

WATER ENVIRONMENT FEDERATION

# Nutrient Symposium

2019

## **Nutrient Removal and Recovery**

### **Draft Technical Program**

(Updated January 31, 2019)

**July 23 - 25, 2019**

**Renaissance Minneapolis Hotel, The Depot**

**Minneapolis, Minnesota**

## **Pre-Conference Workshops**

(Additional fees apply)

**Tuesday, July 23**

**8:30 AM – 5:00 PM**

### **WORKSHOP A Removal and Recovery of Phosphorus: What Does the Future Hold?**

The main objective this workshop is to address needs and challenges of mainstream phosphorus removal and recovery by showcasing and debating about recent advances. There have been concerted efforts to overcome inefficiencies of conventional phosphorus removal processes. Which is also aligned with wastewater utilities embracing a new paradigm of recovery of resources from wastewater. To this end, minimization of chemicals, energy and footprint requirements for phosphorus removal/recovery has been benefited from the use of efficient biological pathways as well as innovative processes.

### **WORKSHOP B Fundamentals of Nutrient Removal and Recovery: Theory, Technologies, Operation Troubleshooting using Process Simulators**

This short course will cover the fundamental concepts of operating an activated sludge plant to achieve nitrogen and phosphorus removal via a combination of lecture material and hands-on use of a process simulator. The program includes a series of modules with each covering a fundamental concept of biological treatment or nutrient removal that will then be followed up with attendees being led through a series of simulations to demonstrate how the concept is applied to a plant layout. State-of-the-art software SimuWorks™ used in the class is based on the program, GPS-X, developed by Hydromantis. This program is commonly used for treatment process evaluation and design but has been enhanced to serve as a platform for plant O&M manuals and operator training. This software is the basis for the simulator event included in WEFTEC Operations Challenge. Each attendee will be provided with a computer to use for simulations through the course of the course.

**Opening General Session**  
**Wednesday, July 24**  
**8:30 AM – 12:15 PM**

**More information coming soon.**

**Session 01: Granular Sludge**  
**Wednesday, July 24**  
**1:30 PM - 5:15 PM**

- 1:30 PM**      **Full Scale Performance of Aerobic Granular Sludge Technology in North America**  
Manuel De Los Santos, Terry Reid, Brian Bates, Aqua-Aerobic Systems Inc
- 1:50 PM**      **Optimizing Operation of Pilot Plant Sidestream Granular Activated Sludge Reactor for Bioaugmentation of Mainstream Nitrification**  
Maxwell Armenta, University of Washington; H Stensel, Bob Bucher, King County West Point Treatment Plant; Pardi Sukapanpotharam, Bao Nguyen-Quoc, University of Washington; Mari Winkler
- 2:10 PM**      **Utilizing Metabolic Selectors to Facilitate the Path to Densification of Activated Sludge**  
Wendell Khunjar, Hazen and Sawyer
- 2:30 PM**      **Technical Brief: Extracellular Polymeric Substance Composition as Bridge Between Process and Clarifier Models**  
Khoa Nam Ngo, The Catholic University of America; Tim Van Winckel, DC Water and Sewer Authority; Arash Massoudieh; Imre Takacs, EnviroSim Associates Ltd; Bernhard Wett, ARA Consult; Charles Bott, Hampton Roads Sanitation District; Ahmed Al-Omari; Haydee De Clippeleir, DC Water
- 2:35 PM**      **Facilitated Panel Discussion**
- 3:00 PM**      **Networking Break**
- 3:45 PM**      **Innovative Process for Granulation of Conventional Continuous Flow Activated Sludge - A Novel Cost Effective Infra-Stretching Concept to Treat More Flow and Remove/Recover More Nutrients Without Expanding Your Plant**  
Beverly Stinson, Giampiero Galvagno, Keith Sears, AECOM
- 4:05 PM**      **What Did We Learn from Three Full-Scale Hydrocyclone Implementations?**  
Pusker Regmi, Jose Jimenez, Brown And Caldwell; Sudhir Murthy; Bernhard Wett, ARA Consult
- 4:25 PM**      **Modeling Aerobic Granular Sludge Performance in Sequencing Batch Reactor**  
Rasha Faraj, Belinda Sturm, University of Kansas; Jose Jimenez, Brown And Caldwell; Tanush Wadhawan
- 4:45 PM**      **Technical Brief: Quantifying the Benefits of Densified Activated Sludge on Secondary Clarifier Capacity**  
Alonso Griborio, Hazen & Sawyer; Rasha Faraj, Belinda Sturm, University of Kansas; Nandita Ahuja; Wendell Khunjar, Hazen and Sawyer; Paul Pitt
- 4:50 PM**      **Facilitated Panel Discussion**
- 5:15 PM**      **Session Adjourns for Networking Reception**

