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Biological nutrient removal and fouling behavior in an UCT-MBR process: synergistic effects of aeration intensity and mixed liquor recycling ratio

Zhaozhao Wang[a], Kai Zhang[a], Changwen Wang[b], Lina Yan[c], Wei Zhang[a], Fengbing Tang[a], Simin Li[a,*]

[a]*College of Energy and Environmental Engineering, Hebei University of Engineering, Handan, 056038, China, Tel. +8618303233729, email: W-Z-Z@163.com (Z. Wang), hebeizuiqingfeng@163.com (K. Zhang), zhangwei1981@hebeu.edu.cn (W. Zhang), fbtang1004@163.com (F. Tang), 18303233729@163.com (S. Li)*
[b]*College of Resources and Environment, Linyi University, Linyi, 276000, China, email: wangchangwen@lyu.edu.cn (C. Wang)*
[c]*Graduate School, Hebei University of Engineering, Handan 056038, China, email: yanlina01@126.com (L. Yan)*

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ABSTRACT

A bench-scale university of cape town-membrane bioreactor (UCT-MBR) process was operated treating real municipal wastewater with reference to the synergistic effects of aeration intensity and mixed liquor recycling ratio on biological nutrient removal performance and membrane fouling propensity. Results showed that chemical oxygen demand (COD) and NH_4^+-N removal was slightly dependent on variations in aeration intensity and recycling ratio. The increase in recycling ratio strengthened the enrichment of denitrifying poly-phosphate accumulating organisms (DPAOs) and the anoxic dephosphorization efficiency. The largest ratio of DPAOs to poly-phosphate accumulating organisms (PAOs) (50.7%) could be obtained when a low aeration intensity (100–125 L/h) and the highest recycling ratio (r_1: 400%) were demonstrated. In contrast, a higher aeration intensity level (250–300 L/h) resulted in the deterioration of the anoxic dephosphorization efficiency, decreasing to 78%, 77.03% and 70% from 93%, 92.6% and 79.6% (r_1 from 400% to 200%), respectively. The bio-cake resistance was significantly reduced by a higher aeration intensity notwithstanding higher concentrations of extracellular polymeric substances (EPS). The combined shear forces induced by these two parameters promoted the smaller-size particles and higher concentrations of soluble microbial products (SMP) in the bulking sludge which resulted in the increased resistance of deep pore clogging. Fourier transform infrared spectroscopy (FT-IR) analysis revealed that variations in these two parameters had no effect on the main composition of organic matters in the membrane foulants.

Keywords: Membrane bioreactor; Aeration intensity; Mixed liquor recycling ratio; Denitrifying dephosphorization; Membrane fouling

*Corresponding author.