JoinUS: Gliederung der Ausschreibung

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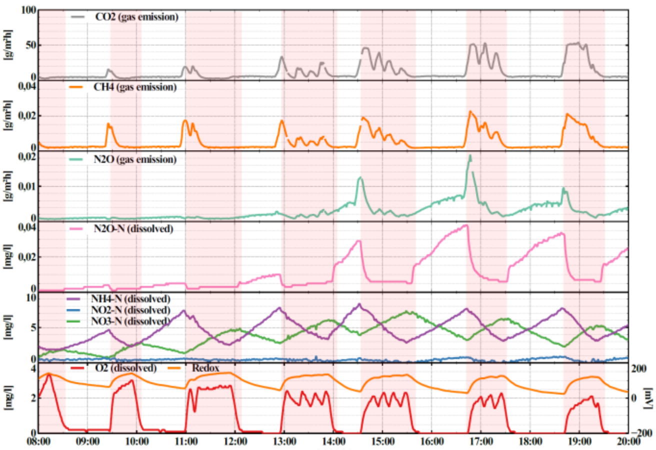
<u>Research group / department</u>: Department of Environmental Microbiology

<u>Title of the proposed research project:</u> Understanding the seasonal variation of greenhouse gas production in wastewater treatment plants

<u>Keywords:</u> microorganisms, denitrification, nitrification, (anaerobic) ammonia oxidation, methanogenesis, microbial community structure, microbial activities, cultivation, microcosms emissions, greenhouse gases

<u>Introduction / Background:</u> Wastewater treatment plants (WWTPs) are estimated to contribute 8 – 11% of the methane and 2.7% of the nitrous oxide global gas emissions. Methane and nitrous oxide are greenhouse gases (GHG) and are 27 and 273 times more potent than CO_2, respectively (Intergovernmental Panel On Climate Change (IPCC), 2023). Additionally, nitrous oxide is considered to be the major anthropogenic contributor to the depletion of atmospheric ozone (Gruber, Von Känel, et al., 2021). These GHG are produced in the WWTPs by the action of methanogenic, nitrifying, and denitrifying microorganisms with the latter two being integral parts of the wastewater treatment process. For example, previous studies have shown that a decrease in the number of nitrite-oxidizing bacteria could lead to an accumulation of nitrite in the system (Gruber, Niederdorfer, et al., 2021). Nitrite accumulation coupled with suboptimal aeration rates can induce the denitrification activity of ammonia-oxidizing bacteria, leading to higher production of nitrous oxide (Chen et al., 2018). There is also seasonal and diurnal variations in nitrous oxide emissions which are correlated with the accumulation of nitrite or suboptimal oxygen concentrations in the system, respectively (Daelman et al., 2013, 2015; Gruber, Von Känel, et al., 2021). Seasonal variations in methane emission rates also occur and appear to be positively correlated with seasonal changes in water temperature (Masuda et al., 2015). Understanding how changes in the composition and flow rates of incoming wastewater can affect microbial community dynamics in WWTP is of the utmost importance. This will allow us find potential solutions that could lead to the reduction of GHG emissions from the wastewater treatment process.



Research Environment: The newly established Department of Environmental Microbiology at the Institute for Sanitary Engineering, Water Quality and Solid Waste Management (ISWA) at the University of Stuttgart consists of an interdisciplinary, international, and dynamic team of environmental microbiologists, microbial ecologists, and chemists. The research group focusses on fundamental research with links to applied areas and studies topics related to microbial pollutant degradation. More information can be found on our webpage: https://www.iswa.uni-stuttgart.de/institute/em/. The PhD candidate will get the opportunity to be creative and innovative, and to work on a challenging and interdisciplinary topic.

Research goals:

- To unravel the seasonal microbial interactions between key microbial communities involved in the production of GHGs in WWTPs.
- To establish laboratory microcosms using labelled substrates to determine how changes in the microbial community and environmental parameters lead to changes in GHG emissions.
- To perform *in situ* experiments at the WWTP located in ISWA to study how control parameters can be optimized to minimize changes in the plant's microbiota leading to reduced GHG emissions.

Methods to be used:

- Quantification of physicochemical parameters, substrates, and products (e.g., via HPLC, IC, GC-MS)
- Aerobic and anaerobic enrichment of WWTP microbial communities
- Electrochemical sensors to quantify dissolved nitrous oxide and other related parameters in the wastewater, FTIR to quantify GHG emissions
- 16S rRNA gene amplicon sequencing
- Metagenomic and metatranscriptomic sequencing
- Statistical analysis of the obtained data sets

Prerequisites:

- Solid background in molecular ecology and environmental microbiology
- Ability to work independently and in a team
- Excellent management and communication skills
- Highly motivated and committed to pursuing interdisciplinary research
- Very good computer and language skills (English)

References

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