Effects of the hydraulic retention time on the fouling characteristics of an anaerobic membrane bioreactor for treating acidified wastewater

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ABSTRACT
This study focused on the effect of hydraulic retention time (HRT) effect on microbial activity and fouling potential in submerged anaerobic membrane bioreactors (AMBRs). Three submerged AMBRs were operated at HRT of 14, 16, and 20 days with polypropylene U-shaped hollow fiber microfiltration membranes (nominal pore size = 0.45 µm; effective filtration area = 0.003 m²). Extracellular polymeric substances (EPS) and soluble microbial production (SMP) production increased as HRT was decreased from 20 to 14 days: from 24.2 to 29.4 mg/g volatile suspended solids (VSS), from 105.2 to 357.1 mg dissolved organic carbon (DOC)/L, respectively. Although high production of EPS and SMP at short HRT caused high cake resistance, it improved soluble COD removal efficiency by preventing small particles or macromolecules from passing through the membrane. Microbial floc in sludge showed similar resistance values regardless of HRT, while colloids and solutes had higher fouling potential than microbial floc, and this trend was severer at short SRT. In conclusion, in the operation of submerged AMBRs, HRT can significantly affect the cake formation on the membrane surface, which causes severe fouling. However, this cake layer plays a major role in additional organic removal, as it acts as a dynamic membrane.

Keywords Anaerobic membrane bioreactor (AMBR); Hydraulic retention time (HRT); Membrane fouling; Sludge characteristics; Dynamic membrane

Conventional anaerobic digestion. With application of microfiltration or ultrafiltration, AMBR can offer a solid free final effluent and ultimately decrease the burden of post-treatment, which is one of the major disadvantages of the conventional anaerobic biological process.

A major obstacle to wide application of AMBRs, however, is membrane fouling. Studies have found that a number of factors affect membrane fouling: hydrodynamic conditions, membrane materials, sludge properties, substrate compositions, and so on [1]. HRT is a very