Chemical Engineering Journal 217 (2013) 466–474

Contents lists available at SciVerse ScienceDirect

Chemical Engineering Journal

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

Start up of a gravity flow CANON-like MBR treating surface water under low temperature

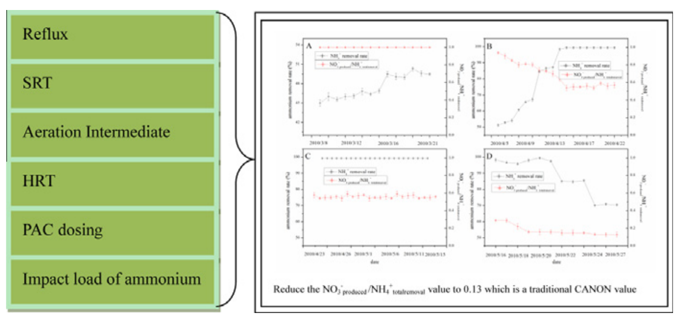
Zhaozhi Wang [a], Heng Liang [a,*], Fangshu Qu [a], Jun Ma [a], Jie Chen [b], Guibai Li [a]

[a] State Key Laboratory of Urban Water Resource and Environment (SKLUWRE), Harbin Institute of Technology, 73 Huanghe Road, Nangang District, Harbin 150090, PR China
[b] Suzhou Litree Membrane Separation Technology Ltd. Co., Suzhou 215152, PR China

HIGHLIGHTS

- ▶ Reflux can give the MBR system a better mixture.
- ▶ SRT did not have effect on washout of NOB but related to membrane fouling.
- ▶ DO is the key factor to control ANAMMOX process treating surface water even under low temperature.
- ▶ Increasing the ammonium loads can really make the ANAMMOX process dominant in the MBR system.
- ▶ Sustainable flux is the key to make this MBR system more sustainable.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 19 June 2012
Received in revised form 3 November 2012
Accepted 14 November 2012
Available online 22 November 2012

Keywords:
Low temperature
CANON
Sustainable flux
Surface water
DO

ABSTRACT

Operation conditions such as reflux, sludge retention time (SRT), aeration intermediate, hydrogen retention time (HRT) and powder active carbon (PAC) dosing were optimized to start up a CANON-like MBR. Reflux can give the MBR system a good mixture. SRT did not have much effect on washout of nitrite oxidized bacteria (NOB) but related to membrane fouling. Decreasing aeration intermediate reduced ammonium removal rate to 50% due to the limited oxygen, but nitrification was dominant. HRT did not have much influence on ammonium removal rate, whereas reduce the $NO_3^-{}_{produced}/NH_4^+{}_{totalremoval}$ value to 0.8. PAC played a great role in ammonium removal and reduced the $NO_3^-{}_{produced}/NH_4^+{}_{totalremoval}$ value to 0.55. Under the optimized operation conditions such as reflux of 1 m^3/L, SRT of 20 days, aeration intermediate of 11 h 50 min off and 10 min on, 20 mg/L of PAC, one column (8#) and a membrane reactor (9#), ammonium removal rate was increased to 99% while the $NO_3^-{}_{produced}/NH_4^+{}_{totalremoval}$ value was around 0.55. Increasing the ammonium concentration to 6 mg/L can reduce the $NO_3^-{}_{produced}/NH_4^+{}_{totalremoval}$ value to 0.13. On a whole, Dissolved oxygen (DO) is the key to start up the CANON-like MBR treating surface water even under low temperature and sustainable flux increased the sustainability of the system.

1. Introduction

The need to conserve energy and resources is well documented, and therefore more attention is being paid to the selection of processes that conserve energy and resources. Operation and maintenance costs plus reliable process control are extremely important to operating agencies. Thus, the operability of treatment plants is receiving more attention [1].

Operational simplicity is preferable for decentral wastewater treatment, and therefore a MBR was applied, a configuration in

Abbreviations: ANAMMOX, ANaerobic AMMonia Oxidation; AOB, ammonia oxidizing bacteria; CANON, completely autotrophic nitrogen removal over nitrite; DO, dissolved oxygen; DOC, dissolved organic carbon; FA, free ammonia; FNA, free nitric acid; HNO_2, nitric acid; HRT, hydrogen retention time; MBR, membrane bioreactor; NH_3, ammonia; NH_4^+, N-ammonium calculated as nitrogen; NO_2^-, N-nitrite calculated as nitrogen; NO_3^-, N-nitrate calculated as nitrogen; $NO_3^-{}_{produced}/NH_4^+{}_{totalremoval}$, ratio of produced; NO_3^-, N concentration and total NH_4^+-N concentration; NOB, nitrite oxidized bacteria; OLAND, oxygen-limited autotrophic nitrification-denitrification; PAC, powder active carbon; PVC, polyvinylchloride; SHARON, single reactor for High activity Ammonia Removal Over Nitrite; SRT, sludge retention time; UV_{254}, UV absorbance at 254 nm.

* Corresponding author. Tel./fax: +86 451 86283001.
E-mail addresses: zhaozhiwang_1985@hotmail.com (Z. Wang), hitliangheng@163.com (H. Liang), hitsteven@gmail.com (G. Li).

1385-8947/$ - see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.cej.2012.11.062