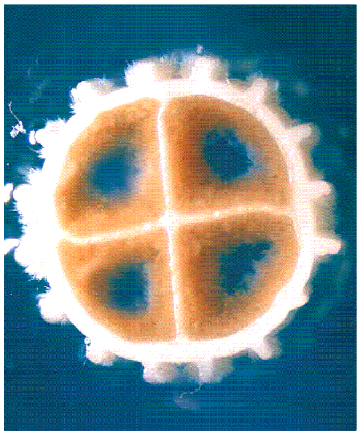
Seminar on

"Model-based optimization of biofilm systems in wastewater treatment"

Theme

The obvious definition of biofilm is "micro-organisms attached to a surface". A more comprehensive definition is "a layer of prokaryotic and eukaryotic cells anchored to a substratum surface and embedded in an organic matrix of biological origin" (Wilderer and Characklis 1989).



Over 90% of bacterial biomass grows in form of biofilms. The ability of bacteria to attach to surfaces and to form biofilms can become an important competitive advantage over bacteria growing in suspension. Suspended bacteria can be washed out with the water flow, whereas bacteria in biofilm structures are protected against washout and can grow where the conditions are favorable, e.g. relative abundance of substrate.

Biofilms have been used to treat (waste)water since the late 19th century. In the first trickling filter, put in operation in England in 1893, a biofilm developed on the rocks, which provided a specific surface area of about 40 m^2/m^3. Nowadays, trickling filters equipped with rock or plastic filling media are still widely used. Other biofilm applications were developed in the 1970s and 1980s, such as rotating biological contactors in which the biofilm grows on a plastic media attached to a rotating axe, as biological filters in which gravel-sized granular medium provide specific surface areas up to 1000 m^2/m^3, or as fluidized bed reactors that make use of relatively high upflow water velocities to maintain the small carrier particles suspended in the water phase.

As a biofilm grows, a large number of phenomena occur simultaneously and interact over a wide range of spatial and temporal scales. Nutrient conversions (related to bacterial growth); transport of chemical species (by physical processes such as molecular diffusion and convection); the liquid flow through shear forces (determining the detachment of portion of biofilm)... All these phenomena are inter-linked and form a dynamic and complex system.

Mathematical models have proven useful because they allow testing of hypotheses and, in addition, can direct and quantify optimization efforts.

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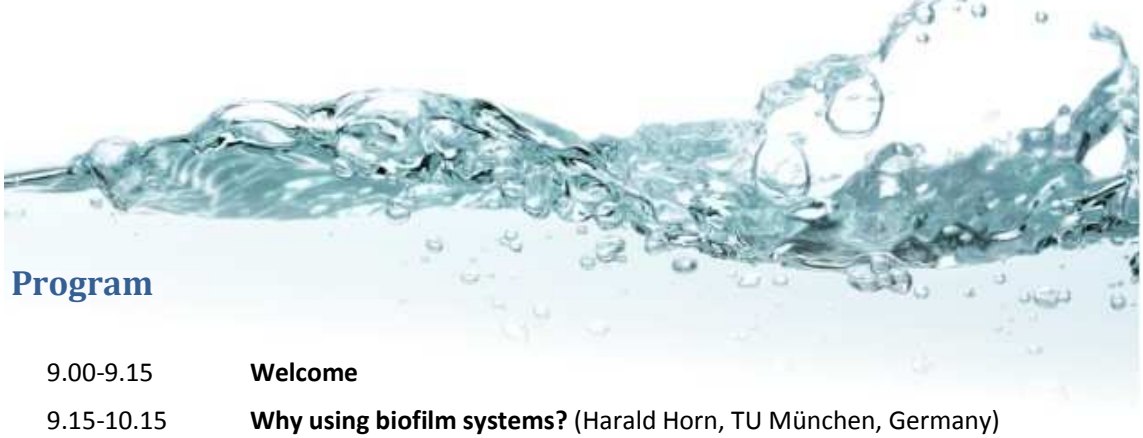

Program

9.00-9.15	**Welcome**
9.15-10.15	**Why using biofilm systems?** (Harald Horn, TU München, Germany)
10.15-10.30	*Coffee break*
10.30-11.30	**Practical implementation of a biofilm system** (Eva Dalentoft, AnoxKaldnes, Sweden)
11.30-12.30	**Application of biofilm models in engineering design: a critical analysis of uncertainty** (Joshua Boltz, CH2M-Hill, USA)
12.30-14.00	*Lunch*
14.00-14.30	**Trying to see through the black-box: observation and data collection for modeling a biofiltration process** (Pascal Boisson, Veolia, France)
14.30-15.00	**Model-based investigation of membrane aerated biofilm reactors for autotrophic N removal** (Barth Smets, DTU, Denmark)
15.00-15.30	**Model-based optimization of a water production facility** (Enrico Remigi, MOSTforWATER, Belgium)
15.30-15.45	*Coffee break*
15.45-16.15	**Model-based optimization of the water treatment of a fish farm** (Kenneth Janning, DHI, Denmark)
16.15-16.45	**Conclusions** (Peter Vanrolleghem, modelEAU - Université Laval, Canada)

Date & Venue

The seminar will be held on **April 29th, 2009** at **DTU** in **Lyngby** (Denmark), near Copenhagen.

Technical University of Denmark
Anker Engelunds Vej 1, Building 101A, meeting room 1 (1st floor) DK-2800 Kgs Lyngby

Who should attend?

