Sequentially aerated membrane biofilm reactors for autotrophic nitrogen removal: microbial community composition and dynamics - DTU Orbit (09/11/2017)

Sequentially aerated membrane biofilm reactors for autotrophic nitrogen removal: microbial community composition and dynamics

Membrane-aerated biofilm reactors performing autotrophic nitrogen removal can be successfully applied to treat concentrated nitrogen streams. However, their process performance is seriously hampered by the growth of nitrite oxidizing bacteria (NOB). In this work we document how sequential aeration can bring the rapid and long-term suppression of NOB and the onset of the activity of anaerobic ammonium oxidizing bacteria (AnAOB). Real-time quantitative polymerase chain reaction analyses confirmed that such shift in performance was mirrored by a change in population densities, with a very drastic reduction of the NOB Nitrospira and Nitrobacter and a 10-fold increase in AnAOB numbers. The study of biofilm sections with relevant 16S rRNA fluorescent probes revealed strongly stratified biofilm structures fostering aerobic ammonium oxidizing bacteria (AOB) in biofilm areas close to the membrane surface (rich in oxygen) and AnAOB in regions neighbouring the liquid phase. Both communities were separated by a transition region potentially populated by denitrifying heterotrophic bacteria. AOB and AnAOB bacterial groups were more abundant and diverse than NOB, and dominated by the r-strategists Nitrosomonas europaea and Ca. Brocadia anammoxidans, respectively. Taken together, the present work presents tools to better engineer, monitor and control the microbial communities that support robust, sustainable and efficient nitrogen removal.

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