Removal of Organic and Ammonium Nitrogen Pollutants in Swine Wastewater Using Electrochemical Advanced Oxidation

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In this study, tests were performed to examine the effects of with/without chloride addition, electrolyte (NaCl vs. Na₂SO₄), anode material (boron-doped diamond (BDD) vs. PbO₂), current density (0.10–0.50 A/cm²), and anode area (2–6 cm²) on the electrochemical abatements of organic pollutants (in terms of total organic carbon (TOC) or chemical oxygen demand (COD)) and ammonia nitrogen in swine wastewater. The results showed that the TOC degradation was greater in the absence of chloride, but an opposite trend was observed for NH₃-N electrochemical abatement. A similar phenomenon was also observed when replacing chloride with sulfate. In the presence of chloride, the NH₃-N removal efficiencies were similar on BDD and PbO₂, although the former anode was better for TOC degradation than the latter. The removal of both COD and NH₃-N increased with increasing current density or anode area on BDD. During the electrolysis of the wastewater, nitrite was not detected in the presence of chloride except in the absence of chloride, in the presence of Na₂SO₄, or on PbO₂ at 0.25 A/cm² and on BDD at 0.50 A/cm² in the presence of chloride. In the presence of chloride, the concentration of nitrate increased and then decreased with increases in electrolysis time for almost all the tested conditions. At 25°C and 0.25 A/cm², the pseudo-first-order rate constants for COD and NH₃-N removal were 7.05×10⁻⁴ and 6.40×10⁻⁴ 1/s, respectively, while the general current efficiency and specific energy consumption were 15% and 9 kWh/kg-COD, respectively on BDD (4 cm²).

Keywords: swine wastewater; organic pollutants; ammonia nitrogen; electrochemical degradation; boron-doped diamond (BDD) electrode

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