Monday, 11/10/2025; 8:00 AM

Innovations in Clean Water: Tech, Investment, and Field Solutions (Potable Water)

IWC Rep: Michael J. Soller, P.E., DBIA, Bowen Engineering, Indianapolis, IN

Session Chair: Russell Huffmyer, V-Systems, Pittsburgh, PA

Discussion Leader: Gavin Watts, MPW Industrial Water Services, Inc., Pickerring, OH

This Potable Water session highlights: 1)Recent advancements in reverse osmosis (RO) technology, including dynamic, single-stage RO systems and pilot study results at drinking water facilities in the southeastern U.S. 2) Results how regional water studies guide investment decisions in areas not traditionally impacted by water scarcity, helping to prioritize public and private funding for market development. 3) Evaluation of UV and hypochlorite disinfection methods for produce washing, using a bench-to-pilot-scale study in a remote island community, achieving simple, low-cost systems suitable for small to mid-sized agricultural operations.

IWC 25-01: Dynamic Single-Stage RO: A Game-Changer for High-Recovery PFAS Removal in Drinking Water Treatment

Time: 8:10

Daniella Mosqueda, Veolia WTS, Oakville, ON Canada; Mike Boyd, Veolia Water Technologies and Solutions, Louisville, CO; Jenn Watt, Veolia Water Technologies and Solutions, Oakville, ON, Canada; Nick Heiner, Veolia Water Technologies and Solutions, Oakville, ON, Canada; Andrew Culton, Veolia Water Technologies and Solutions, Ashland, VA

Recent advancements in reverse osmosis (RO) technology have led to the development of dynamic, single-stage RO (DSSRO) processes. DSSRO, a generic term classifying reverse osmosis systems that feature a single-stage membrane array and operate in a semi-batch (non-steady-state) mode, represents a significant innovation in water treatment, particularly for PFAS removal applications. This technology employs a unique two-pump configuration within a single-stage dynamic environment, offering unprecedented control over operational parameters. The system provides flexible recovery rates and adjustable crossflow while effectively managing fouling and scaling issues. Unlike conventional RO systems, DSSRO demonstrates superior energy efficiency. The technology's ability to maintain high crossflow, regulate lead element flux and distribute flux more evenly, reduces fouling and scaling impacts, minimizing the need for chemical treatments and cleaning procedures. Notably, DSSRO has emerged as a promising solution for PFAS removal, with its enhanced operational flexibility enabling high recovery rates while substantially reducing PFAS-laden concentrate volumes requiring disposal. This capability directly addresses one of the most critical challenges in PFAS treatment: the management of concentrated waste streams. The system's high recovery capability not only minimizes concentrate output but also reduces demands on source water pumping and pretreatment, making it an efficient and sustainable solution for PFAS contamination in water treatment applications.

This paper will discuss pilot studies conducted with three different water sources in the southeast USA to evaluate DSSRO technology concentrating PFAS. The three drinking water facilities had different flowsheets and fed the DSSRO, with the primary objective of enhancing RO recovery beyond 85%. The research established optimal operational parameters and maintenance protocols for sustained maximum recovery performance. System performance was comprehensively evaluated through recovery rates, clean-in-place (CIP) frequency, and permeate quality metrics. The pilot studies demonstrated both technical feasibility and operational sustainability, maintaining continuous operation with extended CIP intervals while producing permeate with PFAS analytes below the method detection limits.

Discusser: Max Finder, ROTEC Reverse Osmosis, Wynnewood, PA

IWC 25-02: Leveraging a Regional Water Study to Support Industry and Promote Utility Partnerships

Time: 9:00

Chad Roby, Jacobs, Columbus, OH

Industries consider a range of criteria when identifying and evaluating suitable sites for capital investments in new and expanded facilities. While specific criteria vary by industry available water resources and utility infrastructure are often key considerations. The State of Ohio developed a comprehensive Regional Water Study (RWS) for a 15-county area of Central Ohio. The RWS supports not only industry with site selection for new investments, but also the state and utilities with planning for sustainable and resilient water resources.
One of the tools developed as part of the RWS is a publicly accessible dashboard. Dashboard users (utilities, economic development agencies, and industries) can evaluate water and wastewater infrastructure, water resource availability, and water demands under both existing conditions and future scenarios. This supports near and long-term water resources management by highlighting gaps – for example, projected limitations in water supply – and identifying opportunities for water reuse and public-private partnerships at local and regional levels.

A second tool developed for the RWS included sets of projects for each county in the study area. The projects illustrated specific reuse opportunties to delay or eliminate planned or potential upgrades of water treatment plants. Regional reuse opportunities included serving large industrial users by upgrading one wastewater treatment plant for reuse to avoid upgrading water treatment plants. A second regional reuse opportunity sought to fill a supply availability gap by using reuse water for agricultural purposes. A more comprehensive but general example was also provided to provide a template for stakeholders of how reuse could increase supply availability while significantly reducing infrastructure costs. Additionally, reuse opportunties can bring unusual water quality challenges such as elevated total dissolved solids often associated with reuse in cooling towers. Initial guidance is provided which includes basic understanding, evaluation criteria, and encouraging partnering with other utilties.

The focus of the RWS is unique to regions not typically associated with water scarcity challenges. The level of engagement and transparency across state, regional, and local organizations strengthens the long-term benefits of this effort. The tools developed for the RWS serve a variety of purposes one of which is a powerful tool that can be used to

attract industries. Furthermore, the tools provide an efficient method to determine what public, and private investments would accelerate the development of an area for a specific market.

Discusser: David Donkin, UCC Environmental, Waukegan, IL

IWC 25-03: Evaluating UV and Hypochlorite Disinfection for Produce Washing

Time: 9:50

Bryan Nielsen, WaterTectonics, Everett, WA ; Thomas Igou, Ph.D., WaterTectonics, Everett, WA; Priyal Panchal, WaterTectonics, Everett, WA

This bench- to pilot-scale process evaluation was formulated to evaluate onsite produce washing and disinfection in a remote island community. Historically farmers used non-potable water for irrigation, and produce washing. Newly implemented regulations for produce washing with irrigation water required treatment to meet a no detectable E. coli standard. Bench-scale testing evaluated three treatment configurations: (1) media filtration, microfiltration, and chlorine disinfection; (2) media and microfiltration with UV disinfection; and (3) microfiltration, ultrafiltration, and UV disinfection. All configurations successfully removed E. coli. Filtration improved water clarity and UV transmittance (UVT), essential for UV disinfection. Chlorine demand testing determined a dosing strategy achieving effective bacterial inactivation. UV treatment efficacy was validated at doses of 16, 40, and 80 mJ/cm².
Bench-scale results were then leveraged for pilot-scale design. Processes were evaluated at 2.5 - 10 GPM. The pilot system used irrigation water and consisted of cartridge filtration (30, 20, 10 µm) followed by either UV or hypochlorite disinfection. Results of three scenarios demonstrated effective E. coli removal, achieving non-detectable levels as required by FSMA. Total coliform removal, while not regulated, further confirmed disinfection efficacy. Disinfection delivered comparable outcomes, with UV doses adjusted based on flow and water quality. Water quality parameters, including pH, turbidity, and temperature remained stable. Chlorine demand was minimal (0.4 mg/L), and UV transmittance (UVT) slightly improved post-treatment. The results validate the pilot system's design and provide a framework for scaling up to full production systems. These findings demonstrate the system's potential to safely repurpose irrigation water for produce washing while meeting stringent safety standards.
Bench- and pilot-scale testing confirmed the feasibility of repurposing irrigation reservoir water for produce washing while meeting the stringent FSMA Produce Safety Rule. Key findings include: (a) Validated Treatment Processes: Both UV and hypochlorite disinfection effectively achieved non-detectable E. coli levels. (b) System Configuration Guidance: Pilot testing demonstrated that a combination of cartridge filtration (30, 20, 10 µm) and disinfection—either UV or chlorine—is sufficient to treat irrigation water for produce washing. This provides a scalable framework for similar applications; (c) Operational Parameters: Chlorine dosing (e.g., 20 mg-min/L CT) and UV transmittance thresholds (≥80%) were critical in achieving disinfection goals. These parameters can be adapted and optimized for other facilities; (d) Economic and Practical Feasibility: The systems tested were simple, cost-effective, and adaptable for field use, making them viable options for small to medium agricultural operations.

Discusser: Dennis Bitter, Atlantium Technologies, Sarasota, FL

Monday, 11/10/2025; 8:00 AM

Media Based Removal of Trace Contaminants

IWC Rep: Jonathan Shimko, Michael Baker International, Pittsburgh, PA

Session Chair: Tom Imbornone, Kurita America, Indianopolis, IN

Discussion Leader: Brandon Kern, DuPont Water Solutions, Midland, MI

The selective removal of trace contaminants continues to present challenges as we treat water streams with growing complexity. This session focuses on the removal of trace contaminants in problematic water streams. The technologies discussed in this session are media based, including but not limited to, ion exchange. The first paper discusses the importance of a complete water analysis when attempting to use ion exchange for selective ion removal, including emerging contaminants. The second paper discusses using an iron oxide media for removal of trace contaminants in challenging streams where ion exchange and membranes are not optimal. Finally, we wrap up the session with column studies showing removal of trace contaminants from a concentrated sodium chloride brine stream using Activated Alumina and a hybrid ion exchange media.

IWC 25-04: Trace Contaminant Removal by Ion Exchange Resin: The importance of a Complete Water Analysis for Modeling

Time: 8:10

Kaitlyn Clark, Ecolab, Purolite™ Resins, Philadelphia, PA

The removal of trace contaminants in water depends significantly on the concentrations of bulk ions as well as the concentration of the trace contaminant. Trace contaminants are present in water at less than 1% of the total dissolved solids (TDS), that is they are often present at parts per billion (ppb) or even parts per trillion (ppt) levels. The “bulk ions” surrounding them tend to be present at 10’s and 100’s of parts per million (ppm).
The low concentration of trace contaminants allows for meaningful throughputs to be achieved with ion exchange resin even when the trace contaminant is not highly preferred. When it is preferred, very long throughputs can be achieved. This paper focuses on the basic principles of trace contaminant removal by ion exchange resin. The paper will highlight the importance of a complete water analysis when planning ion exchange (IX) systems where trace contaminants are present. Emerging contaminants will be discussed and important factors for designing IX systems will be highlighted.

