Submerged anaerobic membrane bioreactor for wastewater treatment: Effect of mean cell residence time on membrane flux, mixed liquor characteristics and overall reactor performance

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1 THESIS ABSTRACT

Mean cell residence time (MCRT) is a major operational parameter in all biological treatment systems because of its relationship to growth rate and thus to metabolic activity. Due to their mode of operation, submerged anaerobic membrane bioreactors (SAnMBR) offer a homogeneous system in which MCRT can be simply controlled through volumetric wastage. Although a number of studies using SAnMBR have been reported, however, little information is available regarding the effect of MCRT on operational performance, mixed liquor characteristics and the influence of these on membrane performance. In this research an innovative SAnMBR using gravity-induced transmembrane pressure to maintain flux was developed and tested for first time. This configuration was then used to evaluate the impact of MCRT on membrane flux, mixed liquor characteristics and overall performance of SAnMBRs treating low-to-intermediate strength wastewater.

Long-term experimental periods of more than 240 days allowed steady-state conditions under different MCRTs, in which the mixed liquor suspended solids (MLSS) adjusted to the applied load, making possible to assess the influence of this growth and metabolism-dependent kinetic parameter. The SAnMBRs were monitored for membrane flux, overall process efficiency and mixed liquor characteristics when operating at 36 °C and 20 °C.

The results of this work showed that at both operational temperatures, the MCRT has a significant effect on the mixed liquor characteristics, particularly on the filterability which was higher at short MCRTs. This resulted in improved membrane flux at relatively short MCRT, although no advantages were observed if the MCRT was further reduced. Higher specific methane production was observed at longer MCRT, most probably due to a higher fraction of carbon incorporated into biomass as a result of higher microbial growth rates. Overall, the results of this research showed that the MCRT has a considerable effect on the mixed liquor characteristics and thus on the membrane fouling and overall reactor performance. It is clear that there is a trade-off to be made between enhanced membrane performance, specific methane production and sludge yield when considering the most suitable operational MCRT. Further studies are required to identify the optimum MCRT for a wider range of wastewater and other operational parameters and to fully understand the causes of these effects.
2 ADDITIONAL INFORMATION

2.1 Supervisory team
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3 PUBLICATIONS
