Biofilm Reactor Technology Conference 2010

August 15-18, 2010
Portland Marriott
Portland, Oregon, USA

Workshop A: Causes and Control of Biofilm Mediated Biofouling in Microfilter/Ultrafilter and Reverse Osmosis Membranes

Sunday, August 15, 2010
8:30am – 5:00pm

Moderator: Glen T. Daigger, *CH2M HILL*

Biofilms are ubiquitous, including in engineered membrane filtration systems where they significantly increase cost and adversely impact performance. Fortunately, the application of advanced biofilm knowledge is providing engineers with new tools to understand the causes of biofilm fouling in such systems, and to develop innovative control techniques. This workshop will describe these advances and present them in an integrated fashion. This represents a unique application of biofilm technology which will be of high interest to conference attendees.

Learning Objectives:

- Understand the principal membrane biofilm fouling mechanisms
- Understand the principals of quorum sensing and how it can be used to control membrane biofilm fouling
- Gain an improved understanding of the hydraulics of membrane systems and its impact on biofilm formation
- Gain a better appreciation of evolving membrane biofilm control technologies

Workshop B: Present and Future Nitrogen Control with Integrated Fixed-Film Activated Sludge (IFAS) and Biofilm Reactors: Post Denitrification to Sidestreat Deammonification

Sunday, August 15, 2010
8:30am – 5:00pm

Moderator: Rip Copithorn, *Sterns & Wheeler GHD*

The purpose of this workshop is to present the state-of-the-art and future direction regarding planning, design, optimization, and application of biofilm reactors for nitrogen. In addition to providing the workshop participant with design fundamentals and guidance for the application of a variety of biofilm reactor systems, this workshop will focus on using biofilm reactors to maximize the use of existing assets when upgrading municipal wastewater treatment plants (WWTPs) and water reclamation facilities (WRFs) for nitrogenous pollutant biodegradation.

Learning Objectives:

- Describe the relevance of tools available for and issues or relevance to designers and operators who are presently tasked with designing or operating systems that are capable of meeting limits of technology nitrogen removal.
- Describe biofilm fundamentals that can be uniformly applied to each of the technologies discussed.
- Describe and define design criteria for state-of-the-art reactors that have a biofilm component and are used for nitrogen control including: MBBR, IFAS, BAF, and Granular Sludge SBR.
- Describe emerging environmental biotechnologies such as novel bacterial types for denitrification, partial nitrification and Anammox.
- Describe and compare biofilm reactor models that incorporate the mathematical description of a one-dimensional biofilm with focus on their use and uncertainties.

Session 1: Microbial Fuel Cells

Monday, August 16, 2010
10:45am - 12:15pm

1A	**10:45am**	**The Role of Homo-Acetogenic Bacteria as Efficient Hydrogen Scavengers in Microbial Electrochemical Systems (MXCs)** Prathap Parameswaran, *Center for Environmental Biotechnology*
1B	**11:15am**	**Effects of Oxygen Crossover on Layered, Microbial Fuel Cell Assemblies** Robert Nerenberg, *University of Notre Dame*
1C	**11:45am**	**Effect of Location on the Performance of Benthic Microbial Fuel Cells** Haluk Beyenal, *Washington State University*
Alternate/Poster A		**Microbial Electrochemical Cells as a Research Tool to Probe Microbial and Biofilm Kinetics** Cesar Ivan Torres, *Biodesign Institute at Arizona State University*
Poster B		**Heterotrophic/Autotrophic Denitrification in Microbial Fuel Cells (MFCs)** Sebastia Puig, *Catalan Institute for Water Research (ICRA)*, Spain
Poster C		**Bioelectrochemical Perchlorate Reduction in a Microbial Fuel Cell: Optimizing Cathode pH and Cathode Potential** Caitlyn Butler, *Arizona State University*

