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Potential of fluorescence excitation emission matrix (FEEM) analysis for foulant characterisation in membrane bioreactors (MBRs)

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ABSTRACT

The relative impact of soluble microbial products (SMP) on membrane bioreactor (MBR) fouling is widely recognized. However, no direct relationship between fouling propensity and the SMP concentration in the bioreactor has been clearly established yet. This is due to (1) the lack of standard methods for SMP characterisation, (2) the limitations of the methods used so far, and (3) the characterisation of the SMP in supernatant rather than those deposited on the membrane surface. The aim of this paper is therefore to identify the feasibility of a novel technology, the fluorescence excitation-emission matrix (FEEM) spectrophotometry to characterise the supernatants and the foulant fractions. Foulant fractions are obtained by rinsing, backwashing (BW) and chemical cleaning (CC) the membrane modules, from two MBRs operated under different solid retention times (SRTs). FEEM was able to provide qualitative and quantitative information about the compounds present in MBR. In this study, FEEM results demonstrated that tryptophan-like proteins dominated in most samples rather than humic/fulvic-like substances. As expected, FEEM of the permeate collected from lab-scale ultrafiltration (UF) demonstrated that, these larger molecular weight proteins rather than humics were retained by membranes. These proteins were also in higher ratio in the chemical cleaning solutions of both MBRs, revealing preferential attachment to the membrane surface. Thus, proteins and humic compounds present in supernatants and their preferential deposition on or into membrane surface could be efficiently characterised in a simple, robust, non-destructive method like the FEEM analysis.

Keywords: Membrane bioreactor (MBR); Foulants; Cleaning; FEEM; Fouling layers; LC-OCD

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