This seminar is intended for professionals who are interested in, or involved in biofilm systems for wastewater treatment, e.g. plant managers, researchers, process engineers and design engineers.

Organization

Peter Steen Mikkelsen on behalf of DTU

Kenneth Janning on behalf of DHI

Youri Amerlinck on behalf of MOSTforWATER

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People

Harald Horn, PhD

Harald Horn is professor for water quality control at the institute of water and environment TU München since 2005. The current research fields in his group are water quality management in rivers, new technologies in waste water treatment, modeling of aquatic systems and anaerobic technology. Among these research fields biofilm systems are of high interest both in natural aquatic systems and within the technosphere. Main methods, which are used to indentify structure and function in such systems are confocal laser scanning microscopy and other spectroscopic techniques. Additionally microelectrode measurements were combined with structural data to increase the knowledge for biofilm modeling.

Barth F. Smets, PhD

Barth Smets is professor of Environmental Microbiology in the Department of Environmental Engineering DTU since 2004. His research spans the areas of microbial ecology and technology with applications to environmental engineering. He has a special interest in biofilm science and engineering: elucidating cellular-level and ecologica- processes which occur in natural and engineered biofilms, and developing/using biofilm-based reactor for wastewater treatment. He is currently the coordinator of the Urban Water Engineering theme, as well as the research groups Wastewater Technology and Microbial Ecology.

Peter A. Vanrolleghem, PhD

Peter Vanrolleghem is a full professor holding the Canada Research Chair in Water Quality Modelling in the research group modelEAU at the Département de génie civil at Université Laval in Québec. He is a modeling, monitoring and control expert. His research involves using automated measurement stations and mathematical models to optimize the design and operation of the urban wastewater infrastructure (sewer, treatment plant) from a river water quality perspective. He has over 250 peer-reviewed papers and is very active within IWA and WEF.

Joshua P. Boltz, PhD

Joshua Boltz is a Senior Wastewater Process Engineer with the CH2M HILL Water Business Group. His background includes the simulation, design, planning, and optimization of biochemical reactors and water-solids separation systems (with emphasis on biofilm-based systems) for the stabilization of municipal wastewater and sludge streams. He is experienced in using whole-wastewater treatment plant modeling software to perform process evaluations and designs. His research and development efforts have been focused on biofilm reactors, mathematical modeling of biofilms, and advancing the use of mathematical biofilm models in engineering practice.

Eva Dalentoft

Eva Dalentoft is the COO of AnoxKaldnes AB in Sweden. AnoxKaldnes AB is a high technology company focusing on biological treatment of industrial and municipal wastewater. Eva has more than 20 years experience from wastewater treatment and works daily with design and implementation of the AnoxKaldnesTM MBBR biofilm technology for treatment of municipal as well as industrial wastewater treatment. The AnoxKaldnesTM MBBR biofilm technology has been used at more than 500 wastewater treatment plants in more than 50 different countries as a stand-alone process (Moving Bed™ and NatrixTM), as a preliminary treatment stage (BAS™), as a combined IFAS hybrid stage (HYBAS™) and as final a polishing step (LagoonGuard™).

Kenneth F. Janning, PhD

Kenneth Janning is working as a senior engineer at DHI, Denmark where he has been employed since 1999. In his Master study and PhD education at DTU (1990-1998) he studied kinetics of biofilm processes in laboratory scale and full scale biofilter installations supervised by professor Poul Harremoës. During his professional carrier at DHI he continued to work within the field of biofilm reactors and optimization of these and within development of new biofilm applications. Like this he assisted Grundfos to develop a new pressurized biofilm reactor (designated the BioBooster process) for aerobic wastewater treatment. The recent years he has focused on further development and optimization of biological processes in recirculated aquaculture farms which also use biofilters for transformation and removal of nitrogen

Enrico Remigi, PhD

Enrico Remigi is working for MOSTforWATER since April 2007 where he is responsible for the technical support and the training programs. He is also involved in the development of WEST® (implementation of models and user interface programming). He has implemented the latest biofilm model in WEST®. Prior to MOSTforWATER, he has worked as researcher at the School of Chemical Engineering of the University of kwaZulu-Natal (South Africa). He holds a PhD in Environmental Engineering from Politecnico di Milano (Italy).

Pascal Boisson

Pascal Boisson is a young researcher in the Biological Process Team at Veolia R&D Centre since 2007. For two years, he has mainly focused on attached biomass processes with a core work on biological aerated filters (BAF), based on laboratory and pilot scale experiments sustained by a modelling approach. He has special interest in understanding how biofilms behave and can be manipulated. His interdisciplinary background in agronomy, ecological modelling and genetics allows him to find lots of challenging ecological questions to be answered in wastewater treatment activities. He is currently engaging in a PhD thesis at TUM with Prof. Harald Horn. Aside of this, he is involved in different on-going studies with a special interest in data reconciliation and model-based plant wide understanding for assessment of existing or conceptually new plant design. .

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Registration

Please send an email to the Seminar Secretariat before April 15th, 2009

Registration fee

	Early* registration	Late registration
Regular participant	250 €	300 €
WEST client with CSA	200 €	250 €
Student**	150 €	200 €

* Early registration before March 15th, 2009

** As the number of participants is limited, priority may be given to regular participants and WEST clients over students.

The fee includes lunch and coffee.

Annulment only by writing. For annulations up to 2 weeks prior to the workshop 50 € administration costs will be requested. For annulations less than 2 weeks prior to the workshop the full price is indebted.

Seminar Secretariat

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