



29TH ANNUAL CSWEA EDUCATION SEMINAR



The Future of Nutrient Removal:
Decarbonization, intensification and emerging technologies

APRIL 9TH
2024

Mark your calendars for the CSWEA 29th Annual Education Seminar to be held in person on April 9th, 2024 at the Monona Terrace in Madison, WI. We have an exciting program to discuss trends in biological nutrient removal. Presentations will include discussions on decarbonization, activated granular sludge, low dissolved oxygen operation, membrane bioreactors, primary filtration, annamox, intensification, fermentation, and more.

MIDWEST STUDENT DESIGN COMPETITION (MSDC)

We encourage attendees to arrive April 8th to support University students from CSWEA and surrounding states that will be presenting their environmental and wastewater design projects at the Monona Terrace. Please consider attending to learn about their contributions to the industry and support these budding professionals. Competition starts at 10:00 am.

I&T DINNER

There will be an Innovation and Technology (I&T) dinner after the meet and greet at Cooper's Tavern (20 West Mifflin Street). If interested in attending, please sign up when registering.

29th ANNUAL CSWEA EDUCATION SEMINAR **SPEAKERS**



Julian Sandino, PhD,
PE, BCEE



Mari Winkler, PhD



Daniel Noguera, PhD



Kendra Sveum, PE



Matt Magruder



Jim McQuarrie, PE.



Cyrus McMains, PE



Kam Law, PE



Scot Strassburg, PE



Susan Danzl, PE

Meet and Greet Reception – April 8th

A meet and greet will be held April 8, 2024 after the Midwest Student Design Competition where both university students and seminar presenters will be available for networking. This event will be from 5:00 pm until 6:30 pm at the Monona Terrace.



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8:00 - 8:10: WELCOME AND INTRODUCTIONS

8:10 - 8:55: NUTRIENT REMOVAL: WHERE HAVE WE COME FROM AND WHERE ARE WE GOING

SPEAKER: JULIAN SANDINO, PHD, PE, BCEE
VICE PRESIDENT,
TECHNOLOGY SENIOR FELLOW, GLOBAL
WASTEWATER SOLUTIONS DIRECTOR
EMERITUS AT JACOBS

The past 30 years of our industry has seen an increasing influx of new ideas, technologies, and solutions related to nutrient removal. This presentation will take us through that history, discussing key advancements (and, in some cases, failures). It will touch on the early upgrade ideas to BNR within conventional activated sludge facilities, early biofilm technologies, the advent of membrane bioreactor (MBR) technology, and more recent advancements and trends, including the trend towards decarbonization and its impact on nutrient removal. Finally, it will include some advice on designing nutrient removal facilities knowing that the future is uncertain with respect to technologies developments and regulations.

DETAILED BIO:

Dr. Julian Sandino is a Vice President, Technology Senior Fellow, and Global Wastewater Solutions Director Emeritus in Jacobs, ENR -ranked No. 1 firm in Wastewater Treatment. He also serves as an advisor and special consultant to the World Bank in the areas of Water and Sanitation. Julian is named in Global Water Intelligence's Top 40 Global Water Influencers list and is a Fellow of the Internationally Water Association (IWA) and of the Water Environment Federation (WEF).

8:55 - 9:30: THE IMPORTANCE OF BIOFILMS AND GRANULES FOR NUTRIENT REMOVAL

SPEAKER: MARI WINKLER, PhD
ASSOCIATE PROFESSOR AT CIVIL &
ENVIRONMENTAL ENGINEERING DEPARTMENT
AT THE UNIVERSITY OF WASHINGTON

This talk highlights the integration of the activated granular sludge (AGS) technology

in existing wastewater infrastructure. We reported for the first time that granules are commonly present at full-scale continuous flow systems with low SVI, and granule growth may be associated with operational factors favoring PAO/GAO growth. AGS consists of variable granule sizes and this talk will show that granule sizes strongly impact nitrification, nitrogen removal as well as N_2O production rates at different operational DO. Moreover, a proof-of-concept for phosphorus recovery was tested by utilizing the high thickening properties of AGS. Furthermore, the talk will highlight the intensification of nitrogen removal with hydrogel immobilized mixed communities of AOB/anammox and pure culture of comammox.