Discusser: Lois Remmel, Graver Technologies, Spring, TX

IWC 25-05: Regenerable Activated Alumina and Hybrid Ion Exchange Resins for the Removal of Fluoride, Silica, and Arsenate from High-TDS Sodium Chloride Brines

Time: 9:00

Larry Gottlieb, ResinTech, Inc., Camden, NJ ; Mark Babijaev, Noram Engineering and Constructors Ltd., Vancouver, BC, Canada

This paper presents the findings of two extended column studies evaluating the use of Activated Alumina and a Hybrid Ion Exchange resin for purifying sodium chloride brines. The first study focused on the removal of fluoride and arsenate from a 1% brine using ResinTech SIR-900, a granular aluminum oxide adsorbent traditionally applied in potable water treatment. The second study examined the removal of silica and arsenate from an 8.7% brine using ResinTech ASM-125, a hybrid anion exchanger with high selectivity for silica and arsenate, originally developed for nuclear fuel pool water treatment. Each column underwent two regeneration cycles and three exhaustion cycles to assess performance under simulated industrial operating conditions. The results provide insights into the effectiveness, selectivity, and operational feasibility of these treatment technologies for high-TDS brine purification. The study serves as a foundation for full-scale equipment design, and if available, an update on plant design and operational implementation will be presented.

Discusser: Douglas Kellogg, Graver Technologies, Glasgow, DE

IWC 25-06: Silica and Phosphate Removal with a Granular Iron Oxide Media

Time: 9:50

Zhendong Liu, LANXESS Corporation, Birmingham, NJ ; Stefan Hilger, LANXESS Deutschland GmbH, Cologne, Germany; Dirk Steinhilber, LANXESS Deutschland GmbH, Cologne, Germany; Stefan Neufeind, LANXESS Deutschland GmbH, Cologne, Germany; Firuza Mir, LANXESS Corporation, Birmingham, NJ

In some industrial or drinking waters, certain tough species (such as silica, boron, phosphate, selenite, fluoride and antimony) are often encountered. While these species can be largely removed by precipitation/co-precipitation/biological technologies and disposed in a sludge, a polishing adsorption media (e.g. ion exchange resin) or membrane technology (e.g. reverse osmosis) are often needed to further reduce the species concentrations to meet effluent requirements. Ion exchange resins (except certain chelating resins or specially doped resins) are generally less effective in treating these tough species due to their unfavorable selectivity to other common species in water, such as chloride, sulfate, bicarbonate and nitrate. The membrane technologies have limitations in being non-selective, fouling or low rejection rates with some of these species.

The paper reports explorative studies using a special iron oxide media (Bayoxide®) to treat these tough species. The data shows:
• >95% silica, boron, phosphate, selenite and antimony could be successfully removed by this media. Some of the tests were conducted in high TDS waters (such as lithium brines).
• in certain experiments, silica could reach non-detect levels in effluents.
• this media could be repeatedly regenerated by simple chemicals to unload/load silica and phosphate with stable cycle performance.
• the removal of fluoride seemed to be only feasible at low feed concentrations. More dynamic studies are needed to confirm the data.

In summary, the iron oxide media demonstrated great promises in selectively removing these tough species in complex waters. It offers a simple new way to effectively treat these species with high selectivity and flexibility.

Discusser: Paul Nedwick, ResinTech, Inc., Camden, NJ

Monday, 11/10/2025; 8:00 AM

Decarbonization: Overcoming Water Challenges for a Sustainable Future

IWC Rep: Patricia M. Scroggin-Wicker, P.E, Burns & McDonnell, Kansas City, MO

Session Chair: Andrew Erickson, Sargent & Lundy, Kansas City, MO

Discussion Leader: Sanjay HG, Bechtel Corporation,

As the urgency for decarbonization grows, the integration of carbon capture technologies and hydrogen production present both opportunities and challenges. This session brings together three studies that explore innovative strategies and technologies aimed at enhancing water treatment and management. Papers for this session will put a focus on the critical issues in both carbon capture and green hydrogen including ammonia-laden wastewater to hourly cooling evaluations in water-scarce regions, and finally, a case study evaluating three methods for production of high purity water. Join us for this engaging session that promises to highlight the challenges of water for a sustainable future!

IWC 25-07: Sustainable Wastewater Treatment in Carbon Capture Facilities: Evaluating Ammonia Control Technologies

Time: 8:10

Bryan Hansen, P.E., Burns & McDonnell, Kansas City, MO ; Ali Feroz Khan, Burns & McDonnell, Kansas City, MO

The implementation of post-combustion carbon capture (PCCC) in power plants presents new challenges in wastewater management, particularly with ammonia contamination. Ammonia slip from selective catalytic reduction (SCR) systems enters the flue gas and is subsequently absorbed into the quench water used in the PCCC process. This ammonia accumulates in the blowdown stream, necessitating effective treatment to prevent environmental discharge violations and ensure regulatory compliance.

This paper examines various ammonia treatment technologies and evaluates their effectiveness in mitigating ammonia-laden wastewater. Conventional methods such as nitrification-denitrification and breakpoint chlorination are analyzed for their efficiency and applicability. Additionally, advanced treatment approaches, including electro-oxidation and membrane degasification, are assessed for their potential to enhance ammonia removal while optimizing operational

performance. The impact of these technologies on the final effluent quality is explored, with specific consideration for facilities operating under zero-liquid discharge (ZLD) conditions.

A comparative cost analysis is conducted to evaluate capital investment and long-term operational expenses associated with each treatment method. This analysis provides insight into the trade-offs between conventional and emerging technologies in terms of efficiency, cost, and integration feasibility. By addressing ammonia contamination proactively, power plants can improve wastewater treatment strategies, enhance water reuse potential, and minimize environmental impact. This study builds upon previous research and contributes to the development of sustainable wastewater treatment solutions for power facilities incorporating carbon capture technology.

Discusser: Juvencio Casanova, Veolia WTS, The Woodlands, TX

IWC 25-08: Reevaluating Cooling System Design: Implications of Hybrid Cooling on Carbon Capture

Time: 9:00

Matthew Porcelli, Sargent & Lundy, Chicago, IL ; Andrew Erickson, Sargent & Lundy, Chicago, IL

As global efforts intensify to combat climate change, carbon capture technology has emerged as a critical industry aimed at mitigating greenhouse gas emissions. This evolving field offers promising solutions for reducing the carbon footprint across various sectors, particularly in energy production and industrial processes. To accommodate the integration of carbon capture, water requirements associated with significant cooling loads must be understood and managed.

The initial step in designing a cooling system involves establishing design parameters and foundational assumptions. Early carbon capture development studies can yield suboptimal results regarding the availability of cooling systems, particularly in water-scarce environments. Conventional assumptions about water demand and storage in early stage studies can rely on a one or two design cases which may fail to adequately account for off-design scenarios and hourly climate fluctuations. These assumptions can significantly impact project design along with the economic and technical feasibility of implementing carbon capture at a site. This issue is especially critical in regions where water availability is limited, and climate variability is pronounced.

This paper will demonstrate the importance of conducting hourly analyses to enhance the accuracy and effectiveness of cooling and water management designs for carbon capture systems through a case study. By integrating detailed hourly data, system designers can make more informed decisions, leading to optimized cooling systems that effectively balance water availability with carbon capture performance.

Discusser: Derek Henderson, P.E., MSc, Duke Energy, Raleigh, NC

IWC 25-09: Green Hydrogen: Estimating the levelized cost of water treatment for three feedwater sources using PEM/AEM Electrolyzers

Time: 9:50

Sean Lowe, Fluor Corporation, Houston, TX ; Jake Lam, Fluor Corporation, Houston, TX; Hudson Nash, Fluor Corporation, Houston, TX; Tamim Popalzai, Fluor Corporation

Hydrogen has developed as one of the viable options for a sustainable source of energy in the energy transition to address decarbonization by 2050 set by the European Commission in 2018. Green Hydrogen could help the energy market to decarbonize when coupled with renewable energy. The most prevalent Green Hydrogen technologies used in the current market are Anion Exchange Membrane (AEM) and Proton Exchange Membrane (PEM) electrolyzer technologies. However, both technologies demand significant volume of ultrapure water. Electrolysis uses a continuous stream of high purity water to produce hydrogen and oxygen by splitting the water molecule. The treatment steps required to produce high purity water to the plant will vary based on the source of the raw water. Two common water sources are groundwater and surface water.

This paper develops a case study to evaluate the water treatment cost for an AEM and PEM type of Green Hydrogen plant based on two different sources of raw water, which are ground water and surface water. Based on the relative treatment cost for each electrolyzer technology and raw water source, an economic metric will be developed to determine expected water treatment costs and how they compare.

This case study and metric can help various stakeholders guide their planning level expectations for determining the conceptual cost based on the electrolyzer technology and water source. This in turn can help them make better decisions about site selection and reduce economic and environmental risks.

Discusser: David Guinta, Burns & McDonnell, Kansas City, MO, USA

Monday, 11/10/2025; 8:00 AM

OARO: The Next Frontier in Brine Concentration

IWC Rep: Ed Greenwood, P.Eng., BCEE, WSP, Cambridge, ON, Canada

Session Chair: Kurt Blohm, Aquatech International, Canonsburg, PA

Discussion Leader: Richard Stover, GP Water,

Osmotically Assisted Reverse Osmosis (OARO) is redefining what's possible in desalination and industrial brine concentration. This session explores how OARO and related membrane innovations are pushing beyond the osmotic limits of conventional seawater RO (SWRO) to increase recovery and reduce brine discharge volumes. Low Salt Rejection RO (LSRRO)—a form of OARO—is also being applied in industrial processes such as chlor-alkali brine purification and reuse, and as a cost-effective strategy to reduce the CAPEX and OPEX of thermal systems in zero liquid discharge (ZLD) applications.

