Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.20504

70 (2017) 275–283
April

Nitrogen removal and microbial community structure in membrane bioreactors with addition of alkali-rice straw

Yu-Li Yang[a], Xiao-Li Yang[a,*], Jia-Jun Wu[a], Jiang Qi[a], Shuai Luo[b]

[a]*School of Civil Engineering, Southeast University, Nanjing 210096, China, Tel. +86-25-83790757; Fax: +86-25-83790757; emails: yangxiaoli@seu.edu.cn (X.-L. Yang), yuli903@vt.edu (Y.-L. Yang), 925184938@qq.com (J.-J. Wu), 582255734@qq.com (J. Qi)*
[b]*Department of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA, email: shuai287@vt.edu (S. Luo)*

Received 26 August 2016; Accepted 12 January 2017

ABSTRACT

Effective carbon source plays a key role in denitrification process in membrane bioreactors (MBRs). In this study, alkali-rice straw was applied to a submerged hybrid MBR to achieve the nitrogen removal enhancement. It was found that total nitrogen (TN) removal of MBR with 1.4 g/d alkali-rice straw addition was 60.8% ± 1.5%, much higher than 44.5% ± 2.3%, 28.9% ± 5.4% from the MBR with 1.4 g/d normal rice straw addition and with 3.0 g/L PVC carrier addition, respectively, but lower than 77.5% ± 3.8% from the MBR with 4.0 g/d ethanol addition. However, chemical oxygen demand (COD) removal of MBR with 1.4 g/d alkali-rice straw addition was 94.6% ± 0.2% higher than 93.2% ± 0.3%, 91.8% ± 0.2% and 90.0% ± 0.4% from the MBR with 1.4 g/d rice straw addition, with 3.0 g/L PVC carrier addition, and with 4.0 g/d ethanol addition, respectively. Though the effect of alkali-rice straw on carbon release was not comparable with ethanol, it could have longer carbon releasing period to improve the carbon utilization rate, provide space for bacterial attachment, and promote the granular biofilm formation to reduce biofouling and increase COD removal efficiency. With alkali-rice straw addition, the dominant microbial community (*Curvibacter, Nitrosomonas, Pseudomonas, Magnetospirillum, Paracoccus*) in membrane bioreactor (MBR) was different from that with addition of other carbon source. Among these bacteria, the denitrifiers were dominantly expressed by nirS gene, and quantitative polymerase chain reaction of nirS gene in MBR with alkali-rice straw addition showed that its abundance was greatly higher than that with common rice straw addition. In summary, alkali-rice straw could serve as effective carbon source to enhance TN removals in MBRs.

Keywords: Alkali-rice straw; Carbon source; Denitrification; Membrane bioreactors; Microbial community structure

* Corresponding author.

1944-3994/1944-3986 © 2017 Desalination Publications. All rights reserved.