Performance and microbial behavior of submerged membrane bioreactor at extremely low sludge ages

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ABSTRACT

The study investigated the effect of sludge age on substrate utilization kinetics, soluble microbial product generation, and composition of the microbial community sustained in a superfast submerged membrane bioreactor (SSMBR). For this purpose, a laboratory-scale membrane bioreactors (MBR) unit was operated at steady state, with three different sludge ages in extremely low range of 0.5–2.0 d, and a hydraulic retention time of 8.0 h. Substrate feeding was adjusted to 220–250 mg COD/L and involved a synthetic mixture representing the readily biodegradable COD fraction in domestic sewage. The MBR operation at sludge age of 1.0 d was duplicated with acetate feeding as the sole organic carbon source. Under different operating conditions, SSMBR was able to secure complete removal of available soluble/readily biodegradable substrate, with a residual microbial product level as low as 20–30 mg COD/L, partly retained and accumulated in reactor volume. Phylogenetic analysis based on polymerase chain reactions-denaturing gradient gel electrophoresis analysis indicated that selected sludge ages affected the composition of microbial community. Lower sludge ages selected a community characterized by faster rates for microbial growth. Results confirmed the existence of a functional relationship between variable process kinetics and changes in the microbial community structure, even for slight variations that can be inflicted on the culture history while operating superfast MBR systems.

Keywords: Respirometry; Process kinetics; Microbial composition; Soluble microbial products; Superfast membrane bioreactor

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