Session 2: Microbial Communities

Monday, August 16, 2010
10:45am - 12:15pm

2A	**10:45am**	**Decoupled Distribution and Control of Phosphorus- and Nitrogen-Removing Microbial Populations Led To Improved Performance In IFAS-EBPR System** April Z. Gu, *Northeastern University*
2B	**11:15am**	**Microbial Ecology of a Completely Autotrophic Nitrogen-Removal Over Nitrite (CANON) Biofilm Process** Kartik Chandran, *Columbia University*
2C	**11:45am**	**Inoculum Effects on Community Composition and Nitritation Success of Nitrifying Biofilm Grown on a Gas-Permeable Membrane** Akihiko Terada, *Technical University of Denmark/Tokyo University of Agriculture and Technology*, Denmark
Alternate/Poster A		**Intermittent Addition of Biocides: The Effect of Dosing Frequency on Biomass Accumulation, Texture and Bacterial Composition of a Biofilm** Kim Milferstedt, *INRA-Laboratoire de Biotechnologie de l'Environnement*, France
Poster B		**Identification of Active Microorganisms in Environmental Biofilms Using 16SrRNA Based Approaches: the Challenge of Obtaining Representative Information About the Microbial Community** René P. Schneider, *Institute of Biomedical Sciences, University of São Paulo*, Brazil
Poster C		**Niche Differentiation Between Biofilm and Suspended Microbial Communities Assimilating Glycerol in a Denitrifying Moving Bed Biofilm Reactor** Kartik Chandran, *Columbia University*
Poster E		**BNR Using Bacillus and Biofilms** Garry Hoyland, *Bluewater Bio*, United Kingdom of Great Britain and Northern Ireland
Poster F		**Impact of Biofilms on the Growth of Filamentous Microorganisms** Maria Inês Matos, *University of Minho*, Portugal
Poster G		**Dispersal Pattern of Contaminant Communities Reflects Flow Scheme in a Paper Mill** Kim Milferstedt, *INRA-Laboratoire de Biotechnologie de l'Environnement*, France
Poster H		**Microalgal Biofilm Reactor: Investigation of Microalgal Attachment to Surfaces** Grant Allen, *University of Toronto*, Canada

Session 3: MBBR IFAS

Monday, August 16, 2010
1:30pm - 5:15pm

3A	**1:30pm**	**Application of Moving Bed Biofilm Reactor for Tertiary Ammonia Removal in High Temperature Industrial Wastewater** Marc A. Deshusses, *Duke University*
3B	**2:00pm**	**Pilot Study to Evaluate MBBR as a More-Sustainable Treatment Solution Than Activated Sludge for Irrigation Reuse in a Warm Climate** Mark T. Steichen, *Black & Veatch Corporation*
3C	**2:30pm**	**Development of IFAS Design Parameters from the Full-Scale Demonstration at the TZ Osborne WRF** W. James Gellner, *Hazen and Sawyer, PC*
	3:00pm	*Networking Break*
3D	**3:45pm**	**Evaluation of Sulfide-Driven Autotrophic Denitrification in a Moving Bed Biofilm Reactor** Karen Bill, *HDR, Inc.*
3E	**4:15pm**	**New Developments in the Understanding of IFAS Systems as it Pertains to Practical Design** James P. McQuarrie, *CH2M HILL*
3F	**4:45pm**	**Separation of Biomass From Moving Bed Biofim Reactors (MBBR's)** Hallvard Ødegaard, *Norwegian University of Science and Technology*, Norway
Alternate/Poster A		**Nitrification of an Industrial Wastewater in a Moving Bed Biofilm Reactor (MBBR)** Simone Maria Ribas Vendramel, *Instituto Federal de Educação, Ciência e Tecnologia do Rio de Janeiro*, Brazil
Poster B		**Biofilm Performance of High Surface Density Vertical-Flow Structured Sheet Media System for IFAS and Fixed Bed Bioreactor (FBBR) Applications** Jianchang Ye, *Brentwood Industries, Inc.*
Poster C		**Experiences in Using MBBR and Denitrification Filters for Nitrogen Removal From Saline Wastewater** Christine deBarbadillo, *Black & Veatch*
Poster D		**Nitrite as a Design Factor for Biological Denitrification Using MBBR** Tamar Arbel, *Aqwise - Wise Water Technologies*, Israel

Poster E **Small Footprint Wastewater Treatment Plants: The Combination of Moving Bed Biofilm Reactors With Ballested Floc Solids Separation**
Claus Poulsen Dahl, *Krüger A/S*, Denmark

Poster F **Two Stage MBBR for the Treatment of High TDS Produced Water**
Eoin Syron, *Veolia Environment*, France

Poster G **Control and Comprehension of Competition Between Plancktonic and Fixed Cells in Couette-Taylor Reactor**
Adeline Caylet, *INRA, UR050, Laboratoire de Biotechnologie de l'Environnement*, France