IWC 25-10: Case Study: Implementation of an NF System at a Chloralkali Facility – Brine Purification, Reuse, & Minimizing Liquid Discharge

Time: 8:10

Xiaofei Huang, Hydranautics, Oceanside, CA ; Frank Miller, Bridgestone Associates, Chads Ford, PA; Xiaofei Huang, Ph. D., Hydranautics, Oceanside, CA; Myles Davis, Hydranautics, Oceanside, CA

As we see advancements in membrane technology, selective ion rejection / passage becomes key to many applications ranging from municipal drinking to seawater to industrial wastes. Nanofiltration (NF) has been widely used in municipal and seawater applications and is becoming more popular in the industrial realm where a balance of lower operating pressures along with specific ion rejection / passage is targeted versus having higher purity, higher operating pressures, and needing heavier duty equipment from reverse osmosis (RO). The PRO-XS series of NF membranes has fit the need in the Chloralkali industry for rejecting unwanted impurities, concentrating up the desired NaCl, operating at lower pressures, while minimizing the volume of the final liquid discharged from sites. There are many reasons due to impurities in their bulk salt, along with commercial cost, availability, and limitations on delivery as to why membrane technology was implemented. At this site, NF membranes concentrate NaCl in the 300,000 mg/l range, while specifically rejecting SO4 - a major impurity, which is rejected in the 90th percentile on mixed ion feed waters. Membrane process also allows being able to reuse portions of spent brine while being able to reduce the cost of trucking the waste slurry away by minimizing the overall volume. This case study will discuss the challenges faced and learned as this Chloralkali facility has benefitted with the use of modern NF technology.

Discusser: Erik Desormeaux, Redwood Materials, San Francisco, CA

IWC 25-11: Optimization of Osmotically Assisted RO for high brine concentration

Time: 9:00

Neil Moe, Ph.D., Veolia Water and Process Technologies, Minnetonka, MN ; Joshua Dewanaga, Veolia Water Technologies & Solutions, Seattle, WA

Osmotically Assisted RO (OARO) using Low Salt Rejection RO (LSRRO) spiral wound membranes is capable of high brine concentration at modest pressures (< 80 bar) as a significant amount of TDS is allowed to pass into the permeate, reducing the osmotic pressure difference across the membranes. Ultra High Pressure RO (UHPRO), typically with high rejection membranes, is utilized for brine concentration at higher pressures up to 120 bar today. However, both technologies face very significant techo-economic challenges in order to achieve concentrations in excess of 200 g/l NaCl. In the case of OARO, the amount of permeate recycling becomes large, driving up membrane area, CapEx, and OpEx. For UHPRO, pressures in excess of 200 bar are required, which is far beyond the capability of spiral wound membranes or the supporting mechanical components.

We have identified an opportunity to optimize the OARO process by operating the LSRRO array at pressures > 80 bar. This is first illustrated from a theoretical point of view; an idealized model developed by Yale University researchers (Wang et al, Water Res. 179 (2020), 115317) was adapted for this purpose. The feed to the process was 75 g/l NaCl, and up to three stages of LSRRO membranes were considered, where the permeate from one LSRRO stage was recirculated to the feed of the previous stage. The permeate of the first LSRRO stage was sent to a conventional second-pass RO for production of low TDS permeate. Simulations were created to compare energy consumption and membrane area at operating pressures of 70, 100, and 120 bar.

The results indicate that the opportunity exists for energy and area to be significantly reduced at higher operating pressures. For example, at 200 g/l NaCl brine concentration, operation at 120 bar rather than 70 could reduce energy by 40% and membrane area by 60%. The reduced energy, membrane area, and number of stages required to reach a given brine TDS at higher pressures is due to the lower volume and lower TDS of LSRRO permeate that needs to be reprocessed.

A membrane element testing campaign has been initiated to determine how OARO system design is enabled or constrained by the capabilities of products available today. The paper will present the results of bench and field studies in progress. We aim to show the practical optimum design of spiral wound OARO systems through analysis of the results.

Discusser: Omkar Lokare, Turing AI, Woburn, MA, USA

IWC 25-12: Cost-Effective Brine Management and Reuse Enabled by Breakthrough Membrane Technologies

Time: 9:50

Alan Daza, Gradiant, Woburn, MA ; Siva Kota, Gradiant, Abu Dhabi, United Arab Emirates; Zubair Tippu, Gradiant, Ghala, Muscat, Oman

As global demand for freshwater continues to escalate, innovative brine management strategies are critical for advancing desalination and wastewater treatment efficiency. This session presents a breakthrough approach integrating Counter Flow Reverse Osmosis (CFRO) and advanced antiscalant chemistry to maximize water recovery, minimize brine discharge, and reduce operational costs.

This technology platform enhances traditional reverse osmosis by employing a multi-stage process that significantly increases water recovery at significantly lower energy consumption compared to high-pressure operations. Unlike conventional RO systems, this technology uniquely overcomes salinity limitations, enabling sustainable, high-efficiency brine concentration. Complementing this process, a custom-formulated antiscalant is applied to the final brine stage, preventing scale formation, extending membrane longevity, and improving system reliability – even at extreme TDS concentrations.

This session will showcase a desalination plan case study in Jeddah, Saudi Arabia, where the solution was successfully implemented to address critical intake constraints. Facing limitations on new feedwater intake, this plant implemented a unique solution to convert brine reject from an existing seawater RO (SWRO) train into a new source of high-quality permeate, eliminating the need for increasing feedwater flow or pretreatment. Another key innovation in project development was the rapid and cost-effective retrofitting of an unused SWRO asset, accelerating deployment while minimizing capital expenditures.

Key outcomes from this project include:
- 80 m³/h of high-quality permeate (TDS < 200 mg/L) produced from brine reject (TDS ~75,000 mg/l)
- 50% reduction in brine discharge
- Enhanced system efficiency with lower energy consumption and extended membrane life
- Rapid deployment by leveraging existing infrastructure for cost-effective implementation

Successfully operational for over a year, this installation continues to deliver exceptional performance, setting a benchmark for next-generation desalination and water reuse technologies. Looking ahead, new improvements are being evaluated to enhance process optimization and system capacity of the solution.

Discusser: Giancarlo Barassi, Ph.D., MBA, Aquatech International, Canonsburg, PA

Monday, 11/10/2025; 1:15 PM

The Future of Membranes is Now

IWC Rep: Lyndsey Pence, ZwitterCo, Los Osos, CA

Session Chair: Craig Mills, WesTech Engineering, Salt Lake City, UT

Discussion Leader: , ,

In this session, we dive into the forefront of membrane technology, unveiling groundbreaking innovations that are transforming water treatment. Discover how modern system designs, inventive membrane element components, novel membrane chemistries, and an innovative way to control scale are revolutionizing efficiency and sustainability. Join us to explore these cutting-edge solutions and gain invaluable insights that could redefine your approach to water treatment. Do not miss this opportunity to stay ahead in the field.

IWC 25-13: Beyond the Mesh: 3D-Printed Feed Channels and the Future of Reverse Osmosis

Time: 1:25

Kevin Roderick, Aqua Membranes, Inc., Albuquerque, NM ; CJ Kurth, Aqua Membranes, Albuquerque, NM

For six decades, the spiral-wound reverse osmosis (RO) element has relied on a consistent feed channel design: a mesh net whose structure is constrained by polyolefin extrusion. This adherence to a single design has significantly impeded a comprehensive understanding of the feed spacer's multifaceted role in RO membrane performance and longevity. The feed channel's function extends beyond merely maintaining space; it critically influences concentration polarization through induced secondary flows, dictates pressure drop, and can precipitate premature failure via extrusion. Moreover, the mesh structure can foster stagnant flow zones, conducive to scale and biofilm formation, while also trapping particulates, ultimately diminishing the element's lifespan. Notably, the feed spacer occupies a substantial volume within the element, surpassing the combined volume of the membrane, permeate carrier, and central tube, thereby limiting the active membrane area. Furthermore, during element assembly, the spacer's structure influences glue penetration, affecting insert leak prevalence.
This work explores an alternative feed channel construction using 3D printing, enabling the direct application of custom patterns onto the polyamide RO membrane surface. These patterns, defined by digital image files specifying feature shape, height, and location, replace the traditional mesh, offering unprecedented design flexibility. This approach allows for systematic variation of feed spacer structures to investigate their impact on element manufacturing and membrane performance.
This study presents a comprehensive analysis, integrating Computational Fluid Dynamics simulations, laboratory experiments, and field data, to elucidate the evolution of printed spacer designs over the past decade. We will demonstrate how specific pattern attributes affect critical parameters, including secondary flow dynamics, pressure drop, and fouling propensity. By correlating design variations with empirical results, we aim to provide a detailed understanding of the structure-performance relationship. Finally, we will outline future directions in pattern design, focusing on the development of specialized configurations tailored for unique applications and challenging operational conditions, opening new avenues for optimizing RO element performance.

Discusser: Omkar Lokare, Turing AI, Woburn, MA

IWC 25-14: Enhancing HERO Performance & Operation in a ZLD Combined Cycle Gas Plant with a Turnkey Installation of Flow Reversal RO

Time: 2:15

Sapir Regev, ROTEC, Los Angeles, CA ; Max Finder, ROTEC Reverse Osmosis Technologies, Philadelphia, PA

This paper will present results from a 2025 turnkey installation of Flow Reversal Reverse Osmosis (FR-RO) at a Zero Liquid Discharge (ZLD) combined cycle gas plant in the Southwestern United States. The system replaced 1 MGD of RO unit treatment capacity in a High-Efficiency Reverse Osmosis (HERO) treatment train treating cooling blowdown that sends waste flows to an evaporation pond. The replacement offered numerous advantages over the legacy HERO process, composed of lime softening and a weak acid cation (WAC) unit as pretreatment for the RO units. This treatment train operates at elevated pH levels to maintain silica solubility, requiring strict hardness control in the WAC unit.
The FR-RO system prevents silica and hardness scaling by periodically reversing the flow direction of the feed and concentrate streams and taking turns rotating out the bank of vessels that is in the last stage scaling position. This allows FR-RO systems to push saturation indices in a stable and sustainable manner to improve recovery rates and operation metrics.
The impact on the treatment train dramatically lowered the required rinse time on the WAC unit, allows the RO unit to operate at a much lower pH, and significantly increased the recovery rate of the RO units to reduce reject flows to the evaporation pond. These improvements reduce caustic and other chemical costs, reduce operator maintenance requirements including the hours spent using permeate for WAC rinsing, and increase plant efficiency and sustainability with better water recovery ratios.
The paper will present data from before and after the plant upgrade and details on the tight turnkey installation during

plant shutdown, demonstrating how FR-RO can improve legacy HERO infrastructure for more efficient and resilient ZLD solutions going forward.