**Session 02: Carbon Management for Nutrient Removal**

**Wednesday, July 24**

**1:30 PM – 3:00 PM**

- 1:30 PM**      **Onsite VFA Production to Support Simultaneous EBPR and Denitrification- Role of Novel PAOs**  
Ramesh Goel, Sunayna Dasgupta, University of Utah Civil and Environmental Engineering Department
- 1:50 PM**      **Energy-Positive Wastewater Treatment Based on an Anaerobic Moving Bed Biofilm Reactor (AnMBBR) and Mainstream Anammox MBBR Process**  
Fernando Morgan-Sagastume, My Carlsson, Magnus Christensson, Henrique Sanchez, Anoxkaldnes-Veolia Water Technologies AB; Hong Zhao, I Kruger Inc
- 2:10 PM**      **Redirecting Methane for BNR: Enrichment of Nitrifying-Denitrifying Methanotrophic Mixed Culture an a Sequential Batch Reactor**  
Ahmed Eldyasti, Ahmed Fergala, Danelle Bishoff, York University; Ahmed Alsayed
- 2:30 PM**      **Technical Brief: Primary Sludge Fermentation: Sustainable and Economical Process of Supplementing Carbon for Short Cut Nitrogen Removal**  
Priyanka Ali, Tri Le, Rumana Riffat, George Washington University; Bernhard Wett, ARA Consut; Sudhir Murthy; Charles Bott, Hampton Roads Sanitation District; Salil Kharkar, Ryu Suzuki, Christine deBarbadillo, DC Water; Ahmed Al-Omari; Haydee De Clippeleir, DC Water
- 2:35 PM**      **Facilitated Panel Discussion**
- 3:00 PM**      **Session Adjourns for Networking Break**
- Poster:**      **Piloting mainstream partial nitrification-anammox in a two-stage configuration**  
Maciej Kowalski, University of Manitoba; Tanner Devlin; Alessandro di Biase, University of Manitoba Civil Engineering; Jan Oleszkiewicz, University of Manitoba

**Session 03: Phosphorus Recovery**

**Wednesday, July 24**

**1:30 PM - 5:15 PM**

- 1:30 PM**      **Realizing The Promise of Nutrient Recovery**  
Ron Latimer, Hazen & Sawyer
- 1:50 PM**      **Building upon Practice and Experience from Early Adopters of Sidestream Phosphorus Recovery**  
Bryan Coday, Tanja Rauch-Williams, Carollo Engineers
- 2:10 PM**      **High Efficiency Calcium Phosphate Recovery Technology at The Madison Metropolitan Sewerage District: Stability Metrics, Design Optimization, and Performance.**  
Menachem Tabanpour, Centrisys-CNP; Phillip Barak, Nutrient Recovery & Upcycling; Mauricio Avila, Zhongtian Li, Centrisys/CNP; Hiroko Yoshida; Gerhard Forstner, Centrisys/CNP; Leon Downing, Black & Veatch; Wendell Khunjar, Hazen and Sawyer
- 2:30 PM**      **Technical Brief: Struvite Recovery through Electrochemical Phosphorus precipitation in Side-stream. Industrial Scale Application of ePhos® at High Phosphorus Concentrations**  
Iosif Mariakakis, Siegfried Egner, Fraunhofer IGB
- 2:35 PM**      **Facilitated Panel Discussion**
- 3:00 PM**      **Networking Break**
- 3:45 PM**      **Finding the Right Solution for Phosphorus Harvesting: A Risk Based Approach to the Evaluation of Process Alternatives**  
Greg Knight, Black & Veatch; Bikram Sabherwal; Lucas Botero; Leon Downing, Eric Redmond, Black & Veatch
- 4:05 PM**      **Innovative Process for the Recovery of Magnesium Phosphate (Newberyite) and Ammonia from Digester Effluents**  
Matias Vanotti, USDA; Patrick Dube, Water Environment Federation
- 4:25 PM**      **Emergy Evaluation of Wastewater-derived Struvite as an Alternative to Conventional Fertilizer for Crop Production**  
Ranjani Theregowda, Cissy (Xin) Ma, Jay Garland, U.S.Environmental Protection Agency
- 4:45 PM**      **Technical Brief: Determining the Dissolution Rate of Field Grown Struvite**  
Tom Johnson, CH2M; Roland Cusick; Sam Aguiar, University of Illinois at Urbana Champaign; Adrian Romero, CH2M; Leon Downing, Black & Veatch; Rachel Lee, Ostara Nutrient Recovery Technologies, Inc.
- 4:50 PM**      **Facilitated Panel Discussion**
- 5:15 PM**      **Session Adjourns for Networking Reception**
- Poster:**      **Onsite production of concentrated urine-derived fertilizer in building-scale systems using remote process monitoring and control**  
Abraham Noe-Hays, Rich Earth Institute; Arthur Davis, Rich Earth Institute; Nicholas Lowe, University of Michigan; Enrique Rodriguez, University of Michigan; Krista Wigginton; Nancy Love, Virginia Tech