Session 4: Membranes and Biofilms

Monday, August 16, 2010
1:30pm - 5:15pm

4A	**1:30pm**	**Hydrogen-Based Nitrate and Selenate Bioreductions** Steven W. Van Ginkel, *Center for Environmental Biotechnology*
4B	**2:00pm**	**Bio-Reduction of Parachloronitrobenzene (p-CNB) in Groundwater Using a Continuous Stirring Hollow Membrane Biofilm Reactor** Siqing Xia, *Tongji University*, China
4C	**2:30pm**	**Sequential Aeration of Membrane-Aerated Biofilm Reactors Yields for Completely Autotrophic Nitrogen Removal: Experimental Demonstration** Barth F. Smets, *Technical University of Denmark*, Denmark
	3:00pm	*Networking Break*
4D	**3:45pm**	**A Hydrogen-Based Hollow-Fiber Membrane Biofilm Reactor Used for Cr(VI) Removal From Groundwater** Siqing Xia, *Tongji University*, China
4E	**4:15pm**	**Heterogeneous Biofilms Can Help to Stabilize Long-Term Flux in Gravity-Driven Dead-End Ultrafiltration Systems: How Protozoan Grazing Influences Biofilm Structure** Nicolas Derlon, *EAWAG*, Switzerland
4F	**4:45pm**	**Restricting the Impact on Biofouling on Spiral Wound Membranes: New Tools and Insights** J.S. Vrouwenvelder, *WETSUS/Delft University of Technology*, The Netherlands
Poster B		**A Study on the High-Flux MBR System Using PTFE Flat Sheet Membrane** Hyungsoo Kim, *SungKyunKwan University*, Republic of Korea
Poster C		**Bioelectrochemical Hydrogen Peroxide Production - An Opportunity for Sustainable Mitigation of Membrane Bioreactor Fouling** Oskar Modin, *The University of Tokyo*, Japan
Poster D		**Strategy for Biofouling Control in Water UF Systems by Pre-Treatment with Silver Nanoparticles** Avital Dror-Ehre, *Hebrew University*, Israel
Poster E		**Biofouling Control by H2O2/UV Advanced Oxidation Process (AOP): Effect of Natural Organic Matter (NOM)** Anat Lakretz, *Tel-Aviv University*, Israel

Poster F **Comparison of the Variance Between Identically Constructed Membrane-Aerated Biofilm Reactors**
Nicholas Landes, *Texas Tech University*

Poster G **Implementation of a Bioreactor With Biofilm and Membranes for Removal of Nutrients Present in Wastewater**
Germán Cuevas, *Guanajuato University*, Mexico

Session 5: Modeling as a Tool for Biofilm Reactor Design and Research

Tuesday, August 17, 2010
8:30am - 12:15pm

5A	**8:30am**	**Model-Based Investigation of Full Scale IFAS Performance Utilizing Plant Data and Batch Testing to Assess Kinetics, Mass Transfer Effects and Population Dynamics** Charles B. Bott, *Hampton Roads Sanitation District*
5B	**9:00am**	**Modeling A Full-Scale IFAS System in Groton, CT** Spencer D. Snowling, *Hydromantis Environmental Software Solutions*, Canada
5C	**9:30am**	**Respirometry as a Simple Operational Tool for Control and Analysis of MBBR and IFAS Biofilm Systems** Remy Blanc, *Aqwise - Wise Water Tecnologies*, Israel
	10:00am	*Networking Break*
5D	**10:45am**	**The Second Generation of IFAS and MBBR: Lessons to Apply** Heather M. Phillips, *Black & Veatch Corporation*
5E	**11:15am**	**Guiding the Development of the Hollow-Fiber Membrane Biofilm Reactor Through Modeling Studies** Kelly J. Martin, *University of Notre Dame*
5F	**11:45am**	**Modeling of Biofouling in Reverse Osmosis Processes** Cristian Picioreanu, *Delft University of Technology*, The Netherlands
Alternate		**Comparison and Modeling of Two Biofilm Processes Applied to Decentralized Wastewater Treatment** Yonghui Song, *Chinese Research Academy of Environmental Sciences*, China
Poster B		**Understanding Differences in GHG Emissions Between IFAS and Activated Sludge Based on Media, Mixing and Aeration in IFAS, Location of Media, Calibrated Simulations and Observed Data From Plants** Dipankar Sen, *Santa Clara Valley Water District*
Poster C		**Modeling Nitrogen Removal, Including Greenhouse Gas, for a Biofiltration Wastewater Treatment Plant** Paul Lessard, *Université Laval*, Canada