Discusser: Giancarlo Barassi, Ph.D., MBA, Aquatech, Canonsburg, PA, USA

IWC 25-15: Fouling-Resistant Zwitterionic Reverse Osmosis Membranes Enable Stable Treatment and Enhanced Recovery of Sugar Refinery Wastewater

Time: 3:20

Andrew Hunt, ZwitterCo, Woburn, MA USA; Umang Yagnik, ZwitterCo, Woburn, MA; Dattaraj Mahale, ZwitterCo, Woburn, MA

Industrial wastewater from sugar refining presents significant treatment challenges due to elevated salinity, variable organic content, and high concentrations of inorganic salts. In one facility, wastewater generated from a Clean Sugar Technology (CST™) process, which produces high-strength effluent containing sugars, proteins, salts, and color bodies, exhibited large fluctuations in organic and inorganic loading due to contributions from ion exchange wash water and other process streams. This composition exceeded the operational tolerance of conventional reverse osmosis systems and negatively impacted downstream biological treatment.

Zwitterionic reverse osmosis membranes, formulated with a proprietary zwitterionic copolymer chemistry, were implemented in a closed-circuit configuration to treat this complex effluent. The system consistently achieved 70 to 80 percent recovery while maintaining stable flux and significantly reducing cleaning frequency. Chloride concentrations were effectively reduced, addressing one of the facility's key regulatory constraints. The consistent permeate quality supported stable clarifier and MBBR performance, contributing to reliable BOD removal and overall process efficiency.

This case demonstrates the capability of zwitterionic RO membranes to maintain high recovery, fouling resistance, and compliance in wastewater applications associated with advanced sugar refining operations.

*Author's Note: To comply with the IWC's commercialism policy, please note that after the first mention of "Clean Sugar Technology (CST™) process", the process will be referred to as "clean sugar process". Please also note that "zwitterionic" is a membrane chemistry and not a product name.

Discusser: Luke Schreiber, WesTech Engineering, Salt Lake City, UT

IWC 25-16: Redefining Silica Limits: An Innovative Approach to Scaling Control in High-Recovery RO/NF Systems

Time: 4:10

Beatriz Colacioppo, AWC (American Water Chemicals), Plant City, FL USA; Joshua Utter, AWC (American Water Chemicals), Plant City, FL, USA; Melissa Fernandes, AWC (American Water Chemicals), Plant City, FL, usa; Mo Malki, AWC (American Water Chemicals), Plant City, FL, USA; Christian Ward, AWC (American Water Chemicals), Plant City, FL, USA

Dissolved silica is a common component of most reverse osmosis (RO) and nanofiltration (NF) feed waters, typically ranging from 1 to 100 ppm. Under typical NF/RO plant operating conditions controlling silica becomes challenging at concentrations exceeding 200 to 250 ppm in the reject. As the industry advances towards higher recoveries, more RO/NF systems must address the risk of silica scaling.

Current technologies have been ineffective in controlling silica polymerization, resulting in the formation of amorphous silica scales on the membranes. Once deposited, these silica scales can dramatically reduce membrane performance by increasing salt passage and dramatically reducing permeability.

To address these challenges, a novel product was developed to slow the rate of silica polymerization, offering enhanced protection under high-silica conditions. Following promising benchtop testing, pilot trials were conducted at multiple sites with reject silica concentrations exceeding 300 ppm—levels previously considered unmanageable. This case study compares full-scale operations before and after implementation, highlighting improvements in membrane performance, reductions in cleaning frequency, and overall operational stability. We will explore how this next-generation technology has reshaped expectations for silica control in high-recovery systems.

Discusser: Vijay Ahire, IDE Water Solutions NA, Carlsbad, CA

Monday, 11/10/2025; 1:15 PM

Wastewaters – Making Membrane Systems Work Even Harder (Wastewater 1)

IWC Rep: Elke Peirtsegaele, Toray Membrane USA, Carpinteria, CA

Session Chair: Emma Wolff, P.E., MS, GAI Consultants,Inc., Homestead, PA

Discussion Leader: Jim Beninati, P.E., HDR, Pittsburgh, PA

Membranes are already relied on as powerhouses in wastewater treatment design applications, but these Authors will share the novel ways on how they are making membrane systems work even harder. In this session, you will learn about new, challenging applications for cross flow ultrafiltration that reduce reliance on clarifiers and multi-media filters (with laboratory and field results), advancements in gas transferer membranes/membrane contactors for ammonia removal/recovery, and holistic strategies for optimizing membrane bioreactor designs.

IWC 25-17: Industrial Wastewater Treatment with Lime/ Soda Ash Softening Coupled with Cross Flow Ultrafiltration as a Pretreatment for Reverse Osmosis

Time: 1:25

Ivan Zhu, Xylem, Pittsburgh, PA ; Justin Higgs, Xylem, Pittsburgh, PA; Hari Gupta, Xylem, Pittsburgh, PA; David Berger,

Xylem, Pittsburgh, PA; Kylie Henline, Xylem, Pittsburgh, PA

Industrial wastewaters such as boiler blowdown (BBD), cooling tower blow down (CTBD), and reverse osmosis reject usually contain high concentrations of calcium, magnesium, silica, total organic carbon (TOC), total suspended solids (TSS), and total dissolved solids (TDS). These wastewaters are sometimes discharged locally into Publicly Operated Treatment Works (POTW) with minimal treatment and without recovery. To recover water for reuse from these wastewaters, lime/ soda ash softening, clarification, filtration, and reverse osmosis (RO) processes are typically used to reduce the fouling potential from calcium, magnesium and silica, and eventually reduce TDS and other constituents. To simplify the pretreatment process and reduce the footprint of the system, an alternative membrane process, cross flow (CF) tubular ultrafiltration (UF) was piloted in lieu of solids contact clarification, media filtration or conventional ultrafiltration.
CF tubular UF, differs from conventional dead-end filtration such as Inge UF (Inside/ Out) and Dupont Integratec or Toray UF (Outside/ In) membranes, by utilizing high cross flow velocities tangential to the membrane surface to dislodge potential foulants and scrubbing the membrane surface with suspended solids. This provides potential advantages such as higher membrane fluxes, lower maintenance, smaller footprint, and less fouling potential.
The pilot was conducted using synthetic wastewater and two different sources of CTBD wastewater. With lime/ soda ash softening at proper doses of lime, soda ash, and magnesium chloride (if needed), it was shown that UF filtrate can reliably maintain Ca, Mg, and Silica less than 20, 20, 10 mg/L respectively. The UF flux was maintained at least 75 gfd for over ten days continuous running with minimal increase of transmembrane pressure (TMP). The concentrated slurry off the CF tubular UF was raised to 3 to 4% TSS without compromising UF flux. The slurry, which showed good dewaterability, can be fed into a thickener directly before dewatering with a filter press. Furthermore, the impact of organic materials on the flux and membrane TMP were investigated.
Our trials so far demonstrated the advantages of using softening reaction and coupled cross flow tubular ultrafiltration as a simplistic approach of RO pretreatment while achieving higher UF fluxes and less maintenance.

Discusser: Harley Schreiber, WesTech Engineering, Salt Lake City, UT

IWC 25-18: Advancing Industrial Water and Wastewater Treatment with Ultrafiltration Membranes Designed for Reduced Pretreatment

Time: 2:15

Jinwen Wang, PSP.US, Inc., Los Angeles, CA ; Jeff Koehler, PSP.US, Inc., Los Angeles, CA; Jianbo Wen, PolyCera (Shanghai) Technology Co. Ltd., Shanghai, China

Ultrafiltration (UF) is widely used in industrial water and wastewater treatment to remove suspended solids, colloids, pathogens, and emulsions. However, conventional UF membranes require extensive pretreatment to prevent fouling, increasing both capital (CAPEX) and operating (OPEX) costs. Inefficiencies or failures in pretreatment can significantly impact system performance. To minimize or eliminate pretreatment while maintaining high flux and stable operation, membrane materials and module designs must be optimized for challenging water conditions.

PolyCera® UF membranes, developed from nanostructured polymeric materials, exhibit ceramic-like stability and hydrophilicity while retaining the cost and manufacturing advantages of polymeric membranes. These membranes operate across an extreme pH range (0–14), at temperatures up to 90°C, and in the presence of organic solvents such as kerosene, xylene, and methanol. They also tolerate oil concentrations up to 3%, reducing treatment complexity and system footprint.

The membrane modules feature a backwashable monolith open-channel design with a corrugated spacer, allowing high suspended solids tolerance (up to 5%) without clogging. This design minimizes pressure drop and supports high crossflow operation, making it suitable for treating streams with elevated solids content.

Field applications have demonstrated the effectiveness of these membranes in reducing pretreatment needs. In a 4.2 MGD zero liquid discharge (ZLD) power plant, they reduced reliance on clarifiers and multi-media filters. In a 12 MGD lithium extraction facility, they removed ~700 mg/L of suspended $Mg(OH)_2$ at pH >13 without pretreatment. In coal mining, they treated wastewater with over 300 mg/L of suspended solids and oil using only a screen as pretreatment. Additionally, automated membrane systems have been deployed for offshore oil and gas produced water treatment, ensuring compliance with discharge regulations.

These findings highlight the potential of advanced UF membranes to enhance industrial water treatment by reducing pretreatment requirements and improving system efficiency.

