Characterisation of the fouling of a ceramic microfiltration membrane by soluble algal organic matter released from *Microcystis aeruginosa*

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Blooms of blue-green algae such as *Microcystis aeruginosa* in aquatic systems can result in substantial algal organic matter (AOM) entering downstream water treatment facilities. It has been demonstrated in a number of recent studies that AOM can cause severe fouling of low pressure membrane filtration systems [1, 2]. In this work the distribution of the foulant on a ceramic microfiltration membrane, and the effects of feed solution chemistry (AOM concentration, pH and ionic strength) and transmembrane pressure (TMP) on the severity of the AOM fouling were investigated. The AOM was extracted from a *M. aeruginosa* culture at stationary growth phase. The filtration experiments were conducted using a lab scale ceramic membrane system (ZrO$_2$–TiO$_2$, 0.1 µm) in dead-end mode at a constant pressure of 70 kPa. A 3-step cleaning approach, namely crossflow flush, dead-end backwash and cross-flow chemical cleaning, was employed to clarify the roles of AOM components in the membrane fouling. The foulant layer which could be removed by crossflow flush contributed to the majority of the fouling resistance (i.e., 68% of the total resistance), suggesting the most flux reduction was due to the deposition of large sized AOM components on the membrane surface. It was revealed by size exclusion chromatography and fluorescence excitation emission matrix analyses that the flushable foulant contained mainly biopolymers. Higher AOM concentration led to higher flux decline and irreversible membrane fouling. No apparent impact of pH over the range of pH 6-9 was observed on the flux. However, the reversibility of the fouling decreased with decreasing pH, which was attributed to more low-molecular weight AOM molecules entering the membrane pores at lower pH as a result of the reduced electrostatic repulsion between AOM molecules and the membrane. Higher ionic strength of the AOM solution gave greater flux decline and lower fouling reversibility. This was most likely due to the increased thickness and compactness of the foulant layer as the result of the reduced repulsion between AOM molecules at high ionic strength environment. Increased AOM fouling potential was observed at higher TMP condition (i.e., 50% of flux decline and 4.22 $\times$ 10$^{11}$ m$^{-1}$ of reversible fouling resistance at 50 kPa cf. 60% of flux decline and 2.60 $\times$ 10$^{11}$ m$^{-1}$ of reversible fouling resistance at 100 kPa). This was due to the compressible AOM foulant layer which becoming more compact at higher TMP condition and more AOM molecules being pushed into the membrane pores.

**Key Words:** Algal organic matter; microfiltration; ceramic membrane; fouling

**References**
