Photocatalytic degradation of geosmin: Reaction pathway analysis

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Abstract

The presence of geosmin in drinking water imparts a musty odour which leads to consumer complaints. Geosmin and other unwanted organics can be treated using photocatalysis. However, the intermediates formed during the photocatalytic degradation process and their degradation pathways have not previously been described. In this study, the degradation profile, as well as the intermediates formed during the photocatalytic degradation of geosmin was monitored in an effort to obtain a better understanding of the degradation kinetics and pathway. Photocatalytic degradation of geosmin in the presence of radical scavengers was shown to be inhibited, as evidenced by the reduction in reaction rate coefficient (k') from 0.055 to 0.038 min^{-1}. The hydroxyl radical reaction was thus shown to be the predominant process over direct photolysis by incident UV energy. Results from mass spectrum analysis of degradation intermediates indicate rapid fission of sp^3—sp^3 (C—C) bonds resulting in ring opening of the cyclic geosmin structure. Bicyclic compounds that could be expected from dehydration and dehydrogenation of geosmin's ringed structure were not found among the detected intermediate products. Intermediates identified consisted of acyclic unsaturated alkenes, carbonyl compounds and some organic acids. Although the identified degradation products are not seen to be directly harmful, chlorine disinfection of water containing these compounds could produce potentially harmful halogenated hydrocarbons.

Keywords: photocatalysis, geosmin, 2-methylisoborneol (2-MIB), taste and odour, degradation intermediates