Autotrophic nitrogen removal in membrane-aerated biofilms: Archaeal ammonia oxidation versus bacterial ammonia oxidation

Recent discovery of ammonia-oxidizing archaea (AOA) not only substantially improved our understanding of the global nitrogen cycle, but also provided new possibilities for nitrogen removal from wastewater. In particular, compared to ammonia-oxidizing bacteria (AOB), the high ammonia oxidation under oxygen-limited conditions driven by AOA is potentially more suitable for autotrophic nitrogen removal in a single-stage membrane aerated biofilm reactor (MABR) through coupling with anaerobic ammonia oxidation (Anammox). In this work, mathematical modeling is applied to assess the system performance and associated microbial community structure of an AOA–Anammox MABR under low- (30 mg N L\(^{-1}\)) and high-strength (500 mg N L\(^{-1}\)) ammonium conditions, with a side-by-side comparison to an AOB–Anammox MABR system under the same conditions. Results demonstrate that both ammonium surface loading (or hydraulic retention time) and oxygen surface loading significantly affect the system performance. In contrast to AOB–Anammox system, the AOA–Anammox MABR shows higher total nitrogen (TN) removal and lower oxygen supply, with much better repression of NOB and substantially wider operating window for high-level TN removal (>80%) in terms of varied oxygen and ammonium loadings. These results provide first insights and useful information for design and operation of this novel AOA–Anammox MABR system in its potential future applications.

General information
Publication status: Published
Organisations: University of Technology Sydney, Ghent University, Sichuan University, University of Queensland
Corresponding author: Ni, B. J.
Number of pages: 10
Pages: 535-544
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Chemical Engineering Journal
Volume: 302
ISSN (Print): 1385-8947
Ratings:
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.16
Web of Science (2016): Impact factor 6.216
Web of Science (2016): Indexed yes
Original language: English
Keywords: Ammonia-oxidizing archaea, Ammonia-oxidizing bacteria, Anammox, Mathematical modeling, Membrane aerated biofilm reactor
DOIs: 10.1016/j.cej.2016.05.078
Source: Scopus
Source-ID: 84977107138
Research output: Contribution to journal › Journal article – Annual report year: 2016 › Research › peer-review