Discusser: Juan Meneses, Naclo Water, an Ecolab Company, Apple Valley, MN

IWC 25-19: Optimizing High-Load Food & Beverage Wastewater Treatment with Anaerobic Membrane Bioreactor (AnMBR) Technology

Time: 3:20

John Dinneen, Mead & Hunt, Milwaukee, WI ; Annie Weidert, Mead & Hunt, Milwaukee, WI; John Dineen, Mead & Hunt, Columbus, OH

This food & beverage facility in the northeastern region of the US, which produces a variety of syrups, sauces, condiments, fillings, and toppings, needed a new wastewater pretreatment system to support production growth. The new system needed to replace a decommissioned, aging aerobic lagoon and a struggling temporary system that was unable to maintain compliance with discharge limits. After evaluation of alternatives and successful pilot testing, the manufacturing facility elected to construct a new anaerobic membrane bioreactor (AnMBR). The new system, designed and constructed by Mead & Hunt under an EPC contract, was commissioned in early 2023 and handles up to 20,000 lbs/day chemical oxygen demand (COD).
New treatment process summary: A new 300,000-gallon equalization tank balances wastewater flow and load fluctuations from highly variable upstream production activities and product mix. Screened, equalized wastewater is fed to a new 400,000-gallon anaerobic digester. Anaerobic activated sludge from the digester is recirculated through two ultrafiltration (UF) membrane skids. Crossflow tubular ultrafiltration membrane modules separate the treated effluent (permeate) from the recirculating mixed liquor solids, which are returned to the digester. The quality of the effluent leaving the membrane skids is so clean that no further treatment steps are necessary. After the equalization tank, the entire treatment process takes place between the digester tank and the UF membrane skids, which are located in a

small adjacent treatment building.

Results:
Performance from the new system has consistently exceeded requirements, treating high COD, TSS, and FOG raw influent wastewater (17,000 mg/L COD average) while producing effluent averaging <20 mg/L BOD and <6 mg/L TSS, more than 10 times lower than required levels. In the first 9 months of operation, average COD removal is 98.9% and has never been lower than 95%, easily handling rapid swings in influent characteristics and slug loads.

Summary of benefits achieved from the new AnMBR system:
•Superior & reliable effluent quality: Consistently high-quality effluent, permit compliance, and avoidance of surcharge costs
•Operational advantages: Significant operating cost savings from 94% reduction in weekly average sludge hauling volume, reduced chemical dosing costs, and reduced electrical use
•Minimized unit operations & compact footprint: >50% reduction in wastewater plant footprint along with increased treatment plant capacity
•Efficient schedule: Plant construction was completed in 9 months utilizing EPC project delivery and in-house UF and pump skid fabrication by Mead & Hunt
•Biogas utilization: Potential to produce renewable energy for plant

Discusser: Larry DeBirk, ClearStream Environmental, Sandy, UT

IWC 25-20: Rethinking MBR Plant Layouts - membranes tanks are not simply replacing clarifiers

Time: 4:10

Emmanuel Joncquez, Alfa Laval Copenhagen, Søborg, Denmark; Christopher Brunn, Alfa Laval Inc., Richmond, VA

In biological wastewater treatment plants, Membrane Bioreactor (MBR) systems are changing plant design by combining activated sludge treatment with membrane filtration. However, the role of membrane tanks should not be viewed merely as a replacement for traditional clarifiers. Many design companies have simply upgraded their models by switching from settling systems to a filtration unit, stating for example that the sludge present in those filtration units would not have an impact on process design.
This paper challenges conventional MBR design approaches, promoting a more holistic design where membrane tanks and the sludge in it are seen as a core component of the treatment process, rather than just a filtration unit. The design of MBR plants should combine the optimization of both biological and membrane filtration processes to lower cost, reduce energy consumption, and ensure operational flexibility. Membrane technologies offered by Alfa Laval, provide high permeability and lower fouling tendencies, which can significantly impact the overall system design. By rethinking MBR plant layouts, wastewater treatment facilities can achieve reduced construction and operational costs and higher-quality effluent, supporting the broader goals of sustainability and water reuse.

Discusser: Luis Suarez, Fluor Corporation, Houston, TX

Monday, 11/10/2025; 1:15 PM

Innovations in Energy-Efficient Water Recovery and Bioenergy Solutions

IWC Rep: Jeffrey Easton, Ph.D., P.E., Clearstream Environmental, Inc., Cottonwood Heights, UT

Session Chair: Bill Malyk, WSP Canada, Cambridge, ON, Canada

Discussion Leader: Philip Benson Jr., P.E., PMP, Geosyntec Consultants, Inc., Washington, DC

This session will explore cutting-edge technologies and methodologies in water reclamation, renewable energy solutions and energy efficiency in water reuse and desalination. The presentations will cover a range of topics, including reverse osmosis (RO) technology, anaerobic digestion, anaerobic membrane bioreactor (AnMBR) processes, biomethane production, and renewable energy integration. Attendees will gain insights into the latest advancements in these fields and their implications for sustainability, energy efficiency, and the transition to renewable energy sources. You won't want to miss out on this session!

IWC 25-21: Advances in Utility Scale Biomethane

Time: 1:25

Andrew Hodgkinson, Worley Consulting, Clifton Hill, Australia; Jeff Zimmer, Worley Consulting, Edmonton, Alberta, Canada

Biomethane producers are exhausting relatively modest scale biomass supplies (e.g. sewage sludges) and turning to much larger biomass resources such as crop residues, and even purpose grown energy crops. This paper will review recent advances in utility scale production of biomethane and its potential to replace declining fossil fuel supplies.
United States natural gas consumption is approximately 33 trillion cubic feet (3250 petajoules) per year. Other large economies, such as India also require several thousand petajoules per year. Historically the production of biogas, and biomethane derived from it has represented a tiny proportion of the total annual natural gas demand in most large industrial economies. However, the demand for sustainable energy supplies is changing this and methods for producing petajoule per year scale quantities of biomethane are now required. This has led to development of anaerobic digestion concepts hundreds of times larger than seen previously.
HIGHLIGHTS
Recent project experiences will be presented describing the new utility scale biomethane systems now in development globally:
• Several projects based around cereal crop residues will be described
• A major biomethane program targeting 750 PJ/yr, based on dedicated energy cropping will be described
• Implications of such large programs for USA energy policy will be discussed
METHODOLOGY/ PROCESS
1. Cereal Crop residue based biomethane digestion experience. Results from concept studies aimed at production of biomethane from wheat straw will be presented. Including:

• Feedstock logistics and optimisation (“hub only” vs. “hub and spokes”)
• Feedstock pre-processing
• Digestion technology
• Digestion residuals management
2. Dedicated energy crop based programs
• An international gas grid scale program (approximately 750PJ/yr) based around energy cropping on non-food production farm land will be described
• Concepts for autonomous harvesting systems and logistics
• Pre-processing, digestion technology
• Potential for system optimisation and management
• Options for further value capture from the biogenic carbon dioxide that is normally wasted from digestion systems
RESULTS/ OUTCOMES: The paper will highlight the learnings, including policy implications, potential problems and likely benefits of the various biomethane systems and projects described.
CONCLUSION: The paper will offer a possible road map and energy industry perspective on the implementation of a substantial transition from a fossil based natural gas energy system to one based on biomethane.

Discusser: Matthew Williams, Thermal Process Systems, Heber City, UT

IWC 25-22: Europe Leading the Way to Reduce Energy Use in Water Reuse and Brackish Desalination Projects: A Tale of Two Plants

Time: 2:15

David Kim-Hak, Energy Recovery, San Leandro, CA ; Eric Kadaj, Energy Recovery, San Leandro, CA

Energy costs in Europe have risen to record high prices in the last few years and electricity rates have stabilized at some of the most expensive prices in the world. Thus, utilities in Europe are implementing new technologies at wastewater reuse and brackish desalination plants to reduce the energy use of the largest load at the plant, the low pressure reverse osmosis (LPRO) system. This abstract covers two cases of utilities in Europe incorporating new isobaric energy recovery devices launched last year to address the pain point of LPRO energy use.

The first plant is the “Deeper Blue” reuse project at the Farys wastewater treatment plant in Aalst, Belgium. The facility is nearing completion of construction and is scheduled to be commissioned in May 2025. It will be one of the first multi-barrier municipal reuse facilities in the EU designed for aquifer recovery and recharge for drinking water supply, also known as indirect potable reuse (IPR). Energy saving technologies such as the new low pressure PX (LPPX), the first positive displacement isobaric type of energy recovery device designed for Nanofiltration (NF) and LPRO pressures, from will reduce the energy use of the LPRO system by approximately 23% and will be the first municipal potable reuse plant in Europe to use this new technology.

The second plant is the Ipsach brackish surface water desalination facility located on Lake Biel in Switzerland that underwent a complete redesign to improve water quality in order to provide clean drinking water for 70,000 people. The utility provider, Energie Service Biel/Bienne (ESB), sought a modern, energy-efficient solution for water treatment to enhance removal of trace contaminants. The goal was to lower trace substances by approximately 50% to combat highly variable raw water quality and prepare for the effects of climate change. This end user also selected the LPPX for their 3.8 MGD LPRO system and estimates that it will reduce RO energy use by 400 MWh/year once Phase 2 is completed based on Phase 1 results. Phase 1 was completed in 2024 and Phase 2 is scheduled for completion in 2026.

