Process performance and microbial community functional structure in a thermophilic anaerobic baffled reactor coupled with biocatalysed electrolysis

In this study, the performances of a conventional anaerobic baffled reactor (ABR) and an ABR combined with microbial electrolysis cells (MECs) for enhancing degradation of volatile fatty acids (VFAs) were evaluated in 55°C. The ABR-MECs system achieved a total chemical oxygen demand (COD) removal rate of 97.2% and a methane yield of 236±5 mL g⁻¹ CODremoved at organic loading rate (OLR) of 6.9 kg COD m⁻³ d⁻¹, which were higher than those of the ABR with 77.6% and 207±5 mL g⁻¹ CODremoved, respectively, at OLR of 5.1 kg COD m⁻³ d⁻¹. The pyrosequencing analysis confirmed that the introduction of MECs into ABR was conducive to establishing stable functional communities of syntrophic fatty acids oxidizing bacteria (SFOB), exoelectrogens and hydrogenotrophic methanogens, such as Syntrophobacter (5.4%), Thermodesulfovibrio (2.0%), Methanobacterium (43.8%), Methanolinea (20.4%). The content of unclassified bacteria increased from 12.4% in the ABR system to 52.3% in the ABR-MECs system. In contrast, the proportion of aceticlastic methanogens decreased from 50.1% in the ABR to 24.5% in the ABR-MECs system. The improved performance of the thermophilic ABR-MECs system resulted from phase separation, wide ecological niche and intensification of methanogenesis process via functional microbes, which significantly enhanced the degradation of propionic acid and acetic acid.

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