Biochemical characterization of algal flocs using spectroscopic techniques: towards improved understanding of coagulation and flocculation

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Abstract

Algal and cyanobacterial blooms in freshwater water sources may cause serious challenges in drinking water production. Organic compounds released by the cells can cause water discoloration, odor and toxicity problems as well as operational problems in the drinking water treatment plants. Conventionally, algae is treated using coagulation–flocculation (C-F) followed by physical solid-liquid separation (sedimentation or filtration). Therefore, C-F is a key barrier to algal treatment at water facilities due to its effectiveness, simplicity and low cost. However, C-F is difficult to optimise due to various factors affecting the process, leading to carryover of cells and coagulant to downstream processes. Research in a water treatment context has focused on natural organic matter (NOM) and turbidity particles. A greater, understanding of coagulation of algal cells and resultant flocs properties is required to improve process robustness. The aim of this study was to examine the physical and chemical floc properties of algal and cyanobacterial species found in water reservoirs in Australia using a range of coagulation conditions, and to advance knowledge on the customization of the C-F process when treating algae-laden drinking water sources. A novel technique to analyse the chemical fingerprint of algal cell, flocs and algogenic organic matter using a spectroscopic technique (Fourier transform infrared spectroscopy) was used. This study showed that FTIR is a powerful technique for analysis of algal flocs as allows the detection of changes in the organic character in the flocs and visualization of the distribution of biomolecules.