Bioresource Technology 126 (2012) 358–361

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Short Communication

Anaerobic digestibility of the waste activated sludge discharged from large-scale membrane bioreactors

Zhiyong Yu, Xianghua Wen *, Meilan Xu [1], Meng Qi, Xia Huang

Environmental Simulation and Pollution Control State Key Joint Laboratory, School of Environment, Tsinghua University, Beijing 100084, China

HIGHLIGHTS

- The waste activated sludge discharged from MBRs has poor anaerobic digestibility.
- High inorganic content will reduce the accessibility of substrate to microorganism.
- The humic-like substances absorbed in the WAS will be released during digestion.

ARTICLE INFO

Article history:
Received 24 July 2012
Received in revised form 7 September 2012
Accepted 10 September 2012
Available online 14 September 2012

Keywords:
Waste activated sludge
Anaerobic digestibility
Membrane bioreactor
Conventional activated sludge processes
Wastewater composition

ABSTRACT

Anaerobic digestibility of the waste activated sludge (WAS) discharged from large-scale membrane bioreactors (MBRs) and conventional activated sludge processes (CASs) were compared using batch trials. Four wastewater treatment plants were sampled. Results showed that the sludge from MBRs had poor anaerobic digestibility as it had lower volatile solid (VS) reduction rate and lower maximum biogas production rate. The partial sludge stabilization during the long sludge retention time (SRT) typically applied in MBRs was the possible reason. On the other hand, the difference in wastewater composition had a great impact on the properties of activated sludge and the downstream sludge digestion. Inorganic matter accumulation in the WAS may hinder the access of microorganisms to substrate. The humic-like substances accumulating in the activated sludge was expected to contribute to the worse digestibility and these substances were observed to be released during anaerobic digestion through three-dimensional excitation–emission matrix (EEM) fluorescence spectra.

1. Introduction

Membrane bioreactors (MBRs) are being increasingly used for municipal and industrial wastewater treatment due to the requirement for excellent effluent quality. Since membrane fouling is widely considered as a major obstacle to the application of MBRs, considerable investigations had been performed to understand membrane fouling in detail. The differences of sludge properties between MBRs and conventional activated sludge (CAS) processes had been compared as well (Holbrook et al., 2005; Hu et al., 2012; Masse et al., 2006). However, comparatively little attention has been paid to the influence of membrane technology on waste activated sludge (WAS) treatment that commonly represents up to 50% of the current operation costs of a conventional wastewater treatment plant (WWTP). It was reported that, more than a hundred full-scale MBR installations were in service by the end of 2009 in China, providing a treatment amount of nearly 1.2×10^6 m^3/d (Huang et al., 2010). A quick increasing amount of WAS would be discharged with the continuous construction of MBRs, resulting in a serious problem. Therefore, the investigation of the impact on WAS properties deriving from membrane separation become compulsory.

Anaerobic digestion offers an attractive method for WAS disposal in the modern WWTP. Biogas is a common product during anaerobic treatment, and moreover, the volatile fatty acids generated during hydrolysis stage were expected to be a valuable carbon source (Xiong et al., 2012). However, some variables were identified to affect the WAS digestibility, such as sludge retention time (SRT). The long SRT would probably lead to poor specific gas production, since endogenous metabolism occurs at low organic loading rate. Actually, MBRs were generally operated at long SRT. The poor sludge digestibility had been testified for pilot-scale MBR (Bolzonella et al., 2005), however, no investigation was performed for large-scale plants. Additionally, it is noteworthy that the wastewater quality directly affects the characteristics of the aerobic activated sludge, which would subsequently determine the sludge digestibility. It is important to consider the impact of influent in

* Corresponding author. Tel.: +86 10 62772837; fax: +86 10 62771472.
E-mail address: xhwen@tsinghua.edu.cn (X. Wen).
[1] Current address: Department of Environmental Engineering, Xiamen University of Technology, Xiamen 361009, China.

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.09.024