Eawag, the Swiss Federal Institute of Aquatic Science and Technology, is a Swiss-based but internationally active research institute within the domain of the ETH (Swiss Federal Institute of Science and Technology). It is committed to the ecologically, economically and socially responsible management of water.

The Department of Environmental Engineering seeks to recruit

Three PhD Positions in Environmental Engineering

PhD project 1:

Reducing biological sludge production

The aim of the first PhD project is to evaluate mechanisms that can increase the degradability of particulate organic matter and reduce overall sludge production. Handling and disposal of waste activated sludge results in significant costs. Sludge management is a major concern for the operation of small and decentralized wastewater treatment systems. This project is focused on biological processes that enhance endogenous decay of active biomass and/or increase hydrolysis of particulate organic matter. A significant reduction in sludge production can, for example, be observed in response to cyclic exposure aerobic, anaerobic, and low oxidation reduction potential (ORP) conditions. In addition to influencing overall sludge production, cyclic exposure to different redox conditions will also influence the conversion of many micropollutants that are otherwise not degraded. But biological mechanisms leading to reduced sludge production are not well understood.

The goal is to evaluate sludge reduction processes within the broader context of overall system performance, costs, and the overall energy balance of wastewater treatment in centralized and decentralized systems. This PhD project should develop a mechanistic understanding of the underlying biological processes, develop a mathematical modeling approach to describe relevant processes, and provide guidance for design and operation of sludge reduction processes.

PhD project 2:

Influence of mass transport limitations on ammonia oxidation/anammox

The aim of the second PhD project is to evaluate the influence of floc size and structure on the stability of a single reactor ammonia oxidation/anammox process. Ammonia oxidation/anammox in a single reactor is a new process that has been introduced in full-scale plants for nitrogen removal from concentrated nitrogen streams. The single reactor nitrogen removal process is beneficial as it allows uncoupling the removal of organic carbon and nitrogen allowing for more organic carbon to be directed to anaerobic digestion for energy production. Full-scale experience has shown that the single reactor nitrogen removal is very efficient – but also that periodically the process can become unstable.

The goal for this PhD project is to evaluate the influence of mass transport limitations in different types of aggregates (flocs, granules, biofilms on suspended carriers) for understanding the influence on process efficiency and also the stability in response to dynamic operating conditions. Mass transport limitations are necessary in this process to provide aerobic conditions for ammonia oxidation and anaerobic conditions for anammox. Advanced imaging using confocal laser scanning microscopy (CLSM) and optical coherence tomography (OCT) followed by advanced image analysis will be used to quantify aggregate size and structure. The abundance of ammonia and nitrite oxidizing bacteria as well as anammox bacteria will be monitored using fluorescent in situ hybridization (FISH) and quantitative real time polymerase chain reaction (qPCR). Linking the analysis of aggregate size and structure with abundance and distribution of relevant bacteria in these aggregates and with the physiological response of the system will allow to better understand the underlying mechanism leading to system instability and will allow to develop a mathematical model and monitoring approach that is suitable to guide practical design and operation of single reactor ammonia oxidation/anammox processes.

PhD project 3:

Interactions of suspended cultures and biofilms

The aim of this PhD project is to evaluate the interaction of the microbial communities in biofilms and suspended in the water phase. Overall rates and specific mechanisms of attachment and detachment of microorganisms and particulate matter will depend on the biofilm structure and on mixing conditions within the system. The main focus in this project will be on evaluating biofilms involved in membrane fouling. But results are also relevant and will be evaluated in hybrid bioreactor systems (i.e., combining biofilms growing on suspended carriers and activated sludge in one system) and in fixed bed biofilm reactors. While the project is based on practical systems the focus will be on evaluating fundamental mechanisms of how biofilm structure influences the ability of suspended bacteria to colonize a surface and under what extent detached biofilm will influence the composition and function of the suspended microbial community. Biofilm and suspended biomass structure will be imaged using confocal laser scanning microscopy (CLSM) and optical coherence tomography (OCT) followed by advanced image analysis. The microbial communities will be characterized using fluorescent in situ hybridization (FISH) and denaturing gradient gel electrophoresis (DGGE).

The goal is to develop an improved understanding of conditions resulting in similar or different microbial communities in the biofilm and in suspension and how these interactions between biofilm and suspended cultures are relevant for process performance. The evaluation of fundamental mechanisms should be linked to developing mathematical models and testing the relevance for selected engineering applications.

We are looking for independent and motivated students with a broad background and interest in wastewater treatment, mathematical modeling, microbiology, and engineering applications. The candidates should hold an MS degree in Environmental Engineering, Environmental Sciences, Civil Engineering, or similar. Eawag offers an interdisciplinary and international environment with ongoing PhD studies in related areas, with excellent research infrastructure, and with strong links to the engineering practice.

The three positions start as soon as possible. The duration of the PhD program at ETH-Zurich is generally three years. Applications should include a cover letter describing the applicant's motivation for pursuing a PhD, a complete resume, and contact information for three references. The cover letter should indicate which of the project(s) the applicant is interested in. Copies of prior publications or theses will also be considered if made available as PDF.

Please submit your application – including CV, motivation letter, and copies of academic qualifications and references – in electronic form as one single PDF file to Sandra Egler, Human Resources Department recruiting@eawag.ch, indicating PhD project number and reference number 104501. The deadline for applications is 15 August 2010.

For further information, consult www.eawag.ch or contact:
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