*Session 3 Posters Continued on the Next Page*

**Session 3 Posters Continued from Previous Page**

- Poster: Cost Effective Phosphorous Recovery for Small and Medium Sized Resource Recovery Facilities**  
Margaret Hollowed, Veolia Water Technologies; Thomas Johnson, Kruger Inc.; Sudhakar Viswanathan, Veolia Water Technologies; Hong Zhao, I Kruger Inc; Luke Wood, Kruger Inc; Wesley Yellin, Kruger
- Poster: Tons of Green: Algae-Based Nutrient Recovery in Waupun, Wisconsin**  
Leo Kucek, Applied Technologies, Inc
- Poster: Achieving Stable EBPR Performance at the Gary Sanitary District WWTP**  
Anthony Giovannone, CDM Smith; Rhonda Anderson
- Poster: A Case Study of Using a Revolving Algal Biofilm (RAB) Treatment System to Treat Anaerobic Digester Effluent at Pilot Scale**  
Martin Gross; Xuefei Zhao, Gross-Wen Technologies; Zhiyou Wen
- Poster: Improving removal of nonreactive phosphorus using a UV/H<sub>2</sub>O<sub>2</sub> advanced oxidation process.**  
Eileen Kennedy, Marquette University; Kaushik Venkiteshwaran, Marquette University; Brooke Mayer, Marquette University; Patrick McNamara

**Session 04: Planning and Decision Making**

**Wednesday, July 24**

**3:45 PM - 5:15 PM**

- 3:45 PM**      **The Power of Principle: How One Danish Utility is Achieving Sustainable Development Goals in their Operations**  
Per Henrik Nielsen, Mads Leth, Troels Bjerre, VCS Denmark
- 4:05 PM**      **Embracing the uncertain allows NEW Water to plan for their upcoming phosphorus TMDL**  
Colin Fitzgerald, Jacobs; Thomas Sigmund, Green Bay Metro Sewerage Dist; Nathan Qualls, Philip Mentink, New Water, Green Bay Metro Sewerage Dist; William Desing; Glen Daigger, CH2M
- 4:25 PM**      **Tool for Estimation of Capital and Operating Costs of Nitrogen and Phosphorus Recovery from Wastewater and Agricultural Wastes**  
Ankit Pathak, Wendell Khunjar, Kelly Landry, Hazen and Sawyer; Christine Radke
- 4:45 PM**      **Technical Brief: Regulatory Strategies for the Metropolitan St. Louis Sewer District Comprehensive Ammonia and Nutrient Master Plan**  
John Stober, HDR; Jay Hoskins, Metropolitan Saint Louis Sewer District; David Carani, HDR; John Christiansen, Geosyntec Consultants Inc
- 4:50 PM**      **Facilitated Panel Discussion**
- 5:15 PM**      **Session Adjourns for Networking Reception**
- Poster:**      **Comprehensive modelling of full-scale nitrifying and post-denitrifying biofilters**  
JIALU ZHU, SIAAP; Jean Bernier, SIAAP, Direction Innovation et Environnement; Sam Azimi, SIAAP, Direction Innovation et Environnement; André Paus, Université de Technologie de Compiègne; Vincent Rocher, SIAAP, Direction Innovation et Environnement; Peter Vanrolleghem, Université Laval - modelEAU
- Poster:**      **Performance of Pilot-scale Anaerobic Ammonium Oxidation (Anammox) Reactors in Treating Ammonium Rich Wastewater for Pima County Wastewater Reclamation Facility (WRF)**  
Guangbin Li, University of Arizona; Jim Field, University of Arizona; Jeff Prevatt, Pima County Wastewater Management; Mallory McMurray, University of Arizona; Jacob Smutzer, Pima County Regional Wastewater Reclamation Department; Steve King, Pima County Regional; Joleen Shiroma, University of Arizona; Reyes Sierra-Alvarez, University of Arizona
- Poster:**      **Findings from a Capital Expenditure Analysis Timing Evaluation Performed for the Fairfax County NCPCP**  
Kelly Landry, Hazen and Sawyer; Timothy Devine, Hazen & Sawyer; Janice Carroll, Hazen & Sawyer PC; Ronald Taylor, Hazen and Sawyer; Sarah Motsch
- Poster:**      **Watershed Protection through Liquid Manure Valorisation – Turning a Problem into a Commodity**  
Iosif Mariakakis, Fraunhofer IGB; Siegfried Egner, Fraunhofer IGB
- Poster:**      **Instrumentation Comparison for Different Modes of Ammonia-based Aeration Control**  
Mark Miller, Brown and Caldwell; Jose Jimenez, Brown And Caldwell; Pusker Regmi, Brown and Caldwell

