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Priority pesticide dichlorvos removal from water by ozonation process: reactivity, transformation products and associated toxicity

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ABSTRACT

The treatability of waters contaminated with priority pesticide dichlorvos (DDVP) by means of ozonation has been assessed for the first time. In order to do so, reaction kinetics, transformation mechanisms and associated toxicity have been inspected in detail. Second-order rate constants of DDVP reactions with O_3 and $OH\cdot$ were determined to be 590 and $2.2 \cdot 10^9 M^{-1}s^{-1}$, respectively. These values partly explained the degradation profiles obtained during experiments with and without the presence of an $OH\cdot$ scavenger, in which the significant contribution of the indirect degradative route in the removal of DDVP was revealed. LC-MS analyses for ozonated samples allowed the elucidation of desmethyl dichlorvos (d-DDVP), dichloroacetic acid (DCA) and dimethyl phosphate (DMP) as main transformation products (TPs). DMP was found to be present in both O_3 and $OH\cdot$ -mediated oxidation pathways. Three possible degradation routes were proposed for $OH\cdot$ degradation, whereas the direct oxidation by O_3 was only well-explained by the addition of this oxidant to the double bond of DDVP dichlorovinyl moiety. Microtox[®] bioassays revealed the inability of molecular ozone to reduce the toxicity of the medium and pointed out the importance of $OH\cdot$ contribution in the degradation process. In general, ozonation could be a suitable treatment alternative for DDVP, formed TPs and associated toxicity abatement.

KEYWORDS

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