DETAILED BIO:

Dr. Winkler (Mari) is a John R. Kiely Endowed Associate Professor at Civil & Environmental Engineering Department at the University of Washington (US). She received her PhD from the Environmental Biotechnology Department at Delft University of Technology (NL) and did a Marie-Curie Postdoc at Ghent University (BE). She also worked as a sales manager (DE, AT) and as a consultant (NL) shaping her application driven research. Dr Winkler received several prizes for her work (AEESP outstanding PhD dissertation award, Paul L. Busch Award, Huber Technology prize, Jaap van de Graaf award, B-IWA industry award, ISME-IWA Biocluster award, and Rhurverband water award). Her academic interests include microbial ecology of mixed culture communities, mathematical modeling of microbial interactions, and innovative wastewater and sludge treatment processes including Anammox, nDAMO, aerobic granular sludge, resource recovery, biosolids technology, SARS-CoV2 surveillance in the sewer.

9:30 - 9:50: POSTER SESSION & BREAK

9:50 - 10:30: YES, IT WORKS! BIOLOGICAL NUTRIENT REMOVAL (BNR) WITH MINIMAL AERATION

SPEAKER: DANIEL NOGUERA, PhD
DISTINGUISHED PROFESSOR OF CIVIL AND
ENVIRONMENTAL ENGINEERING AT THE
UNIVERSITY OF WISCONSIN – MADISON

In biological nutrient removal (BNR) treatment plants, removal of nitrogen and phosphorus is achieved by cycling the mixed liquor through aerated and not aerated zones. Aerated zones are required for ammonia oxidation and as part of the cycle that enriches polyphosphate-accumulating organisms (PAO). However, aeration is also an energy intensive operation, and thus, minimizing the amount of oxygen delivered to the process can help reduce energy requirements during treatment. This presentation will describe bench-scale, pilot-scale, and full-scale experiments demonstrating that the adaptation of key microbes to low dissolved oxygen conditions leads to the establishment of efficient BNR with minimal aeration. Lessons learned from 20 years of conducting these experiments will be discussed.

DETAILED BIO:

Professor Daniel R. Noguera is the Wisconsin Distinguished Professor of Civil and Environmental Engineering at the University of Wisconsin – Madison. He earned MS and PhD degrees in environmental engineering from the University of Illinois at Urbana-Champaign and was a postdoctoral researcher at Northwestern University before moving to Wisconsin in 1997. He specializes in sustainable biotechnology and bioenergy research. His lab currently studies bacterial transformation of lignocellulosic biomass, aromatic degradation pathways, conversion of agro-industrial residues into specialty biofuels and bioproducts, anaerobic digestion, and operation of biological nutrient removal processes under minimal aeration. He has received multiple awards, including the National Science Foundation CAREER award, the Paul L. Busch award from the Water Environment Research Foundation, and research or education awards from

the Water Environment Federation and the American Water Works Association.

10:30 - 11:10: ULTRA-LOW NUTRIENT REMOVAL AT THE BROAD RUN WATER RECLAMATION FACILITY: PAST, PRESENT, FUTURE

SPEAKER: KENDRA SVEUM, PE
DIRECTOR OF WATER RECLAMATION AT LOUDOUN WATER

The Broad Run Water Reclamation Facility (BRWRF) is a relatively new WRF located in Loudoun County, VA. The BRWRF went online in 2008 and was the largest MBR facility in the world at that time. The unique treatment train at the facility was driven by the stringent effluent limits that were put in place by the Virginia Department of Environmental Quality due to the effluent discharge location within close proximity of the Fairfax Water Drinking Water intake. This facility also faces stringent effluent challenges from the Chesapeake Bay Nutrient Program which assigned Nitrogen and Phosphorus waste load allocations (WLA) to all WWTPs in the state of Virginia based on their design capacity in the year 2011. The current regulations have no pathway to acquire additional WLA to accommodate new WWTPs since that date or expansion of existing WWTPs due to economic growth. This presentation will cover BRWRF nutrient removal performance to date as well as current work and challenges to meet future effluent discharge requirements that could be as low as 1.46 mg/L Total Nitrogen and 0.036 mg/L Total Phosphorus.

