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Biodegradation of olive mill wastewater in a membrane bioreactor: acclimation of the biomass and constraints

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ABSTRACT

In order to overcome the toxic effect of olive mill wastewater (OMWW) on biomass during biological treatment, this work will test OMWW biodegradation in a membrane bioreactor (MBR) using an acclimation procedure and will study its constraints. Special focus will be put on soluble microbial products (SMP) analysis in MBR and their impact on membrane fouling. The study was realized in an external ceramic ultrafiltration MBR which offers more flexibility than the other biological treatments (i.e. independence between both hydraulic and sludge retention time) and a smaller footprint. Fed with a mass ratio of 40% OMWW/60% glucose, MBR biomass showed efficient chemical oxygen demand and polyphenols removal rates of, respectively, 90 and 65% despite a low activity of 3.2 $mg_{O2}\ g_{MLVSS}^{-1}\ h^{-1}$ due to the harsh and toxic environment. Moreover, HPLC analysis has showed a removal from the permeate of the major phenolic compounds including hydroxytyrosol, tyrosol, and caffeic acid. The monitoring of SMP concentrations has contributed to identify the presence of an environmental stress during OMWW input. Polysaccharide and protein are the main SMP fractions released with, respectively, 10 ± 0.1–20 ± 0.5 mg g_{MLVSS}^{-1} and 4 ± 0.01–8 ± 0.01 mg g_{MLVSS}^{-1}. These SMP and higher molecular weight compounds brought by OMWW were found to be partially responsible for the intensive membrane fouling obtained. The feasibility of biomass acclimation directly to OMWW composed of multi-phenolic compounds was proved in MBR and its constraints were discussed. Microfiltration membrane would be suggested to overcome the constraints observed when ultrafiltration membrane was used (150 kDa).

Keywords: Acclimation; External ceramic membrane bioreactor; Soluble microbial products; Fouling; Olive mill wastewater

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