Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2019.24233

158 (2019) 97–104
August

Simultaneous nitrification and denitrification using a novel up-flow bio-electrochemical reactor

Qi Tang[a,b], Meng Zheng[a], Yanqing Sheng[a,*], Robert J.G. Mortimer[c]

[a]*Research Center for Coastal Environment Engineering Technology of Shandong Province, Yantai Institute of Coastal Zone Research, Chinese Academy of Sciences, Yantai 264003, China, Tel. +86-535-210-9265; Fax: +86-535-210-9000; emails: yqsheng@yic.ac.cn (Y. Sheng), qtang@yic.ac.cn (Q. Tang), mzheng@yic.ac.cn (M. Zheng)*
[b]*University of Chinese Academy of Sciences, Beijing, China*
[c]*School of Animal, Rural and Environmental Sciences, Nottingham Trent University, Brackenhurst campus, Southwell, Nottinghamshire NG25 0QF, UK, email: Robert.Mortimer@ntu.ac.uk*

Received 23 October 2018; Accepted 6 April 2019

ABSTRACT

Nitrogen removal is a problem in the field of water treatment, especially in the presence of sulfate. Conventional nitrification and denitrification are usually carried out in two separate reactors. In addition, the effect of sulfate on hydrogenotrophic denitrification is not clear. In this study, simultaneous nitrification and denitrification (SND) for nitrogen removal from water was conducted using a single novel up-flow bio-electrochemical reactor (UBER). The influence of dissolved oxygen (DO) on nitrogen removal was investigated. When influent DO was 7.0–8.0 mg L^{-1}, a heterotrophic nitrification zone (with DO 3.2–5.5 mg L^{-1}) and a hydrogenotrophic denitrification zone (with DO 1.6–4.2 mg L^{-1}) were obtained within the reactor, and the removal rates of NH_4^+–N and TN reached more than 90%. The distribution of DO inside developing biofilms was measured using microelectrodes. When DO in the hydrogenotrophic denitrification zone was 2.9 mg L^{-1}, DO inside the biofilm was just 0.5 mg L^{-1}. The effect of sulfate on hydrogenotrophic denitrification was studied by regulating the S/N ratio of influent water. Simultaneous removal of nitrate and sulfate can be achieved at low S/N, and the removal rates of nitrate and sulfate were ~80%. With increasing S/N ratio, sulfide produced by sulfate reduction inhibited both denitrification and further sulfate reduction.

Keywords: Nitrification and denitrification; Bio-electrochemical reactor; Biofilm; Sulfate

* Corresponding author.