DETAILED BIO:

Kendra Sveum is the Director of Water Reclamation at Loudoun Water, in Ashburn, VA, where she oversees the operation of wastewater treatment, wastewater conveyance, remote small community systems, and the production/distribution of reclaimed water for Industrial non-potable reuse. Kendra is a licensed Professional Engineer and has a Bachelors of Science in Chemical Engineering and a Masters of Environmental Engineering from the Illinois Institute of Technology.

11:10 - 11:30: MORNING PANEL Q&A

11:30 - 12:45: LUNCH WITH POSTER SESSION

12:45 - 1:15: PRIMARY FILTRATION AS A REPLACEMENT FOR CONVENTIONAL STATE-OF-THE-ART PRIMARY CLARIFICATION FOR IMPROVED CARBON DIVERSION AND BIOGAS PRODUCTION, DOWNSTREAM ENERGY EFFICIENCY, AND PLANT GHG EMISSIONS REDUCTIONS

SPEAKER: MATT MAGRUDER
RESEARCH MANAGER AT THE MILWAUKEE METROPOLITAN SEWERAGE DISTRICT

Conventional primary clarification is the state-of-practice to remove readily settleable solids and scum. The downside of conventional treatment is that it requires a lot of space and time to achieve desired removals. To address these limitations, filter technologies have been engineered to improve removals in a fraction of the space, time, and with more consistency over wider ranges of flows and loadings without chemicals. Preliminary analysis by MMSD shows potential for decrease in WAS production, aeration costs, chemical consumption reduction, increase in biogas production and significant wet weather management risk reduction. MMSD is receiving Department of Energy grant funding to support demonstrating two alternative primary filter systems side-by-side against the conventional state-of-the-art primary clarifiers. This presentation will provide an overview of the research and updates on the project.

DETAILED BIO:

Matt Magruder has been with the Milwaukee Metropolitan Sewerage District for more than 14 years, and he is currently serving as the Environmental Research Manager. In addition to managing and coordinating the District's research efforts, Matt is leading MMSD's Digital Transformation Framework Project. Matt represents the District on various planning, advisory, and industry working groups. He received his BS in Biology from UW – Whitewater, his MBA from Cardinal Stritch University, and is an

American Society for Quality Certified Six Sigma Black Belt.

1:15 - 1:50: SCALING THE BENEFITS OF PARTIAL DENITRIFICATION/ANAMMOX (PDNA) TO FULL-SCALE FACILITIES

SPEAKER: JIM MCQUARRIE, PE
NATIONAL WASTEWATER MARKET SECTOR LEAD AT AECOM

Current best practice for removing nitrogen from municipal wastewater relies on complete oxidation of ammonia coupled with heterotrophic respiration to complete the conversion to nitrogen gas. This widely adopted approach for nitrogen removal is effective and reliable. However, in some cases, space limitations, operating costs, or constraints of the current biological process motivate the need for an alternative to convention. New process engineering concepts are being scaled from research that leverage the redox benefits of anammox bacteria to mainstream biological nitrogen removal configurations. This presentation seeks to share with the audience important background information, plus status of full scale anammox-based mainstream treatment processes.

