pesticide, from aqueous solutions. Experiments were conducted using a batch glass reactor and two leads as anodes, and stainless steel electrode as a cathode. The influence of various experimental parameters including initial IM concentration (1–150 mg/L), pH (3–11), electrolysis time (20–120 min), current density (12.5–50 mA/cm^2) and NaCl concentration (4.28–26.74 mmol/L) were assessed to determine the optimum conditions. Scanning electron microscopy and X-ray diffraction analyses were used to study the type of materials formed on the electrode surfaces at the electrode preparation stage. The results from this investigation show that at pH = 5, current density = 25 mA/cm^2, electrolysis time = 30 min, initial pesticide concentration = 100 mg/L and NaCl concentration = 10.69 mmol/L are optimum experimental conditions for achieving maximum IM and chemical oxygen demand (COD) removal from water. Accordingly, the maximum IM and COD removal efficiencies of 99.69% and 85.66% were achieved, respectively. At optimum conditions and applied voltage of 23.95 V, the electrical energy consumption was calculated about 5.35 kWh/kg COD. Based on the results, electrochemical degradation method was found to be a highly efficient technology in comparison with existing conventional methods and could be considered as a cost-effective method to remove IM from water and wastewater.

Keywords: Imidacloprid; Electrochemical degradation; Agriculture wastewater; PbO_2 and stainless steel electrodes

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