Discusser: Denney Eames, P.E., WaterTectonics, Everett, WA

IWC 25-23: Innovative Brewery Waste Management: Integrating Advanced Anaerobic Digestion (AAD) and Anaerobic Membrane Bioreactor (AnMBR) Technologies

Time: 3:20

Aryan Alidadi, Veolia WTS, Oakville, ON Canada; Dawn Lane, Veolia WTS; Lianna Major, Veolia WTS; Brian Arntsen, Veolia WTS; Youngseck Hong, Veolia WTS

There has recently been an upsurge in the demand for innovative technologies in the industrial sector to meet new regulations and take advantage of financial incentives for sustainable solutions. These incentives aim to aid businesses to meet regulatory and environmental goals. In this case, a brewery has sought Veolia’s expertise in designing a comprehensive waste management solution to treat both spent grains (high organic loading, low annual tonnage) and wastewater streams consisting of spent beer and sanitary water (low organic loading, high annual volume).
As an initial phase in assessing the various options, a waste stream characterization and a biochemical methane potential (BMP) test were performed. These tests are used to analyze the streams’ properties and behavior under anaerobic conditions. The results of this test confirmed the samples are highly biodegradable making them suitable for anaerobic digestion treatment.
The proposed solution handles the spent grains via an Advanced Anaerobic Digestion (AAD) process that features hydrolysis followed by digestion in a gas-mixed liquid phase reactor. The digestate is sent for solids separation to produce a nutrient rich digestate cake and centrate liquid. The centrate is combined with the bulk of the wastewater for treatment in the Anaerobic Membrane Bioreactor (AnMBR) process. The AnMBR brings together Veolia’s anaerobic digestion and ZeeWeed® membrane filtration technologies into one simplified process, producing high-quality effluent suitable for reuse in wastewater applications.
This combined approach effectively removes high levels of digestible organics and solids while producing methane rich biogas without the need for aeration, a significant energy consumer, in the bioreactor. The biogas produced can be upgraded using MemGasTM technology which purifies biogas into biomethane (97% to 99% methane) which will be injected into the grid as renewable natural gas (RNG).
This comprehensive solution offers reduced sludge production, a smaller footprint when compared to aerobic treatment and low power requirements. The combination of proven technologies enables a paradigm shift from “wastewater” to “opportunity water” by extracting valuable byproducts in the form of power and treated water.
This paper details the challenges, experimental data, technologies, and rationale behind this solution, which can be adapted for other industrial applications with high organic wastewaters.

Discusser: Nick Butson, P.Eng. (ON, MB), Geosyntec Consultants, Inc., Waterloo, ON, Canada

IWC 25-24: Water Reclamation with Reverse Osmosis – Staging and Energy Recovery

Time: 4:10

Richard Stover, GP Water, Waltham, MA ; Erik Desormeaux, Redwood Materials, San Francisco, CA

Reverse osmosis (RO) technology is critical in water reclamation systems designed to produce potable water from treated municipal effluent. This research considers RO process design and operating parameters that impact the most important operating metrics, namely reliability, permeate recovery rate, flexibility, and energy efficiency, which are inherently interlinked.

A predominant challenge to reliability is membrane fouling, which can drastically decrease membrane productivity and necessitate maintenance interventions, ultimately reducing membrane longevity. Effective pretreatment is vital to mitigate fouling risks; however, optimal system design and operation are equally important. Factors influencing fouling potential include membrane selection, flux distribution, and crossflow characteristics. The latter are enhanced or constrained by the system's staging design.

Generally, high permeate recovery rates are desired, thereby maximizing permeate production and minimizing concentrated residual. Sparingly soluble salts, such as silica and hardness, limit maximum recovery rate from municipal wastewater to 90-94%. Single stage recovery rates are limited to 40-55%, such that multiple stages in series are typically required for achieving recovery rates that approach the scaling limit. The necessity for multiple stages complicates design considerations, particularly at elevated recovery rates where reliability is threatened.

Although municipal wastewater is notoriously consistent in terms of composition, RO process flexibility is important as water temperature changes and as membranes age and foul. Therefore, process designs that facilitate flexible operation enhance reliability, especially at elevated recovery rates, are desired.

Energy efficiency is also a primary concern given that energy consumption is often the highest cost component in water reclamation processes. Emerging low-pressure energy recovery devices can play a pivotal role in reducing operational costs. Device selection and process design are both critical for maximizing the energy-saving potential of these devices. This research presents a comprehensive analysis of both established and novel RO design alternatives, focusing on the significance of staging design and energy recovery device choices. Utilizing operational data from two major California water reclamation plants, the study provides a quantitative evaluation of process and device options while addressing the balance of qualitative performance factors. The findings have far-reaching implications for enhancing the efficiency and reliability of water reclamation efforts both domestically and internationally.

Discusser: Ed Greenwood, P.Eng. BCEE, WSP, Cambridge, ON, Canada

Monday, 11/10/2025; 1:15 PM

Beyond the Barrel: Sustainable Solutions for Produced Water Management

IWC Rep: John A.Korpiel, P.E., Xylem, Pittsburgh, PA

Session Chair: Adam Sutherland, P.E., Stantec, Nashville, TN

Discussion Leader: Joseph Woodley, UCC Environmental, Huntsville, AL

Produced water from oil and gas extraction poses significant challenges due to its large volumes and complex composition. As the industry progresses towards sustainability, this session will examine potential solutions to the regulatory, environmental, and economic issues associated with produced water treatment. Please join us to discuss advanced technologies and innovative approaches designed to improve the reclamation and treatment of produced water.

IWC 25-25: Capabilities of In-situ Generated Stannous Oxide as a Germicidal Means for Produced Water Treatment

Time:

L. Keith McLeroy, Ecolyse, College Station, TX ; Vladimir Dozortsev, Ph.D., AMS, Sunnyvale, CA

The oil and gas industry generates vast quantities of produced water—often exceeding several barrels per barrel of oil extracted—containing a complex mix of hydrocarbons, heavy metals, salts, and microbial contaminants. Managing this wastewater is not only a logistical challenge but also a critical environmental and regulatory concern, as untreated or improperly handled produced water can lead to soil contamination, aquifer depletion, and ecological disruption. Current treatment methods, including mechanical separation, chemical oxidation, and biological processes, have demonstrated effectiveness but often come with high operational costs, energy demands, and secondary waste generation.

This paper explores a newly developed and patented approach to generate a stannous reagent on-site and on-demand through an electrolytic process developed as an effective reagent delivery method to mitigate environmental impacts and enhance the viability of produced water for discharge.

Due to the unstable, corrosive, and toxic nature of industrially produced stannous-based bulk reagents, the implementation of stannous species as a treatment reagent for produced water has been limited. However, now, with the ability to produce a non-toxic reagent in-situ, the limitations of bulk stannous are eliminated and the germicidal power of stannic (tin), in its oxidative state of stannous dioxide (SnO_2) can be fully explored.

Produced water samples, with varying water matrices, were obtained from the Permian Basin, Texas. The in-situ generator unit produced SnO_2 on-site at a concentration of approximately 600 ppm. Using varying SnO_2 dose rates, the germicidal efficacy of the SnO_2 reagent was undertaken during a 30-day evaluation by dosing two produced water samples and performing 4-day, 14-day and 30-day kill study assays. Followed QA/QC bacteriology protocols and used Bactiquant Mycometer and BTS Phenol Reg Bug Bottles during the kill study. The onsite-generated SnO_2 reagent demonstrated a significant germicidal effect by reducing log-growth over the 30-day growth study. The %BQ reduction ranged from 98.26 to 99.93 and the kill rate remained consistently high for each % BQ reduction value during the study. Moreover, the SnO_2 reagent maintained its germicidal residual in the produced water samples utilized in this study. Through microbiological assessments, the effectiveness of the SnO_2 reagent in biofilm degradation and preventative application capacities for produced water treatment, storage and reuse was proven.

The outcomes of using the in-situ generator unit and its liquid form stannous oxide as a germicidal agent in oil/gas-produced water samples of various matrices will be presented.

Discusser: Kris Sticinski, WesTech Water, Gibsonia, PA

IWC 25-26: New Inhibitors for Silicate Scale Control in Once Through Steam Generation Systems

Time:

Kaylie Young, Ph.D., SLB, Sugar Land, TX ; Marlon Norona, Southern Alberta Institute of Technology; Ron Maltman, ChampionX Canada; Corbin Ralph, ChampionX Canada; Ulysses Soto, ChampionX, Sugar Land, TX

Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS) are the two main in situ thermal recovery methods used to extract bitumen, or extra heavy oil, from oil sands deposits that are too deep to be recovered using conventional methods. These methods require the generation and injection of large amounts of high-pressure steam into the reservoir to reduce the viscosity of the bitumen so that it may be pumped to the surface. Once Through Steam Generators (OTSGs) are the main workhorses used to generate steam for thermal recovery methods as their versatile design allows them to handle significantly poorer quality feedwater than is required for traditional drum boilers. The feedwater is often recycled treated produced water from the SAGD or CSS operations, which greatly increases the sustainability of the process. Despite their many advantages, OTSGs are still prone to scaling and fouling due to the elevated TDS and organics in the feedwater. This is particularly true of silicate-based deposits, which are challenging to remove once formed. The buildup of silicate-based deposit layers on the boiler tubes can lead to reduced heat transfer efficiency, which can translate to increased fuel consumption and GHG emissions.
In this follow-up study from our 2024 IWC paper, we will present the results of pilot OTSG studies with 3 new polymer-based OTSG internal treatment chemistries. Each of the three chemistries was continuously dosed to synthetic feedwater that was previously demonstrated to scale the pilot OTSG unit over the course of 5 days. All three chemistries showed significant performance in mitigating tube wall temperature increases, indicative of reduced scaling, in the economizer section of the pilot OTSG unit compared to the untreated blank. Ion transport was monitored throughout the pilot studies and the data suggest more effective transport of problematic ions compared to the blank. Importantly, the new chemistries do not boost iron recovery significantly over 100%, which can be a risk with chelant-based programs. Dosage response studies showed that the three chemistries are effective over a wide range. Lastly, the boiler tube bundles were cut open and analyzed in order to compare the deposits that formed during each pilot test.
It is our hope that this university/industry collaboration will lead to the development of new chemistries for the internal treatment of OTSG systems in order to create more sustainable heavy oil recovery operations that require less fresh water, less energy and less production downtime.

Discusser: Youngchul Choi, Jacobs

IWC 25-27: Revolutionizing Industrial Wastewater Management: Successful Pilot of a Low-Energy Solvent-Based Desalination Technology

Time:

Michael Grossman, Aquafortus Inc., Hobbs, NM ; Richard Brunton, Ph.D., Aquafortus Technologies Limited, Mangere, Auckland, New Zealand

This paper presents groundbreaking pilot results of a novel solvent-based desalination technology for treating high-salinity industrial wastewaters. With increasing regulatory restrictions and growing sustainability pressures, industries need alternatives to conventional disposal without relying on high-energy desalination methods. This study evaluates the technical feasibility, energy efficiency, and economic viability of a solvent-driven process that enables the recovery of high-quality water while minimizing the carbon footprint and operational costs of the desalination process.