Session 6: Granular Sludge Reactors

Tuesday, August 17, 2010
8:30am - 12:15pm

6A	**8:30am**	**Characterization of Alginate-Like Exopolysaccharide Isolated From Aerobic Granular Sludge in Pilot-Plant** Yuemei Lin, *The Hebrew University of Jerusalem*, Israel
6B	**9:00am**	**Biodegradation of Phenol-Polluted Air in Aerobic Granular Reactors** Yonghui Song, *Chinese Research Academy of Environmental Sciences*, China
6C	**9:30am**	**Segregation of Biomass in Aerobic Granular Sludge Favours Phosphate Accumulating Organisms Over Glycogen Accumulating Organisms at High Temperatures** Mari-Karoliina Henriikka Winkler, *Delft University of Technology*, The Netherlands
	10:00am	*Networking Break*
6D	**10:45am**	**Aerobic Granulation in Sequencing Batch Reactors Fed With Both Municipal and Synthetic Wastewater** Tobias Rocktäschel, *Technical University Munich*, Germany
6E	**11:15am**	**Cultivation and Performance of Aerobic Granules in a Pilot Scale SBR to Treat Real Domestic Sewage** Jianrong Zhu, *Beijing Normal University*, China
6F	**11:45am**	**Overview of Applied Research in the Netherlands for Treatment Municipal Wastewater With Nereda®-Technology in the Netherlands** Bart de Bruin, *DHV B.V.*, The Netherlands
Alternate/Poster A		**Mass Transport and Conversion in Aerobic Granules** Christina Klarmann, *Technische Universität München*, Germany
Poster B		**Aerobic Granulation With Palm Oil Mill Effluent (POME) in a Column-Typed Sequencing Batch Reactor** Norhayati Abdullah, *Universiti Teknologi Malaysia*, Malaysia

Breakout Sessions

Tuesday, August 17, 2010
1:30pm – 3:30pm

These breakout sessions will be held concurrently and be coordinated by industry professionals to encourage interactive discussions and exchanges.

- Biological Drinking Water Treatment
  - Moderators: Robert Nerenberg, *University of Notre Dame*
    Jess C. Brown, *Carollo Engineers*

- Nitrogen Removal Using Biofilms/Ecologic Niches Inside of Biofilms
  - Moderators: Mark van Loosdrecht, *Delft University of Technology*
    Julian Sandino, *CH2M HILL*

- Modeling of Biofilm Systems
  - Moderators: Denny Parker, *Brown and Caldwell*
    Eberhard Morgenroth, *Eawag*

- Activated Sludge vs. Biofilm
  - Moderators: Glen Daigger, *CH2M HILL*
    Kim Sorensen, *Veolia Water*

Dedicated Poster Session

Tuesday, August 17, 2010
3:45pm – 5:15pm

All posters listed in the program will be presented during this dedicated poster session. Posters are also listed below for your reference.

Microbial Electrochemical Cells as a Research Tool to Probe Microbial and Biofilm Kinetics
Cesar Ivan Torres, *Biodesign Institute at Arizona State University*

Heterotrophic/Autotrophic Denitrification in Microbial Fuel Cells (MFCs)
Sebastia Puig, *Catalan Institute for Water Research (ICRA)*, Spain

Bioelectrochemical Perchlorate Reduction in a Microbial Fuel Cell: Optimizing Cathode pH and Cathode Potential
Caitlyn Butler, *Arizona State University*

Intermittent Addition of Biocides: The Effect of Dosing Frequency on Biomass Accumulation, Texture and Bacterial Composition of a Biofilm
Kim Milferstedt, *INRA-Laboratoire de Biotechnologie de l'Environnement*, France

Identification of Active Microorganisms in Environmental Biofilms Using 16SrRNA Based Approaches: the Challenge of Obtaining Representative Information About the Microbial Community
René P. Schneider, *Institute of Biomedical Sciences, University of São Paulo*, Brazil

Niche Differentiation Between Biofilm and Suspended Microbial Communities Assimilating Glycerol in a Denitrifying Moving Bed Biofilm Reactor
Kartik Chandran, *Columbia University*

BNR Using Bacillus and Biofilms
Garry Hoyland, *Bluewater Bio*, United Kingdom of Great Britain and Northern Ireland

Impact of Biofilms on the Growth of Filamentous Microorganisms
Maria Inês Matos, *University of Minho*, Portugal

Dispersal Pattern of Contaminant Communities Reflects Flow Scheme in a Paper Mill
Kim Milferstedt, *INRA-Laboratoire de Biotechnologie de l'Environnement*, France

Microalgal Biofilm Reactor: Investigation of Microalgal Attachment to Surfaces
Grant Allen, *University of Toronto*, Canada

