AN ABSTRACT OF A THESIS

ANALYSIS OF ACTIVATED CARBON-HUMIC SUBSTANCE INTERACTIONS USING FLOW FIELD-FLOW FRACTIONATION

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Activated carbon treatment in drinking water applications can be used to remove organic contaminants such as pesticides and organic precursors to disinfection byproducts. The organic precursors that can lead to the formation of disinfection byproducts include humic substances present in natural organic matter. Although these humic substances generally have a large number of charged functional groups, the innate hydrophobic nature and size of these compounds render them amenable to activated carbon adsorption. Natural organic matter present in the water can also interfere with activated carbon treatment by blocking the porous structure of the carbon. The nature of this interference can be characterized by looking at the fractions of humic substances that are removed by the activated carbon adsorption process. Both batch equilibrium studies and minicolumn studies were performed using granular activated carbon to treat humic substances.

Flow field-flow fractionation (FFF) is a useful analytical tool for this type of environmental application. One advantage of utilizing flow FFF is the ability to characterize macromolecules according to diffusion coefficients and molecular weight distributions, which can in turn yield information about the fate and transport of pollutants in the environment. Moreover, flow FFF is a nondestructive technique allowing for further analysis of macromolecule fractions. The scope of this research was to develop the use of flow FFF as an analytical tool to observe interactions between humic substances and activated carbon.

The experimental methodology required to utilize flow FFF as a monitoring technique for activated carbon adsorption of humic substances was developed. This involved automation of the flow FFF system, integration of fluorescence detection, and increasing detectability. Adsorption isotherms were constructed using ultraviolet absorbance - dissolved organic carbon calibration and integration of FFF data for Aldrich humic acid at pH 6 and 9, an Aldrich extract at pH 6, and Suwannee Fulvic Acid at pH 6. Increased adsorption was observed at pH 6 as compared to pH 9 for Aldrich humic acid. The pH effect was more pronounced for fluorescing species present in the Aldrich humic acid solution. For each of the humic substances mentioned above, preferential adsorption of the fluorescing components was shown to occur. The use of FFF data to create breakthrough curves was also illustrated.

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