*Session 4 Posters Continued on the Next Page*



***Session 4 Posters Continued from Previous Page***

**Poster:**           **Simplification of Treatment Processes and Equipment Replacement Results in Energy Efficient Biological Nutrient Removal at the Bensenville, IL WWTP**  
Troy Stinson, Strand Associates; Nick Bartolerio, Strand Associates, Inc.; Mark Swayne

**Poster:**           **Fast scale-up strategies of pilot-scale single-stage deammonification seeded with conventional BNR (Biological Nutrient Removal) sludge**  
Daehee Choi, Yeungnam university; Hojin Shin, Yeungnam university; Dongeun Park, Yeungnam university; Sukhyun Cho, Yeungnam university; Jinyoung Jung, Yeungnam University

**Session 05: Biological Phosphorus Removal: Main/Sidestream**  
**Thursday, July 25**  
**8:30 AM- 12:15 PM**

- 8:30 AM**      **Meeting Stringent Phosphorus and Copper Limits in BNR Processes: Challenges, Success and Lessons Learned**  
Mehran Andalib, Stantec; Kristen Rolison, MWH; [Christopher Andres](#), Art Umble, Stantec
- 8:50 AM**      **Occurrence of Partial Denitrification Using Internally Stored Carbon in an Intermittently Aerated Process Configured for Shortcut Nitrogen and Biological Phosphorus Removal**  
[Stephanie Klaus](#), HRSD; Kathryn Printz, Water Environment Federation; Kester McCullough, Lindsey Ferguson, HRSD; Varun Srinivasan, Northeastern University; Dongqi Wang, Xi'an University of Technology; Peisheng He; Bernhard Wett, ARA Consut; Haydee De Clippeleir, DC Water; April Gu, Department of Civil and Env. Eng; Charles Bott, Hampton Roads Sanitation District
- 9:10 AM**      **Elucidating the Microbial Ecology of Side-stream Enhanced Biological Phosphorus Removal (S2EBPR)**  
[Varun Srinivasan](#), Nicholas Tooker, Northeastern University; Dongqi Wang, Xi'an University of Technology; Guangyu Li, Northeastern University; Annalisa Onnis-Hayden; Ameet Pinto, Northeastern University; April Gu, Department of Civil and Env. Eng
- 9:30 AM**      **Technical Brief: S2EBPR Case Study – Full Scale Experience at South Cary Water Reclamation Facility 20 Years of Sidestream EBPR Process Operation**  
[Frederick Stroud](#), CDM Smith
- 9:35 AM**      **Facilitated Panel Discussion**
- 10:00 AM**      **Networking Break**
- 10:45 AM**      **Insights on Bio-P Optimization Using MLSS Fermentation at the Western Wake Regional WRF**  
[David Wankmuller](#), Katya Bilyk, Joseph Rohrbacher, Ron Latimer, Hazen & Sawyer; Damon Forney
- 11:05 AM**      **Elucidating Factors for the Success or Failure of Biological Phosphorus Removal: A Comparison Between Two Lab-Scale and One Pilot/Full-Scale EBPR Processes**  
[Paul Roots](#), Northwestern University; Fenghua Yang, Milwaukee Metropolitan Sewage District; Fabrizio Sabba; Alex Rosenthal; Joseph Kozak, Heng Zhang, MWRD of Greater Chicago At Cicero Stickney WTP; George Wells, Northwestern University
- 11:25 AM**      **The New Nutrient! Applications of Sulphur and Redox Modeling in Phosphorus Control**  
[Bruce Johnson](#), Heather Stewart, Colin Fitzgerald, Jacobs
- 11:45 AM**      **Technical Brief: Organic Phosphorus Removal using an Integrated Advanced Oxidation/Ultrafiltration System and Implications for Phosphorus Recovery**  
[Holly Gray](#), Tony Powell, Purifics Water Inc.; Scott Smith, Wilfrid Laurier University, Department of Chemistry; Wayne Parker, University of Waterloo
- 11:50 AM**      **Facilitated Panel Discussion**
- 12:15 PM**      **Session Adjourns for Lunch**
- Poster:**      **Going Green: Mankato WRRF Clearas ANBR Bench Scale Testing**  
[Patrick Haney](#), HDR

