Formation of genotoxic compounds by medium pressure ultraviolet treatment of nitrate-rich water

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Received 20 February 2014; Accepted 15 May 2014

ABSTRACT

Genotoxic compounds were produced by full-scale medium pressure (MP) ultraviolet hydrogen peroxide (UV/H\textsubscript{2}O\textsubscript{2}) treatment of nitrate-rich pretreated surface water. It was hypothesized that this formation was caused by the reaction of nitrate photolysis intermediates with natural organic matter (NOM). An increase in the Ames test response was also found after MP UV photolysis of water containing Pony Lake NOM from the International Humic Substances Society (IHSS) and nitrate, while no increase in the Ames test response was found when nitrate was absent. The same trend in an Ames test response and nitrite formation was observed for both nitrate-rich pretreated surface water and reconstituted water containing NOM and nitrate. Therefore, the conversion of nitrate by MP UV photolysis was studied in several water types. In organic-free water, nitrate was completely converted into nitrite, while no inorganic nitrogen was lost. Also in nitrate-rich surface water, nitrite was found as the only inorganic reaction product, while a small decrease of the inorganic nitrogen content was observed. When NOM was replaced by phenol, MP UV photolysis caused a restricted nitrite formation only, together with a large loss of inorganic nitrogen. The formation of the nitrated phenol derivatives, 2- and 4-nitrophenol and 4-nitrocatechol, was observed with highest concentrations under practical UV conditions. It is hypothesized that the formation of nitrated aromatic compounds is the cause of the increased Ames test response by MP UV treatment.

Keywords: Ames test; UV; Nitrate photolysis; Genotoxicity; Nitration; Nitrosation

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