Nitrification of an Industrial Wastewater in a Moving Bed Biofilm Reactor (MBBR)
Simone Maria Ribas Vendramel, *Instituto Federal de Educação, Ciência e Tecnologia do Rio de Janeiro*, Brazil

Biofilm Performance of High Surface Density Vertical-Flow Structured Sheet Media System for IFAS and Fixed Bed Bioreactor (FBBR) Applications
Jianchang Ye, *Brentwood Industries, Inc.*

Experiences in Using MBBR and Denitrification Filters for Nitrogen Removal From Saline Wastewater
Christine deBarbadillo, *Black & Veatch*

Dedicated Poster Session Continued

Nitrite as a Design Factor for Biological Denitrification Using MBBR
Tamar Arbel, *Aqwise - Wise Water Technologies*, Israel

Small Footprint Wastewater Treatment Plants: The Combination of Moving Bed Biofilm Reactors With Ballested Floc Solids Separation
Claus Poulsen Dahl, *Krüger A/S*, Denmark

Two Stage MBBR for the Treatment of High TDS Produced Water
Eoin Syron, *Veolia Environment*, France

Control and Comprehension of Competition Between Plancktonic and Fixed Cells in Couette-Taylor Reactor
Adeline Caylet, *INRA, UR050, Laboratoire de Biotechnologie de l'Environnement*, France

A Study on the High-Flux MBR System Using PTFE Flat Sheet Membrane
Hyungsoo Kim, *SungKyunKwan University*, Republic of Korea

Bioelectrochemical Hydrogen Peroxide Production - An Opportunity for Sustainable Mitigation of Membrane Bioreactor Fouling
Oskar Modin, *The University of Tokyo*, Japan

Strategy for Biofouling Control in Water UF Systems by Pre-Treatment with Silver Nanoparticles
Avital Dror-Ehre, *Hebrew University*, Israel

Biofouling Control by H2O2/UV Advanced Oxidation Process (AOP): Effect of Natural Organic Matter (NOM)
Anat Lakretz, *Tel-Aviv University*, Israel

Comparison of the Variance Between Identically Constructed Membrane-Aerated Biofilm Reactors
Nicholas Landes, *Texas Tech University*

Implementation of a Bioreactor With Biofilm and Membranes for Removal of Nutrients Present in Wastewater
Germán Cuevas, *Guanajuato University*, Mexico

Understanding Differences in GHG Emissions Between IFAS and Activated Sludge Based on Media, Mixing and Aeration in IFAS, Location of Media, Calibrated Simulations and Observed Data From Plants
Dipankar Sen, *Santa Clara Valley Water District*

Modeling Nitrogen Removal, Including Greenhouse Gas, for a Biofiltration Wastewater Treatment Plant
Paul Lessard, *Université Laval*, Canada

Mass Transport and Conversion in Aerobic Granules
Christina Klarmann, *Technische Universität München*, Germany

Aerobic Granulation With Palm Oil Mill Effluent (POME) in a Column-Typed Sequencing Batch Reactor
Norhayati Abdullah, *Universiti Teknologi Malaysia*, Malaysia

Monitoring Bacterial Twitter: Why Quorum Sensing is Important to Wastewater Treatment
Joshua D. Shrout, *University of Notre Dame*

Dedicated Poster Session Continued

What You Really Need to Know About IFAS!
Donald B. Howard, *City of Greensboro NC*

Influence of Bioaugmentation in the Sewer to Improve the Economics of Wastewater Treatment in a Full-Scale Activated Sludge System
Rich Schici, *In-Pipe Technology Company, Inc.*

Biological Activated Filters in Wastewater Treatment - A Useful Process for an Efficient Performance
Eva Exner, *TU Berlin*, Germany

UASB/Trickling Filter Technology for the Treatment of Domestic Wastewater in Developing Countries: Operational Simplifications and Enhancement of Ammonia Removal
Paulo Sertório de Almeida, *Federal University of Minas Gerais*, Brazil

Efficient, Fixed-Bed Biological Nitrate Removal from Reverse Osmosis By-Pass Water
Jess C. Brown, *Carollo Engineers*

A Component Approach to Standardizing Methods for Biofilm Reactors
Diane K. Walker, *Montana State University*

Nitrate Removal in Drinking Water Treatment: Biological Denitrification versus Ion Exchange
Kerry J. Meyer, *CH2M HILL*