A pilot system was deployed to treat Permian Basin produced water (PW) using a solvent-based separation process. Unlike conventional thermal desalination, this method leverages selective solvent interactions to efficiently extract water from brine and eliminates the need for high-energy phase changes. Key performance indicators included water recovery rates, treated water quality, brine concentration, and energy consumption. Optimization strategies were explored to balance water recovery and operating costs, providing insights into maximizing system efficiency and long-term economic value.

This pilot confirmed that the solvent-based desalination technology can efficiently produce high-quality freshwater while significantly reducing energy requirements compared to conventional methods. The process achieved a high water recovery rate while maintaining operational flexibility to manage discharge brine concentration, including the potential for Zero Liquid Discharge (ZLD), depending on the operator’s needs. By avoiding energy-intensive phase transitions, the technology reduces costs and carbon emissions, offering a practical alternative for PW management.

As regulatory and economic pressures drive various industries toward more sustainable water management solutions, this solvent-based process presents a viable alternative to conventional disposal and high-energy desalination. Its ability to provide a low-cost, energy-efficient treatment method enhances operational control over water management strategies, making beneficial reuse more accessible and financially attractive. The success of this pilot study highlights the potential for widespread adoption, supporting long-term water resource sustainability in oil and gas, power plants, mining, and other industries.

Discusser: Ivan Morales, Nalco Water, an Ecolab Company, Calgary, AB, Canada

IWC 25-28: Innovative Venturi-Based Gas Stripping and Destruction for Produced Water Treatment

Time:

Denney Eames, P.E., Watertectonics, Everett, WA ; Patrick Ryan, Water Street Solutions, Minnetonka, MN; Kurt Hansen, WaterTectonics, Everett, WA; William Kohl, Hyperion Water Technologies, Madison, WI

WaterTectonics evaluated a new technology to remove BTEX and VOCs from produced water. The unique gas extraction technology utilized a Venturi Air Stripper technology that is very different from most water treatment liquid-gas mass transfer equipment used in water treatment.

The “Maxi-Strip” (Tradename) uses cavitating, high velocity fluid films within an open bore. The micro turbulence achieved reduces the fluid film boundary layers increasing the speed of mass transfer while creating the large surface area normally produced by packing or trays in traditional air strippers. The jet action and the venturi shape produced by the water, aspirate air, eliminating the need for noisy blowers.

This technology easily removed volatile organic compounds (VOCs) and oxidized dissolved iron. The stripped gases can be safely destroyed using a Regenerative Thermal Oxidizer (RTO). The air stripper design can handle high total suspended solids (TSS) in the water stream along with oil and grease without fouling the gas transfer surface area.

The paper will present the pilot data showing the influent and effluent VOCs. The pilot data showed that 99% of the VOCs were removed in the process. The full-scale design will be presented showing the other downstream processes. The paper will present other potential applications for this gas-liquid mass transfer technology.

Discusser: Oscar Velastegui, Veolia Water Technologies, Brea, CA

IWC 25-M8R: Reclamation of Produced Water – Process and Financial constraints of a minimally used resource

Time:

Dan Wilson, Kiewit, , ; Charles Statler, Kiewit

With the growing increase in water shortages in the US, particularly in oil producing states, there been an increased look at reclaiming produced water from oil production. Reclamation of produced water poses significant process challenges due to water quality issues such as high in TDS, BTEX, oil residue, silica, and boron. Due to the shear volume of produced water generated a year, 130 billion gallons per year in CA alone, there has been increased in reclaiming this water. Absent public funding in this area, the private development sector has been leading most of this interest.

The major process configuration requires oil and gas separation, cooling (due to temperatures in excess of 120 deg F) softening, and RO. The RO is typically a high pH configuration due to high silica concentrations and frequently requires two passes to meet boron requirements. Additional advanced oxidation for polishing may be required as a final treatment step. Additionally, a brine management plan will also be required.
While the treatment processes are typically well understood there is still work to be done in optimizing performance of the overall system which creates some very challenging economics and very expensive water. At this time, the predominant means for funding produced water is private equity and the oil producers themselves. Given the typical return on investment for oil producers and private equity, the challenges of try to reclaim the 130 billion gallons of produced water yearly in CA and 200 Billion gallons of produced water in Texas are significant and need to be worked on by the community at large.
While Daniel Wilson is the primary author, the presentation will most likely be given in two parts- Process description, by Charles Statler, followed by the discussion of the economic impacts and challenges to funding, by Noshir Irani. The current proposed presentation structure is as follows:
1.Water quality overview and highlight some differences between CA and TX produced water.
2.Process overview and description of treatment processes to meet reclaimed water quality goals. This will include discussion of the effect constituents like BTEX, boron, and temperature have on treatment and how impacts recovery and treatability and how that impacts economics
3.The economic feasibility of produced water plants given the complexities and demands by private equity in the absence of public funding.
The data presented in this study is based on real engineering and economics of projects that Kiewit

Discusser:

Tuesday, 11/11/2025; 8:00 AM

1.PFAS Removal and Cost Implications with Adsorption and Membrane Processes (PFAS 1)

IWC Rep: Kristen Jenkins, Kiewit Engineering Group Inc., Atlanta, GA

Session Chair: Haley White, Ph.D, Bechtel, Reston, VA

Discussion Leader: Devesh Mittal, Aquatech, Canonsburg, PA

The presence of Poly- and Perfluoroalkyl substances (PFAS) in many water sources necessitate advanced treatment technologies for their removal. In this session, raw water, storm water, wastewater, and landfill leachate require PFAS treatment before use, reuse, or discharge. Adsorbents, nanofiltration, and reverse osmosis are compared for their efficacy in PFAS removal from water sources with varying qualities.

IWC 25-33: Navigating the PFAS Puzzle: Strategic Assessment and Prioritization for Stormwater Management

Time:

Andrea Collier, P.E., Barr Engineering Co., Jefferson City, MO ; Heather Lau, P.E., Barr Engineering Co., Minneapolis, MN

Many industrial facilities are currently assessing or considering the assessment of PFAS presence at sites. Initiating the evaluation process and determining the next steps can present unique challenges, particularly in stormwater. In this case study, I will outline an approach to evaluating PFAS contaminants in stormwater at industrial facilities, from initial document review and data gathering to designing and implementing best management practices. This evaluation approach includes a method for prioritization to help make informed decisions about resource allocation. Addressing stormwater contaminants is often an iterative process, and I will discuss some management practices and regulatory drivers that might be considered as the evaluation of PFAS progresses towards implementing solutions.

Many industrial facilities are currently assessing or considering the assessment of PFAS presence at sites worldwide. Initiating the evaluation process and determining the next steps can present unique challenges, particularly in stormwater, due to the complex nature of these contaminants and how they are readily transported in surface water. In this case study, I will outline a comprehensive approach to evaluating PFAS contaminants in stormwater at industrial facilities. This will cover everything from initial document review and data gathering to designing and implementing best management practices tailored to specific site conditions. This evaluation approach includes a method for prioritization to help make informed decisions about resource allocation, ensuring that efforts are focused where they are most needed. Addressing stormwater contaminants is often an iterative process, requiring ongoing assessment and adjustment. I will discuss some effective management practices and regulatory drivers that might be considered as the evaluation of PFAS progresses towards implementing practical and sustainable solutions. This holistic approach aims to provide a clear roadmap for tackling PFAS contamination in stormwater, ultimately contributing to improvements in environmental outcomes.

Discusser: James Scholl, P.E., ENV SP, BCEE, Kiewit, Lenexa, KS

IWC 25-34: 2025 Update on PFAS Rejection by NF and RO

Time:

Wayne Bates, Hydranautics, Rockton, IL ; David Shin, Hydranautics, Oceanside, Ca; Yuha Okazaki, Hydranautics-Nitto, Shiga, Japan; Kirk Lai, Hydranautics, Buda, TX

This paper will report updated support data for rejection rates and ranges of various NF and RO membranes. There will be a number of on-site case studies and a lab study with spiked PFAS compounds. The challenge of case studies is there is typically a smaller amount of detectable PFAS compounds in the permeate and feed, which is the reason for spiked lab cell tests. The USA EPA has identified in UCMR-5 that 29 PFAS (out of 15,000) be monitored through 2027 by large municipalities, and six of those PFAS compounds which include PFOA and PFOS, will be pressured into meeting an ambitious compliance target by 2029. Our observations and reports indicate that only 10-20 PFAS compounds may be relevant and detectable. We have improved our NF/RO design program to be able to project rejection of six different PFAS compounds using default values or pilot generated values. We will also discuss other mitigating factors that may influence rejection rates for various feed water parameters such as TDS, TOC, NOM, pH, temperature, flux rates, and PFAS concentrations.

Discusser: Bridget Moyles, P.E., GHD, Allison Park, PA

IWC 25-35: PFAS Treatment Total Cost of Ownership (10-Year and 25-Year) Study

Time:

Chris Scott, Veolia, Trevose, PA ; Elaine Towe, P.Eng., Veolia, Oakville, ON, Canada

We examine 10-Year and 25-Year Total Cost of Ownership based on cases of water treatment for PFAS removal, both within and outside the authors' organization. Costs are aggregated & categorized, including all components and labor. Greenhouse Gases from all related sources are also examined. Averages from existing operations were applied to develop a cost model, and were calculated from the point of view of the industrial or municipal site owner procuring the equipment & services. We confined the study to the treatment of PFAS in an industrial or municipal setting utilizing at a minimum a Lead Lag Vessel configuration, filled with either Carbon or Resin media. We found significantly different (higher) costs than PFAS treatment cost estimates that have been made by various government authorities.

The boundary limits for the comparison were drawn around the traditional lead lag vessel system, together with the sufficient level of pretreatment necessary to protect the media and the system (membrane treatment, filtration, oxidant removal). Thus, post treatment such as iron sequestration, chlorine, orthophosphate/SeaQuest, clear wells, towers; and other downstream costs and civil works, are not included. An attempt was made to focus on the core PFAS removal addition to the plant.

