Master/Bachelor Thesis at *Technische Universität Darmstadt*

Department of Civil and Environmental Engineering Sciences,
Chair of Wastewater Engineering

TECHNISCHE UNIVERSITÄT DARMSTADT

Short-cut Nitrogen Removal for Mainstream Municipal Wastewater Treatment

Background

The application of advanced nitrogen removal processes for municipal wastewater treatment has gained more and more importance over the past years. Aside from traditional nitrification denitrification (N/DN) new approaches became increasingly relevant to facilitate efforts for cost and energy savings.

Short-cut nitrogen removal processes via nitrite as intermediate rather than the classical N/DN route via nitrate are promising alternatives. Depending on the wastewater and application two options for short-cut N removal processes are possible: nitritation-denitritation (Ni/DNi) and partial nitritation-anammox (PN/A). In both processes, the ammonium in the influent wastewater is oxidized only to nitrite but not further to nitrate. The nitrite is then either reduced via denitritation with organic carbon as the electron donor or by anammox bacteria using ammonium as electron donor. This combination also only requires approximately half of the ammonium to be oxidized to nitrite.

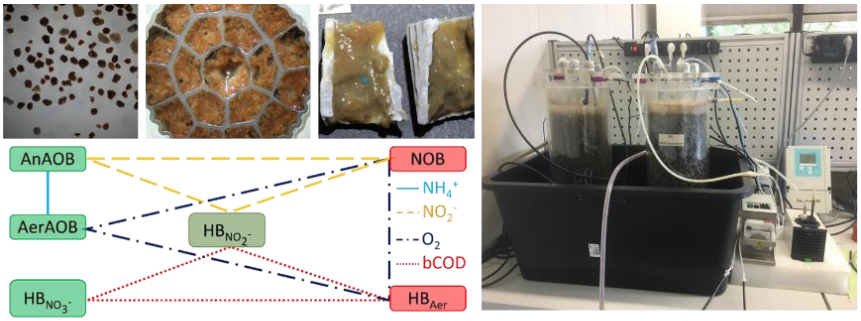

Figure 1: Correlation of the microbial players in Short-Cut N-removal systems (adopted from Agrawal S. et al., (2018) Success of mainstream partial nitritation/anammox demands integration of engineering, microbiome and modeling insights. Curr Opin Biotechnol, 50, 214-221)

Applying these short-cut N-removal pathways under mainstream conditions requires stable production of nitrite, which is rather challenging under the given conditions. The main hurdles for short-cut N-removal are the low and constantly varying temperature (10-20°C) and an unfavorable C:N ratio (too high concentrations of organic carbon).

Thus, more research is required to facilitate stable nitrite production for the subsequent denitritation or anammox stages.

Tasks and Requirements

The student will operate lab-scale reactor(s) to study specific aspects of partial nitritation, denitritation or anammox. We are operating several types of reactors at the moment (CSTRs with conventional suspended biomass/sludge or pure cultures, MBBRs with different carrier types and biofilm geometries, and MABRs for membrane aerated/counter diffusion biofilms) addressing different research questions. Specific tasks for a thesis student include chemical analyses (ammonium, nitrate, nitrite, COD), maintenance of the reactor(s) (feed preparation, cleaning, sensor calibration), (batch) activity tests, and - depending on the skill-set - the use of molecular techniques to follow the microbial community in the reactor(s).

Contact

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