High Rate Nutrient Removal in Fluidized Bed Biofilm Reactors
Trevor Ghylin, *CH2M HILL*

Session 7: Operations

Wednesday, August 18, 2010
8:30am - 12:00pm

7A	**8:30am**	**Start-Up of a Bench Scale Nitritation-Anammox MBBR to Treat Centrate from Wards Island WPCP in NYC** Roland Jezek, *City College of New York*
7B	**9:00am**	**Nitric and Nitrous Oxide Formation in Biofilms** Brenda Read-Daily, *University of Notre Dame*
7C	**9:30am**	**IFAS Process for Nitrogen Removal With an HRT of 4 Hours** Jon Albizuri, *CEIT*, Spain
	10:00am	*Networking Break*
7D	**10:30am**	**Experiences From MBBR Post-Denitrification Process in Long-Term Operation at Two WWTPs** Maria A. Mases, *VA SYD*, Sweden
7E	**11:00am**	**Low-Level Nutrient Supplementation Enhances Biofiltration Hydraulic Performance and Treatment Efficiency** Chance V. Lauderdale, *Carollo Engineers*
7F	**11:30am**	**Lessons Learned From Startup and Commissioning of Three IFAS Facilities** Bikram Sabherwal, *Black & Veatch*
Alternate		**Ten Years Gone: An Operational and Capacity Update of Annacis Island, the World's Largest Trickling Filter Solids Contact Treatment Facility** Richard T. Kelly, II, *Brown and Caldwell*
Poster B		**Monitoring Bacterial Twitter: Why Quorum Sensing is Important to Wastewater Treatment** Joshua D. Shrout, *University of Notre Dame*
Poster C		**What You Really Need to Know About IFAS!** Donald B. Howard, *City of Greensboro NC*
Poster D		**Influence of Bioaugmentation in the Sewer to Improve the Economics of Wastewater Treatment in a Full-Scale Activated Sludge System** Rich Schici, *In-Pipe Technology Company, Inc.*
Poster E		**Biological Activated Filters in Wastewater Treatment - A Useful Process for an Efficient Performance** Eva Exner, *TU Berlin*, Germany

Poster F

UASB/Trickling Filter Technology for the Treatment of Domestic Wastewater in Developing Countries: Operational Simplifications and Enhancement of Ammonia Removal

Paulo Sertório de Almeida, *Federal University of Minas Gerais*, Brazil

Session 8: BAF's, Fixed and Fluid Beds

Wednesday, August 18, 2010
8:30am - 12:00pm

8A	**8:30am**	**Compact and Modular Biofilm Reactors for Complete Nitrogen Removal in Recirculated Aquaculture Systems** Kenneth F. Janning, *DHI*, Denmark
8B	**9:00am**	**Using BIOBROx to Convert Water Treatment Residuals to Reuse Water: From Conceptualization to Full-Scale Implementation** Jess C. Brown, *Carollo Engineers*
8C	**9:30am**	**Municipal Wastewater Treatment Using a Full-Scale Pumped Flow Biofilm Reactor (PFBR)** Edmond O'Reilly, *National University of Ireland, Galway*, Ireland
	10:00am	*Networking Break*
8D	**10:30am**	**Tertiary Nitrification in an Expanded Bed Biofilm Reactor** Michael J. Dempsey, *Manchester Metropolitan University*, United Kingdom of Great Britain and Northern Ireland
8E	**11:00am**	**Oil-Refinery Wastewater Treatment by Biofilm Processes: Moving Bed Reactor and Biological Activated Carbon Filter** Marcia Dezotti, *Federal University of Rio de Janeiro*, Brazil
8F	**11:30am**	**Factors Affecting the Design and Operation of Biologically Active Filters** Christine deBarbadillo, *Black & Veatch*
Alternate		**Commissioning of 21st Century Trickling Filter Process Design Features in a Trickling Filter / Solids Contact Process** Lloyd A. Slezak, *Brown and Caldwell*
Poster B		**Efficient, Fixed-Bed Biological Nitrate Removal from Reverse Osmosis By-Pass Water** Jess C. Brown, *Carollo Engineers*
Poster C		**A Component Approach to Standardizing Methods for Biofilm Reactors** Diane K. Walker, *Montana State University*
Poster E		**Nitrate Removal in Drinking Water Treatment: Biological Denitrification versus Ion Exchange** Kerry J. Meyer, *CH2M HILL*
Poster G		**High Rate Nutrient Removal in Fluidized Bed Biofilm Reactors** Trevor Ghylin, *CH2M HILL*