Effect of Water Treatment on the Gadolinium Cycle

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Complexes of the rare earth element gadolinium (Gd) are used as contrast agents in MRI diagnostics, which lead to an increasing input of dissolved Gd species into the aquatic environment [1]. These complexes are intendedly very stable to prevent patients from the toxic effects of free ionic Gd [2]. In most cases Gd complexes are excreted unmetabolized within 24 hours via urine [3]. Due to a lack of their elimination within conventional sewage water treatment, these compounds further reach surface and ground waters and become, at an increasing amount, trace constituents in drinking water being influenced by (un)treated sewage water [4].

Since rising numbers of anthropogenic substances are detected in drinking water, methods to eliminate these contaminants during water treatment are intensively discussed and might be implemented in the future. Elimination of Gd complexes would reduce the Gd input into the environment and can lead to recycling of anthropogenic Gd. This study therefore aimed at assessing the potential of eliminating anthropogenic Gd complexes during drinking water treatment, specifically in water disinfection.

Laboratory studies using different Gd complexes were performed to investigate their decomposition rates towards chlorination, UV radiation and heating as disinfection treatments. Samples were analyzed using liquid chromatography in combination with inductively coupled plasma mass spectrometry.

Our results show decomposition for all Gd complexes and indicate that decomposition rates depend on the chemical structure and stabilities of Gd complexes. Findings are in line with recent medical studies investigating the fate of Gd complexes in the human body [2].

References:

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