Environmental Engineering and Management Journal *March 2012, Vol.11, No. 3, Supplement, S122*
http://omicron.ch.tuiasi.ro/EEMJ/

"Gheorghe Asachi" Technical University of Iasi, Romania

Oral presentations

NITROGEN REMOVAL FROM PIGGERY MANURE DIGESTATE SUPERNATANT AND CHARACTERIZATION OF MICROBIAL COMMUNITIES IN DIFFERENT ANAMMOX REACTORS

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Abstract

In recent years, the anammox process has attracted attention as a possible alternative to conventional nitrification-denitrification systems for biological nitrogen removal from wastewater, which are commonly used in most wastewater treatment plants. However, due to the extremely slow growth rate and the high sensitivity to nitrite and oxygen of anammox bacteria, the start-up of a full scale anammox treatment system is not trivial. Several reactor solutions have been developed in recent years, but a general agreement on the identification of most effective process has not been completely reached.
In this work, the efficiency of nitrogen removal from the liquid fraction of piggery manure digestate was evaluated at laboratory scale in two different reactor solutions, a Sequencing Batch Reactor (SBR) and a Membrane Biological Reactor (MBR). The two reactors were inoculated with mature anammox granules from another plant and initially fed with a synthetic mineral medium added with ammonium, nitrate and nitrite at the desired concentrations, and NaHCO3 as carbon source for autotrophic growth. During the 6 months of operation the mineral medium was gradually replaced by the supernatant from a piggery manure digestate (PMD). The presence and variations of anammox, AOB and NOB populations in the reactors were monitored with FISH (Fluorescence In Situ Hybridization) analyses using specific probes, while the abundance of anammox microorganisms and AOB was determined by real-time PCR. The structure of the microbial community in each reactor was studied with DGGE (Denaturing Gradient Gel Electrophoresis), targeting the V3-V5 hypervariable regions of the 16S rRNA gene.
While working with a percentage of PMD between 0 and 70%, average nitrite and ammonium concentrations were quite similar for both reactors and corresponded to a satisfactory overall N-removal efficiency (between 74 and 92%). The maximum anammox activity (AAmax) increased from 1 to 5 gN L-1 d-1 for the SBR and from 0.4 to 2 gN L-1 d-1 for the MBR, while a good activity of anammox bacteria was evidenced by FISH analyses. A decrease in the AAmax and an increase in ammonium and nitrite effluent concentrations were observed after 5 days of feeding with 100% of PMD. In parallel to that, anammox bacteria showed a decrease in activity with respect to the previous phases, as evidenced by FISH analyses. The inoculated anammox population was entirely formed by Brocadia sp. and its species composition was not affected by supernatant addition in both reactors.