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Abstract

Cyanotoxin Removal from Water Using Activated Carbon Magnetic Beads †

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Abstract: There are many contaminants in water that may damage the health of people and animals, such as naturally occurring cyanotoxins, which have increased their presence in recent years due to climate change and eutrophication. Although water must pass through a treatment station before consumption, none of the treatment methods used are totally effective for the elimination of cyanotoxins. In this study, a complementary method for toxin removal is investigated which consists of using nanostructured beads with a magnetic core coated by an adsorption material. In contact with water, the beads are capable of adsorbing different toxic compounds on their surface and can be easily separated from water, afterwards, by a magnet. Adsorption spheres are prepared with nanostructured magnetite cores coated with activated carbon using sodium alginate as an agglutinating compound. The adsorption capacity of these magnetic beads is assessed with water solutions of microcystin-LR, cylindrospermopsin, and anatoxin-A. Toxin removal from water is evaluated by quantification using ultra-high-performance liquid chromatography coupled to tandem mass spectrometry. The results show that these activated carbon-coated magnetic beads can remove approximately 20% of microcystin-LR from mili-Q water at concentration levels 60 times higher than the WHO recommended level of 1 µg/L. With the same conditions, 20 % of cylindrospermopsin is also captured. For anatoxin-A, with a much smaller molecular weight, 70% is removed at a six-fold lower concentration. Toxin removal increases throughout the 2-h duration of the experiments. Microcystin-LR adsorption is affected by pH, with a higher removal at highly acidic or alkaline pHs. In addition, these beads can be regenerated and reused for several adsorption cycles. In summary, activated carbon magnetic beads can be used to remove cyanotoxins from water with varying effectiveness, depending on toxin size and solution pH, and they can be reused for several removal cycles after optimized regeneration protocols.

Keywords: magnetic beads; activated carbon; cyanotoxins; detoxification

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