THE OHIO STATE UNIVERSITY

Environmental Science Graduate Program Student Seminar Series

Evaluating the removal of microcystin variants with powdered activated carbon

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Abstract

In our research, we focus on studying the adsorption of algal toxins to activated carbon and today we will look at how differences in the properties of microcystin (MC) variants alter their interactions with powdered activated carbon (PAC). These systems were studied using batch experiments evaluating the kinetics of MC-LR, MC-LA, MC-RR and [DAsp3]-MCRR adsorption with wood, coal-blend and coal-based PAC. These experiments were conducted in model fresh water with different concentrations of natural organic matter. The three types of PAC have different sources and properties such as pHpzc, surface area, total pore volume and volume of mesopores. The results show the wood PAC adsorbs all of the microcystin variants more rapidly and to a greater extent than the other PAC types, while the coal-blend and the coal-based PAC have similar adsorption capacities. These results indicate that PAC properties influence the adsorption rate and capacity. In the case of the wood PAC, it has the most mesopores, the largest surface area and the highest total pore volume of the PACs tested. This suggests these physical properties of the PAC provides a reference for selecting PAC for treatment of water with microcystins. The adsorption rates and extents of the different microcystin variants also varied, with MC-RR adsorbing the most and the most rapidly on all PAC types. This variant is neutrally charged, suggesting the charge of microcystin variants plays an important role in affecting both adsorption capacity and adsorption rate. Competition with the natural organic matter was also assessed and the results indicate that natural organic matter inhibits microcystin adsorption, because for all PAC types the largest adsorption extent and highest adsorption rate occurred in the absence of natural organic matter. However, this competition did not increase with natural organic matter concentration. Overall, these results reflect that PAC properties and variations in the microcystin variants present during harmful algal blooms need to be considered in treatment decisions. For selecting PAC, a high volume of mesopores leads to a high adsorption capacity of microcystin. While more results are needed, our initial results indicate that microcystin variants with neutral charge are most effectively removed. Also, removing natural organic matter in the water before the treatment of algal toxins can improve the removal of microcystin.