**Session 06: High Strength Wastewater Treatment**

**Thursday, July 25**

**8:30 AM- 10:00 AM**

- 8:30 AM**      **IFAS ANITA™ Mox deammonification process for treating THP reject water: from lab/pilot to full scale**  
Jon Albizuri, AnoxKaldnes-Veolia; Magnus Christensson, AnoxKaldnes AB; Brandy Nussbaum, Veolia Water Technologies; Hong Zhao, I Kruger Inc; Frederic Veuillet, Veolia Research & Innovation; Laure Graveleau, Romain Lemaire, Veolia Technical & Performance Department
- 8:50 AM**      **Treatment of Gold Mine Wastewater with Aerobic Up-Flow Submerged Attached Growth Reactor**  
Alessandro di Biase, Victor Wei, Maciej Kowalski, University of Manitoba; Michael Bratty, Golder; Martin Hildebrand, Nelson Environmental; Tanner Devlin; Pouria Jabari; Jan Oleszkiewicz, University of Manitoba
- 9:10 AM**      **Successful Upcycling of Residual Brewery Nutrients into an SCP Ingredient**  
Seth Terry, Andy Logan, Jian Hua Song, iCell Sustainable Nutrition
- 9:30 AM**      **Technical Brief: Single Stage Partial Nitrification/Anammox in Treatment of Complicated Urban Waste-streams Containing High Recalcitrant Organic Matter**  
Aditi Podder, University of Utah; Debra Reinhart, University of Central Florida; Ramesh Goel, University of Utah
- 9:35 AM**      **Facilitated Panel Discussion**
- 10:00 AM**      **Session Adjourns for Networking Break**

**Session 07: Operations Experience at Nutrient Removal Plants**  
**Thursday, July 25**  
**8:30 AM- 10:00 AM**

- 8:30 AM**            **Record Rainfall and Sewer Flows Not Enough to Dampen New Denitrification Filter Startup**  
Thor Young, GHD; Scott Crosswell; Stona Cosner, City Of Frederick Public Works
- 8:50 AM**            **Real-Time Process Controls to Meet Increasingly Stringent Effluent Limits and Improve Operational Sustainability: A Case Study of Three North Carolina Facilities**  
Victoria Boschmans, Katya Bilyk, Hazen and Sawyer; Erika Bailey; John Dodson, Charles Cocker, City Of Durham
- 9:10 AM**            **Full-Scale Optimization of a BNR Facility in Northwest Montana**  
Rickey Schultz, HDR
- 9:30 AM**            **Technical Brief: How Biological Filtration was used to Surpass Tough Nitrogen Limits for Long Island Sound**  
Matthew Edds, Veolia
- 9:35 AM**            **Facilitated Panel Discussion**
- 10:00 AM**           **Session Adjourns for Networking Break**
- Poster:**            **The Effect of Aeration Strategies on Simultaneous Nitrogen and Phosphorus Removal**  
Yihan Zhang, University of California at Davis; Maureen Kinyua, University of California at Davis; Olivia Harrington, University of California at Davis; Yeymi Aguilar, University of California at Davis

