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Understanding the fouling of UF/MF hollow fibres of biologically treated wastewaters using advanced EfOM characterization and statistical tools

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HIGHLIGHTS

- Coupling of EEM and LC-OCD predicts the fouling potential of secondary effluents.
- Identification of the OM characteristics responsible for a high fouling potential.
- Correlation between protein content indicators and a high fouling potential.
- Differentiation of HS from terrestrial origin and HS produced in biological reactors.
- Impact of biological treatment on the EfOM composition by OM characterization.

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ABSTRACT

Five secondary effluents and a river water source were characterized using size exclusion chromatography (LC-OCD-UVD-OND) and emission–excitation matrix (EEM) fluorescence spectroscopy in order to identify the major effluent organic matter (EfOM) fractions responsible for membrane fouling. This study showed the feasibility of coupling fluorescence EEM and LC-OCD-UVD-OND to investigate the fouling potential as well as a means to differentiate natural organic matter (NOM) from EfOM. The secondary effluents and river water showed a significant difference in organic matter characteristics and fouling potential, highlighting the importance of biological processes and the feed water source on EfOM characteristics and fouling potential. On the basis of statistical analysis, protein-like substances were found to be highly correlated to the fouling potential of secondary effluents.

1. Introduction

Treated sewages have been considered for wastewater reuse and/or reclamation to resolve water shortages. Wastewater reclamation plants mainly use biological processes as secondary treatment for the removal of suspended solids, organics and nutrients followed by membrane filtration in order to produce high quality water suitable for reuse purpose. However, a major issue in wastewater treatment plant is membrane fouling. Membrane fouling results in reduction of membrane performance and the need for cleaning. Effluent organic matter (EfOM) has shown to play an important role in this phenomenon (Amy, 2008; Shon et al., 2006). Therefore, several studies aimed to characterize the composition of the EfOM to better understand the effects on membrane fouling (Jarusutthirak et al., 2002; Shon et al., 2006).

EfOM is described as a combination of natural organic matter (NOM) and soluble microbial products (SMP). NOM in waters is derived from plant or terrestrial (allochthonous) and algal (autochthonous) sources and it is composed of higher molecular weight refractory humic and fulvic substances, lower molecular weight proteins, organic acids, carbohydrates and other possible

Abbreviations: EfOM, effluent organic matter; EEM, emission–excitation matrix fluorescence spectroscopy; NOM, natural organic matter; SMP, soluble microbial products; BP, biopolymers; HS, humic substances; BB, building blocks; LMW, low molecular-weight; OND, organic nitrogen detection; SUVA, specific UVA; UF, ultrafiltration; MF, microfiltration; CAS, conventional activated sludge processes; MBR, membrane bioreactor; TOC, total organic carbon; DOC, dissolved organic carbon; MW, molecular weight; LC-OCD-UVD-OND, liquid chromatography with organic carbon, UVA and organic nitrogen detections; FRI, fluorescence regional integration; Ex, excitation; Em, emission; UMFI, unified membrane fouling index; PCA, principal component analysis; CTOC, chromatographic organic carbon values; HOC, non-chromatographic organic carbon values.

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