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SHORT RESEARCH AND DISCUSSION ARTICLE

Evaluation of azamethiphos and dimethoate degradation using chlorine dioxide during water treatment

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Abstract

Chlorine dioxide (ClO_2) degradation of the organophosphorus pesticides azamethiphos (AZA) and dimethoate (DM) (10 mg/L) in deionized water and in Sava River water was investigated for the first time. Pesticide degradation was studied in terms of ClO_2 level (5 and 10 mg/L), degradation duration (0.5, 1, 2, 3, 6, and 24 h), pH (3.00, 7.00, and 9.00), and under light/dark conditions in deionized water. Degradation was monitored using high-performance liquid chromatography. Gas chromatography coupled with triple quadrupole mass detector was used to identify degradation products of pesticides. Total organic carbon was measured to determine the extent of mineralization after pesticide degradation. Real river water was used under recommended conditions to study the influence of organic matter on pesticide degradation. High degradation efficiency (88–100% for AZA and 85–98% for DM) was achieved in deionized water under various conditions, proving the flexibility of ClO_2 degradation for the examined organophosphorus pesticides. In Sava River water, however, extended treatment duration achieved lower degradation efficiency, so ClO_2 oxidized both the pesticides and dissolved organic matter in parallel. After degradation, AZA produced four identified products (6-chlorooxazolo[4,5-b]pyridin-2(3H)-one; O,O,S-trimethyl phosphorothioate; 6-chloro-3-(hydroxymethyl)oxazolo[4,5-b]pyridin-2(3H)-one; O,O-dimethyl S-hydrogen phosphorothioate) and DM produced three (O,O-dimethyl S-(2-(methylamino)-2-oxoethyl) phosphorothioate; e.g., omethoate; S-(2-(methylamino)-2-oxoethyl) O,O-dihydrogen phosphorothioate; O,O,S-trimethyl phosphorodithioate). Simple pesticide degradation mechanisms were deduced. *Daphnia magna* toxicity tests showed degradation products were less toxic than parent compounds. These results contribute to our understanding of the multiple influences that organophosphorus pesticides and their degradation products have on environmental ecosystems and to improving pesticide removal processes from water.

Keywords River water sample · Organophosphorus pesticides · Chlorine dioxide treatment · Water quality · Ecotoxicity · Gas chromatography with triple quad mass detector

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