**Session 08: Membrane Aerated Biofilm Reactors**  
**Thursday, July 25**  
**10:45 AM - 12:15 PM**

- 10:45 AM**      **BNR Process Intensification using Membrane Aerated Biofilm Reactors**  
Sandeep Sathyamoorthy, Yueyun Tse, Kelly Gordon, Black & Veatch; Dwight Houweling; Daniel Coutts, Suez Water
- 11:05 AM**      **A One Year Demonstration of Nutrient Removal with Membrane Aerated Biofilm Reactor (MABR)**  
Jose Bicudo, Regional of Waterloo Water Services Div; Barry Heffernan, Oxymem; Amber Klassen, Region of Waterloo; Max Rao; John McConomy, Eoin Syron, Oxymem Ltd
- 11:25 AM**      **Going Bubbleless: Design and Start-Up of the Full-Scale MABR Demonstration at the Ejby Mølle WRRF**  
Timothy Constantine, Jacobs; Nerea Uri, Per Henrik Nielsen, VCS Denmark; Adrienne Willoughby, CH2M; Julian Sandino
- 11:45 AM**      **Technical Brief: Simultaneous Nitrification and Denitrification Throughout a Multi Stage Process Comprising Membrane Aerated Biofilm Reactors**  
Ronen Shechter, Liron Friedman; Yedidya Heffes, Fluence
- 11:50 AM**      **Facilitated Panel Discussion**
- 12:15 PM**      **Session Adjourns for Lunch**

**Session 09: Ultra-Low Nutrient Effluent and Reuse**  
**Thursday, July 25**  
**10:45 AM - 12:15 PM**

- 10:45 AM**      **Maximizing TN Removal and Reliability for SWIFT Reuse with upstream Controls**  
Heather Stewart, Bruce Johnson, Jacobs; Tyler Nading; Charles Bott, Michael Parsons, Hampton Roads Sanitation District
- 11:05 AM**      **Labile Organic Matter Dynamics in Surficial Sediments During Initial Development of a Constructed Wetland**  
Mahsa Izadmehr, University of Illinois At Chicago (UIC); Karl Rockne
- 11:25 AM**      **Meeting Ultra-Low Effluent Quality Standards in Lagoons and Mechanical Plants**  
Tanner Devlin, Nexom
- 11:45 AM**      **Technical Brief: Exeno: Removal of Micropollutants in Municipal WWTP Effluents with Moving Bed Biofilm Reactors**  
Elena Torresi, Veolia Water Technologies-Anoxkaldnes; Magnus Christensson, AnoxKaldnes AB; Christina Sund, Kruger; Henrik Andersen, Kai Tang, DTU; Heidi Andersen, Kruger; Hong Zhao, I Kruger Inc; Brandy Nussbaum, Veolia Water Technologies
- 11:50 AM**      **Facilitated Panel Discussion**
- 12:15 PM**      **Session Adjourns for Lunch**
- Poster:**      **Study of Three Enhanced Nutrient Removal (ENR) Facilities Meeting Stringent Nutrient Limits in the Chesapeake Bay Watershed**  
Ankit Pathak, Hazen and Sawyer; Wendell Khunjar, Hazen and Sawyer; Gregory Pace, Hazen and Sawyer; Sarah Motsch
- Poster:**      **IMPACT OF AVERAGING PERIODS ON NUTRIENT DISCHARGE LOAD AND WRRF DESIGN**  
JB Neethling, HDR Inc; Michael Falk, HDR Inc; David Clark, HDR Inc; Samuel Bruce, HDR
- Poster:**      **Achieving Low Effluent Nutrient Concentrations with No Chemical Addition: Results of a BNR Optimization Study at the 2.54 MGD Louisville, Colorado WWTP**  
Patrick Radabaugh, Dewberry Engineers; Just Elkins, City of Louisville