DETAILED BIO:

Jim McQuarrie's professional career is evenly split between engineering consulting and public utility roles. His career in wastewater began as an entry-level operator working at a small wastewater treatment plant. As an operator, the exposure to wastewater treatment and the service it brings to society fueled his passion to learn more. After graduate school he moved to engineering consulting and specialized in wastewater process design and in particular application of biofilm processes to achieve intensification of processes to reduce footprint. He returned to the public sector for 10 years, serving multiple roles at Metro Water Recovery in Denver, CO where he was tasked with helping to develop and support a culture of innovation and formalizing establishment of a successful Technology



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and Innovation Department. Today, Jim serves as the National Wastewater Market Sector Lead at AECOM and now calls Philadelphia, PA his home city.

1:50 - 2:05: EARLY AFTERNOON Q&A

2:05 - 2:20: AFTERNOON BREAK

2:20 - 2:55: BIOFILMS, DENSIFICATION AND THE ALPHABET SOUP OF YBSD: DEMONSTRATION OF MABR AND ZEE DENSE FOR PROCESS INTENSIFICATION

SPEAKERS: **CYRUS McMAINS, PE**
EXECUTIVE DIRECTOR AT YORKVILLE BRISTOL SANITARY DISTRICT
KAM LAW, PE
WASTEWATER INNOVATIONS PRACTICE LEADER AT DONOHUE ASSOCIATES

Prior to 2017, the Yorkville Bristol Sanitary District (YBSD) facility faced two challenges – increased organic load from population growth and industrial contribution, and a new regulatory target for phosphorous removal. Rather than adopting the conventional solution of building new bioreactor tanks, YBSD implemented an MABR upgrade to increase treatment capacity and implement biological phosphorous removal in the existing infrastructure. This solution was 75% lower in capital cost than a conventional upgrade and was implemented in less than 18 months. The MABR solution has been delivering efficient, high-quality effluent for more than five years. The next bottleneck in the secondary treatment process is clarification and YBSD anticipates the need to build new secondary clarifier capacity in the coming years. An alternative approach is to couple densified activated sludge with the MABR (a process called zeeDENSE) to intensify the capacity of the existing secondary clarifiers and eliminate or postpone the construction of new infrastructure. YBSD embarked on a zeeDENSE demonstration program in February 2023. While the two-year program is still on-going, a

midpoint milestone has been achieved. This presentation will provide an overview of the process intensification journey at YBSD, including drivers, zeeDENSE demonstration program setup, latest test results, and day-to-day impacts on operations, maintenance, sampling and data analyses.

DETAILED BIOS:

Cyrus McMains has a BS in Civil/Environmental Engineering from Bradley University and is a registered Professional Engineer in Illinois. He has worked in the wastewater industry for 25 years, first as an engineering consultant and, since 2017, as Executive Director of the Yorkville-Bristol Sanitary District (YBSD).

Kam Law is the Wastewater Innovation Practice Leader at Donohue & Associates. She has been in the wastewater industry for 28 years focusing on biological treatment and nutrient removal. She served as the Illinois WEA president from 2018 to 2019 and she is currently a Delegate-at-Large for WEF.

2:55 - 3:15: EMBRACING INNOVATION ONE PROJECT AT A TIME

SPEAKER: **SCOT STRASSBURG, PE**
ENGINEER DIVISION MANAGER AT FOUR RIVERS SANITATION AUTHORITY

With expected permit updates, Four Rivers Sanitation Authority (FRSA) began planning to transition their 40 MGD conventional activated sludge treatment plant for nutrient removal. Other goals of the planning and implementation efforts include reducing existing plant bottlenecks, replacing equipment past its useful life, incorporating innovative technologies where appropriate, and phasing the work to minimize disruptions to service while optimizing performance. Currently FRSA has various projects that are completed, in construction, or in design. When using innovative technology, applied research testing is being performed to reduce design assumptions and predict impacts on the

rest of plant. As projects are implemented, the planning level projects are being adapted to avoid unnecessary expense and, in some cases, delaying aspects of a project that may benefit from synergistic effects of other upgrades. Although some of the following will be considered 10+ years into the future, the main projects of our facility upgrades include reducing effluent diffuser headlosses, addition of primary filtration, addition of aerobic granular sludge for a portion of plant flow, conversion to modified University of Cape Town BNR, sidestream RAS fermentation, WAS hydrolysis, deammonification, tertiary filtration, selective wasting, nutrient harvesting, and biosolids drying.

