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Characteristics and simulation of soluble microbial products in membrane bioreactors coupled with moving carriers (MBR-MC)

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ABSTRACT

In this study, three lab-scaled membrane bioreactors (MBRs) coupled with moving carriers (MC) were operated under different sludge retention times (SRTs = 10, 30 and 50 d) for the treatment of synthetic wastewater. The characteristics of soluble microbial products (SMP) at each SRT were examined. The concentration of SMP in the supernatant firstly decreased from around 31.5 to 24.3 mg l^{-1} when the SRT was increased from 10 to 30 d, and then showed a little increase as the SRT was further extended to 50 d. The profile of the molecular weight distribution (MWD) showed that the SMP had a wide spectrum of molecular weight. The dominant fraction with molecular mass higher than 10 kDa increased from 55.9% to 63.8% with the increase of the SRT from 10 to 50 d, while the two other fractions (1 kDa <MW <10 kDa and MW<1 kDa) subtly decreased. The excitation–emission matrix fluorescence spectroscopy (EEM) revealed that the SMP had three similar peak locations regardless of the SRT and the quenching effect of humic-like substance on protein should be considered. Response surface methodology was used to evaluate the effects of SRT, hydraulic retention time (HRT), temperature and aeration rate on the SMP production. The optimal parameters were obtained at an SRT of 33 d, an HRT of 10 h, a temperature of 19°C and an aeration rate of 1.5 m^3 h^{-1}, giving rise to an SMP of 23.9 mg l^{-1}. These results may serve as a useful guide for optimizing the operational parameters of the MBR-MC system to minimize the SMP production, and accordingly, improve the permeate quality and alleviate membrane fouling.

Keywords: Membrane bioreactor; Moving carrier; Soluble microbial products; Characteristics; Response surface methodology

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