**Session 10: Reality Check: Mainstream Shortcut Nitrogen**

**Thursday, July 25**

**1:30 PM - 5:15 PM**

- 1:30 PM**      **AlexRenew's Experience with Aeration Controls for Shortcut Nitrogen Removal**  
Paula Sanjines, Jacobs; Kacey King-Mcrae, Hari Santha, Alexandria Renew Enterprise; Timothy Constantine, Jacobs; Adrienne Willoughby, CH2M
- 1:50 PM**      **Concurrent Mainstream Deammonification and Phosphorus Removal Using the ANITA Mox Process: A Pilot-Scale Evaluation at the Joint Water Pollution Control Plant (JWPCP)**  
Eric Krikorian, Hana Chmielewsk, Thomas Knapp, Michael Liu, Nikos Melitas, LA County Sanitation District; Hong Zhao, I Kruger Inc; Mitchell Johnson, Kruger
- 2:10 PM**      **Single-sludge Shortcut N and Biological P Removal for Sustainable Mainstream Wastewater Treatment in Temperate Climates**  
Paul Roots, Northwestern University; Fabrizio Sabba; Alex Rosenthal; Yubo Wang, Northwestern University; Quan Yuan; Fenghua Yang, Milwaukee Metropolitan Sewage District; Joseph Kozak, Heng Zhang, MWRD of Greater Chicago At Cicero Stickney WTP; George Wells, Northwestern University
- 2:30 PM**      **Technical Brief: Electron Competition as a Mechanism of Nitrite Accumulation in a Denitrating Culture**  
Matthew Baideme, United States Military Academy; Julian van der Made, Kartik Chandran, Columbia University
- 2:35 PM**      **Facilitated Panel Discussion**
- 3:00 PM**      **Networking Break**
- 3:45 PM**      **Exploring the Conversion of Tertiary Denitrification to Mainstream Deammonification: Pilot Scale Filter Results and Challenges**  
Eric Polli, North Carolina State University; Katya Bilyk, Hazen and Sawyer; Erika Bailey; Wendell Khunjar, Hazen and Sawyer; Francis De Los Reyes, North Carolina State University; Tarek Aziz
- 4:05 PM**      **Pushing Process Intensification Limits for Biological Nitrogen Removal using Gel Entrapment Technology**  
Mehran Andalib, Carla Cherchi, Art Umble, Stantec Inc.; Jacangelo Shu Tsuda, Hiroyuki Yoguchi, Hitachi, Ltd.; Kellogg Schwab, Johns Hopkins Bloomberg School of Public Health
- 4:25 PM**      **Nitrogen Removal from Water Resource Recovery Facilities Using Partial Nitrification, Denitrification-Anaerobic Ammonia Oxidation (PANDA)**  
Wendell Khunjar, Hazen and Sawyer
- 4:45 PM**      **Technical Brief: Lab-scale Results from a Partial Nitritation / Anammox Membrane Aerated Biofilm Reactor (MABR) for Mainstream Nitrogen Removal**  
Brett Wagner, University of Michigan; Glen Daigger, CH2M; Nancy Love, Virginia Tech
- 4:50 PM**      **Facilitated Panel Discussion**
- 5:15 PM**      **Symposium Adjourns**
- Poster:**      **Using Sensor-Mediated Control to Achieve Energy Efficient Mainstream Nitrogen Removal with Next Generation Treatment Systems: Long Term Stability and Operating Strategies**  
Zerihun Bekele, University of Michigan; Nancy Love, Virginia Tech; Charles Bott, Hampton Roads Sanitation District
- Poster:**      **Stability of Partial Nitritation–Anammox Process Using Immobilized Gel Carriers For Mainstream Deammonification**  
Shoko Miyamae, Hitachi, Ltd.; Yuya Kimura; Shinichi YOSHIKAWA, Hitachi, Ltd

**Session 11: Case Studies and Optimization**  
**Thursday, July 25**  
**1:30 PM - 5:15 PM**

- 1:30 PM**      **Implementation of Continuous Low DO Aeration Control Strategies for Simultaneous Nutrient Removal**  
Jose Jimenez, Pusker Regmi, Mark Miller, Brown and Caldwell
- 1:50 PM**      **Adapting to the Unexpected: Pre-digestion Waste Activated Sludge Phosphorus Release Process Design and Optimization at St. Cloud Nutrient, Energy & Water Recovery Facility**  
Derek Lycke, Ostara Nutrient Recovery Technologies Inc.; Patrick Shea, Tracy Hodel, City of St Cloud WWTP; Emma Larson, City of St Cloud; Rachel Lee, Pavan Patel, Ostara Nutrient Recovery Technologies Inc
- 2:10 PM**      **Achieving Nitrification and Nutrient Removal through Mainstream Bio-Augmentation from Parallel Plant**  
Mario Benisch, Partick Young, HDR Engineering Inc; Andy Clements, City of St Joseph
- 2:30 PM**      **Technical Brief: 3 Million Pounds of Nitrogen Removed and Counting at the Fairfax County NCPCP**  
Gregory Pace, Joseph Rohrbacher, Wendell Khunjar, Ronald Taylor, Janice Carroll, Hazen & Sawyer; Sarah Motsch
- 2:35 PM**      **Facilitated Panel Discussion**
- 3:00 PM**      **Networking Break**
- 3:45 PM**      **Optimization Strategies at Four BNR Facilities to Reduce Nutrients and Operating Costs**  
David Wankmuller, Katya Bilyk, Hazen and Sawyer; Eric Polli; Damon Forney; John Dodson, Charles Cocker, City Of Durham; Jeffery Mahagan
- 4:05 PM**      **Economic Analysis of Removing Orthophosphate and Improving Dewaterability of Digested Sludge by Struvite Precipitation in Digested Sludge**  
Zhongtian Li, Centrisys/CNP; Hiroko Yoshida; Joshua Gable, Menachem Tabanpour, Gerhard Forstner, Centrisys/CNP
- 4:25 PM**      **Denitrifying PAOs for Low- Carbon and Low-Energy Nutrient Removal in Cold Weather Conditions: The Ejby Mølle Case Study**  
Nerea Uri, Per Henrik Nielsen, Ferenc Szép, VCS Denmark; Timothy Constantine, Jacobs; Kartik Chandran, Columbia University; Catherine Hoar; Christine deBarbadillo, DC Water; George Wells, Northwestern University
- 4:45 PM**      **Technical Brief: An Energy Evaluation of Nitrogen Removal Methods: Is Fancy Nitrogen Removal Worth the Effort?**  
Bruce Johnson, Colin Fitzgerald, Jacobs
- 4:50 PM**      **Facilitated Panel Discussion**
- 5:15 PM**      **Symposium Adjourns**