DETAILED BIO:

Scot Strassburg is a professional engineer with a Bachelor of Science degree in Civil & Environmental Engineering from the University of Wisconsin – Madison. He started his career in the water/wastewater consulting world for 24 years and then transitioned into the public sector for the past 13 years. As Plant Engineer Division Manager with Four Rivers Sanitation Authority, Scot is involved with all aspects of planning, design, construction, and commissioning of plant capital projects.

3:15 - 3:35: NEW ADVANCES IN MBR APPLICATION: THE DETROIT LAKES STORY

SPEAKER: **SUSAN DANZL, PE**
WASTEWATER MARKET LEADER AND PROJECT MANAGER AT SEH

The adoption of Membrane Bioreactors (MBRs) is increasing for nutrient removal facilities, particularly where low-level phosphorus treatment is required. Detroit Lakes, MN began the journey of meeting an effluent phosphorus (P) limit of 0.066 milligrams/liter (mg/L) in 2013. After planning, design, and construction, a new MBR treatment process went online in 2019. The facility has demonstrated its ability to meet the low-level effluent phosphorus target. However, a number of challenges have emerged including membrane fouling, biology sensitivity

to membrane cleans, and influent contaminants. This presentation will discuss the ways Detroit Lakes has worked through these challenges, including results of a full-scale pilot test of a continuous biomass densification. Through before and after testing, the pilot has shown improved performance, lower operating costs, and better sludge quality.

DETAILED BIO:

Susan Danzl is a wastewater market leader and Project Manager at Short Elliott Hendrickson, Inc., specializing in wastewater treatment projects from planning through construction. She earned her Bachelors and Masters degrees from Michigan Technological University and the University of Notre Dame. She has

been a consulting engineer for more than 17 years. Working with the City of Detroit Lakes since 2013, Susan has helped the City plan for and implement upgrades to their water reclamation facility to meet challenging nutrient targets.

3:35 - 4:00: PANEL SESSION Q&A

REGISTRATION CHARGES

1 Registration fee to attend live event (includes continental breakfast, lunch, and refreshments)

Fee per Person	by March 15	after March 15
Education Seminar (ES)	\$200	\$225
Additional Utility Attendee*	\$50	\$55
Student**	\$25	\$30

*After one person from a utility registers at standard price, up to five additional people can register for \$50 per person.

**Students – please indicate if you will present a poster and name of poster:

Yes Tentative title of poster: _____

Please indicate dietary restrictions: vegetarian vegan gluten free other

2 Attending I&T Dinner after Meet and Greet at Coopers Tavern (\$50):

Yes No Any dietary restrictions? _____

3 No refunds given after March 23

Lodging: A limited number of rooms are available at The Hilton Madison Monona Terrace, 9 East Wilson St, Madison. The rooms have been reserved at a conference rate of \$169 per night and will be held until March 9. For reservations, please call the hotel at 608-255-5100 and reference group code "CSW." Parking is available for a fee at the Hilton or next door at the Monona Terrace Community and Convention Center. Other lodging is available nearby at the Best Western Premier Park Hotel (608-285-8000) at \$149 to \$209 per night. Reference CSWEA for the group block. This hotel is about 0.7 miles walking distance from the Monona Terrace Community and Convention Center. Alternatively, rooms for each hotel can be booked online at the conference rates using the unique booking links below:

Hilton: www.hilton.com/en/book/reservation/deeplink/?ctyhocn=msnmhhf&groupcode=csw&arrivaldate=2024-04-08&departuredate=2024-04-09&cid=om,ww,hiltonlink,en,directlink&fromid=hiltonlinkdirect

Best Western: www.bestwestern.com/en_US/book/hotel-rooms.50061.html?groupId=2E6JZ9D3