DAAD GSSP- Stipendienausschreibung

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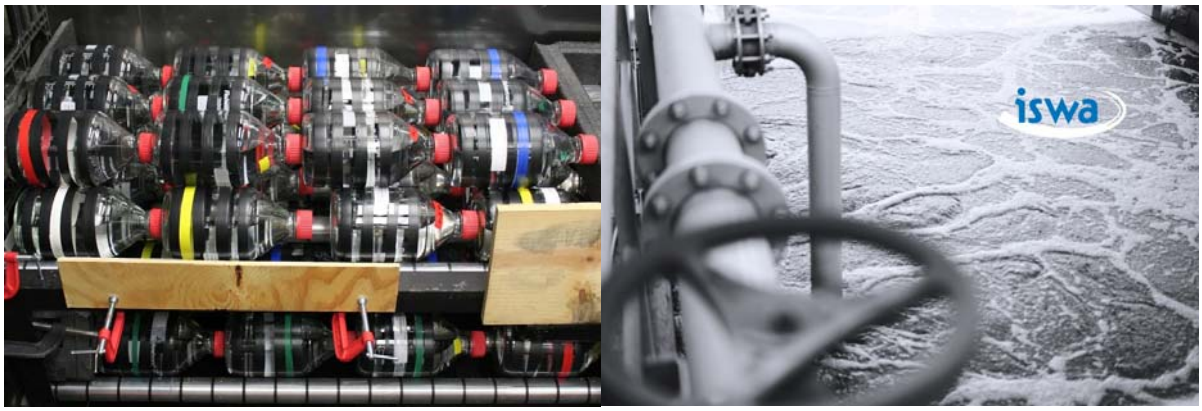
Research group / department: Department of Environmental Microbiology

Title of the proposed research project: Surfactant impacts on the N-cycle in wastewater treatment plants

Keywords: microorganisms, denitrification, nitrification, (anaerobic) ammonia oxidation, microbial community structure, microbial activities, cultivation, microcosms

Introduction / Background: More than 15 million tons of surfactants, a diverse group of synthetic compounds, are produced per year and worldwide (Schinkel *et al.*, 2022). They are applied in the industrial area and in the household as detergents, emulsifiers, and wetting agents. For example, linear alkylbenzene sulfonates (LAS) are the main household detergents (e.g., laundry agents). Secondary alkane sulfonates (SAS) are another important class of anionic surfactants and mainly used as household cleaning agents (laundry and dishwashing detergents) (Li *et al.*, 2018). Most of these surfactants are discharged into wastewater treatment plants (WWTPs). Albeit more than 95% of surfactants (such as LAS and SAS) can be removed from the discharged water (Schinkel *et al.*, 2022), surfactants in the WWTPs can affect key microorganisms involved in the biological treatment of wastewater. For example, previous studies demonstrated that surfactants in WWTPs can influence the activity of denitrifying and nitrifying microorganisms that are especially important to reduce high nitrogen loads (Maazuza *et al.*, 2009; Yin *et al.*, 2020). Additionally, surfactants were shown to be able to inhibit anaerobic ammonia oxidation (annamox) (Zhang *et al.*, 2021), a process that is important to remove ammonia in wastewater. This destabilization of microbial N-cycle processes can further lead to a disruption of wastewater treatment processes and to the discharge of water containing high concentrations of nitrogen and ammonia to water bodies (e.g., rivers), which is an unprecedented hazard for the environment and human health. Thus, it is of utmost importance to unravel the influence of surfactants on microorganisms that drive wastewater treatment processes.



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 and microbial ecologists. 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/EMB/. The PhD candidate will get the opportunity to be creative and innovative, and to work on a challenging and interdisciplinary topic.

Research goals:

- To enrich and isolate microbial key players that drive N-cycle processes (e.g., denitrification and nitrification) in WWTPs.
- To unravel the impacts of surfactants on the physiology of enriched and/or isolated microbial key players involved in the N-cycle.
- To establish laboratory microcosms under oxic and anoxic conditions and to unravel the impacts of surfactants on microbial community composition and microbial activities related to N-cycling.
- To perform a combination of laboratory and *in situ* experiments (e.g., at the aeration tank/rotating disc reactor and deep bed filter) at the WWTP directly located at our institute, to study the impacts of surfactants on the endemic microbial communities and their functions and activities.

Methods to be used:

- Aerobic and anaerobic cultivation and isolation of microorganisms
- Microscopic cell counts and quantification of physicochemical parameters, substrates, products and surfactants (e.g., via HPLC, IC, GC-MS)
- DNA- and RNA-based qPCR for the 16S rRNA gene/transcript and genes/transcripts involved in key microbial N-cycle processes
- 16S rRNA (gene) amplicon sequencing
- Metagenomics and metatranscriptomics
- 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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