**Session 12: Microbial Ecology**

**Thursday, July 25**

**1:30 PM – 5:15 PM**

- 1:30 PM**      **Low Energy Microbiomes for Nitrogen Removal: Rethinking Nitrification and Denitrification**  
Leon Downing, Black & Veatch; Eric Redmond; Colin Fitzgerald, Jacobs
- 1:50 PM**      **Single-Cell Raman Spectroscopy-Based Phenotyping Revealed Metabolic Difference Between Side-Stream and Conventional Enhanced Biological Phosphorus Removal Systems**  
Varun Srinivasan, Northeastern University; Annalisa Onnis-Hayden; April Gu, Department of Civil and Env. Eng; Dongqi Wang, Xi'an University of Technology; Nicholas Tooker, Guangyu Li, Northeastern University
- 2:10 PM**      **Glycerol-Driven Dissimilatory Nitrate Reduction to Ammonium (DNRA): Impact of Kinetic-Limitation on System Performance and Microbial Ecology**  
Matthew Baideme, Luke Plante, Michael Butkus, United States Military Academy; Kartik Chandran, Columbia University
- 2:30 PM**      **Technical Brief: Assessing the Prevalence of Complete Ammonia Oxidizing Bacteria in Wastewater Treatment Systems**  
Irmarie Cotto, Northeastern University; Wendell Khunjar, Hazen and Sawyer; Christopher Wilson; Haydee De Clippeleir, DC Water; Kevin Gilmore, Stearns & Wheeler Pllc; Ameet Pinto, Northeastern University
- 2:35 PM**      **Facilitated Panel Discussion**
- 3:00 PM**      **Session Adjourns for Networking Break**

**Session 13: General Nutrient Management**

**Thursday, July 25**

**3:45 PM - 5:15 PM**

- 3:45 PM**            **Strategies, Tools, and a Case Study for Implementing Watershed Nutrient Management**  
Brent Brown, CH2M-Jacobs Engineering Group; Jeffrey Smudde, New Water, Green Bay Metro Sewerage Dist; Megan Bender
- 4:05 PM**            **Simultaneous Organic Matter Removal and Nitrification in a Highly Loaded Aerated Lagoon Enhanced with Biofilm**  
Bernard Patry, Université Laval - modelEAU; Paul Lessard; Peter Vanrolleghem, Université Laval - modelEAU
- 4:25 PM**            **Comparison of a Modified and Traditional Rapid Infiltration Basin for Control of Nitrate in Reclaimed Water**  
Jessica Cormier, Steven Duranceau, University of Central Florida
- 4:45 PM**            **Technical Brief: Energetics of Nutrient Recovery from Urine by Distillation and Precipitation**  
Jessica Hazard, Kara Stuart, Heather Bischel, Harold Leverenz, University of California, Davis; Russel Adams; George Tchobanoglous
- 5:15 PM**            **Symposium Adjourns**
- Poster:**            **Simulation of Bench-scale Membrane Aerated Biofilm Reactor Design for Energy Efficiency and Nutrient Recovery**  
Avery Carlson, University of Michigan; Glen Daiggerr, Jacobs; Nancy Love, Virginia Tech