Perhaps unsurprisingly, the largest 10-year cost element is media related: this would include purchase, handling, replacement, management, transport, disposal, GHGs, and related administrative costs. In fact, media expense (carbon or resin) accounts for well over half of the typical life cycle cost for such a plant. We found the key drivers of Lifecycle cost changes, either favorable or unfavorable, are related primarily to the Total cost efficiency with which media is employed, those key factors are examined.

Discusser: Paul Nedwick, ResinTech, Inc., Camden, NJ

IWC 25-36: Removal of per-/poly-fluoroalkyl substances (PFAS) from landfill leachate using membrane technology – A Pilot Study

Time:

Mingchen Wu, Mott Corporation, Plymouth, MI ; Kam Broxton, Mott Corporation, Plymouth, MI

Landfill leachate is considered a major source of per- and poly-fluoroalkyl substances (PFAS) along with other contaminants. Authorities across United States are proposing new regulations to restrict PFAS migration to watersheds. A major landfill operator in USA contacted Digested Organics for onsite trials of the innovative membrane technology to demonstrate the cost-effective production of clean water from leachate. The process consists of three key components: a proprietary and fouling-resistant tight ultrafiltration (SF) membrane system, Sub-Induction Time Reverse Osmosis™ (SIT-RO), and a polishing reverse osmosis system (Figure 1A).
The raw leachate was rich in organic matter (5,354 mg/L chemical oxygen demand (COD) average), ammonia nitrogen (2,630 mg/L average), and contaminants like metals and PFAS/PFOA. The SF system ran continuously for 8 days and produced permeate consistently at up to 97.5% permeate recovery at a steady 10 LMH flux rate. Notably, the SF removed 10% of total solids, 25% of COD, 9% of organic nitrogen, and 79% of manganese on average from the leachate, providing enhanced pre-filtration ahead of the SIT-RO. The SIT-RO produced ~ 90% of clean water from the SF permeate. The SIT-RO permeate was then polished in a low-pressure RO to produce a final RO permeate. Most of all measured contaminants in the final clean water were below detection limit, including 28 PFAS compounds.
For a typical 50,000 GPD landfill leachate treatment plant, this system is projected to generate approximately 40,600 GPD of treated water, while producing 1,400 GPD of SF concentrate and 8,000 GPD of RO concentrate. This pilot study demonstrates the potential of this integrated membrane system to effectively remove PFAS and other contaminants from landfill leachate, producing high-quality treated water while minimizing waste generation.

Discusser: John Peichel, Veolia, Minnetinka, MN

Tuesday, 11/11/2025; 8:00 AM

Refinery Water and Wastewater

IWC Rep: Colleen Scholl, HDR, Madison, WI

Session Chair: Mark Owens, P.E., UCC Environmental, Midlothian, IL

Discussion Leader: John Van Gehuchten, V-Systems, Pittsburgh, PA

Refineries use large amounts of water and generate very specific high-strength wastewater streams requiring advanced treatment. This session begins with a paper on optimizing boiler feed water treatment then jumps into the technoeconomic methods for evaluating wastewater treatment projects. The last two papers delve into specific treatment approaches for wastewaters with high concentrations of ammonia and COD. Come and learn more about this fascinating sector.

IWC 25-37: Triumph in Steam Quality: Refinery's Success Through Strategic Boiler Feed Water Optimization

Time:

Ashton Needham, Chevron, Pascagoula, MI

In the quest for improved boiler feed water (BFW) quality, the industry often prioritizes adding new pretreatment capabilities. However, this case study argues that optimizing existing systems, particularly through enhanced condensate recovery and optimized BFW sources, can yield significant benefits. The primary objective is to demonstrate that focusing on optimization rather than expansion improve boiler efficiency, steam quality, and overall operational reliability.

The methodology involved a detailed analysis of historical and recent data from multiple refinery plants, highlighting the impact of condensate recovery on BFW quality. Key performance indicators (KPIs) were established to monitor and limit silica contamination, a major contributor to suboptimal steam quality and equipment outages. The study revealed that optimizing existing pretreatment systems and condensate recovery processes can significantly reduce silica levels and improve steam quality without costly new installations.

Recommendations include enhancing pretreatment capabilities by optimizing current systems, improving condensate recovery, and establishing robust KPI monitoring. Specific actions completed include installing rental demineralizer trailer capabilities, adding hydraulic flexibility, completing condensate recovery projects, optimizing boiler feed water sources, and implementing KPI dashboards. These measures have led to substantial cost-efficient improvements in BFW quality, demonstrating that effective optimization can prevent plant shutdowns and reduce operational costs.

The conclusions emphasize the importance of continuous monitoring and control, proper training for operating crews, and adherence to company standards. By focusing on optimizing existing systems, refineries can achieve better water and energy savings, align with sustainability goals, and ensure long-term reliability and efficiency of their steam systems. This study provides a practical, cost-effective framework for addressing BFW quality issues and enhancing overall refinery performance without extensive new pretreatment installations.

Discusser: Macy Divens, P.E., Michael Baker International, Moon Township, PA

IWC 25-38: Wastewater Treatment for a Petrochemical Facility: Techno-Economic Evaluation for Partial Treatment vs Full Treatment and Reuse

Time:

Luis Suarez, Fluor, Houston, TX ; Sean Lowe, Fluor, Houston, TX

Petrochemical facilities use a large amount of water for utilities such as steam, cooling water, utility water, and potable water. At the same time, they also generate a large amount of wastewater. In this time of increasing water scarcity and tightening wastewater regulations, facilities need to consider the possibility of treating their water for reuse. A critical factor in the decision to treat for reuse is the cost of the increased treatment required to improve the water from minimum allowable quality (pretreated wastewater) up to process water and demineralized water quality. This must be compared to the cost of purchasing fresh water. Facilities with high raw water costs can reduce operating expenses by reusing treated effluent back into their plant.

Wastewater treatment plants in industrial facilities are required to treat wastewater leaving the site to the quality required by local regulations. Common wastewater treatment technologies in petrochemical facilities include dissolved air or nitrogen flotation (DAF/DNF), and corrugated plate interception (CPI) for oily wastewater. Other treatments employed for less common wastewater types are benzene stripping for benzene-contaminated wastewater and wet air oxidation (WAO) or evaporative crystallization for high-TDS wastewater streams, such as spent caustic. The pretreated wastewater leaving these systems can instead be directed to further treatment to recover and reuse the water in the facility.

This paper describes a case study of treating wastewater for a raw-materials to poly-olefins facility which includes a mixed feed steam cracker (MFSC), polyethylene (PE) units, and polypropylene (PP) units. The project site location has limited fresh water available. Desalinated seawater is available but at a high unit cost. The study looks at the cost to treat the facility wastewater to the effluent quality required by the local regulatory authorities while importing desalinated water for all facility requirements. This is then compared to including the additional treatment steps required to improve pretreated wastewater to process and demineralized water qualities and reduced requirement of purchasing desalinated water. The two cases will be compared on cost, footprint, and sustainability. Cost evaluation will include several sensitivity cases varying purchase cost of water, CAPEX, and OPEX.

This case study will give the reader insight into the various factors to consider when determining whether to treat wastewater to minimum pretreatment standards or to reuse quality.

Discusser: David Donkin, UCC Environmental, Waukegan, IL

IWC 25-39: Managing Ammonia Spikes in Industrial Wastewater Treatment: The Impact of Amines on Nitrification and Recovery

Time:

Everett Gill, Brown and Caldwell, Sunrise, FL ; Jeff Allen, Brown and Caldwell, St. Paul, MN

Industrial wastewater treatment facilities, especially those at refineries, face challenges with ammonia limits in their discharge permits, necessitating effective nitrification. These facilities often operate at higher solids retention times (SRT) compared to other activated sludge systems to manage spike loadings of organic nitrogen compounds. These spikes are frequently due to discharges from amine gas treatment processes within the refinery, involving compounds like methyldiethanolamine (MDEA), which hydrolyze to ammonia, increasing the ammonia load that requires nitrification. Additionally, these compounds can inhibit biological treatment and reduce nitrification rates. Our paper will share results from a sensitivity analysis utilizing a validated biological process simulator (BioWin) to assess the maximum rate of change in influent nitrogen loading that maintains effluent ammonia compliance at nitrification rates observed at refinery wastewater treatment plants. It examines effluent ammonia levels under varying influent spike load conditions (duration and concentration) and the required sludge ages across different nitrification rates typically experienced at refineries, including reduced rates due to amine loading. The study also evaluates effluent ammonia due to inhibition, facility recovery times from this inhibition, and strategies to minimize recovery time.

Discusser: David Alvarado, Newterra, Coraopolis, PA

IWC 25-40: Cost Effective Methods for Refinery Wastewater Tank Treatment through Chlorine Dioxide

Time:

Sankaran Murugesan, Baker Hughes, Sugar Land, TX ; Stephen Garza, Baker Hughes, Sugar Land, TX; Michael Carpenter, Baker Hughes, Sugar Land, TX

Refinery wastewater treatment plants (WWTPs) play a critical role in supporting the continuous and efficient operation of crude processing units. These systems rely on primary and secondary treatment processes to manage contaminants. However, process upsets can lead to elevated levels of oil, grease, and chemical oxygen demand (COD), potentially exceeding the treatment plant’s capacity. High COD concentrations, particularly from dissolved organic matter, can disrupt biological treatment efficiency and significantly increase operational costs.
In some cases, high-COD wastewater must be stored temporarily in tanks for later disposal. Due to its contamination level, this water may be classified as hazardous waste, making off-site hauling and disposal an expensive option. A more sustainable and cost-effective alternative is on-site treatment that restores water quality to a reusable state.
This paper presents a case study on the use of chlorine dioxide as an oxidative treatment method for reducing COD in refinery wastewater tanks. Unlike conventional chemical additives that may contribute additional COD or are limited by operational conditions, chlorine dioxide effectively oxidizes dissolved organics without creating secondary waste. The case study demonstrates an 85% reduction in COD—from 120,000 ppm to significantly lower levels—in a short treatment time, making the water suitable for reuse. This approach provides a practical and economical solution for refinery operators dealing with high-COD wastewater storage challenges.

Discusser: Alen Gusa, Ph.D., P.E., Michael Baker International, Moon Township, PA

Tuesday, 11/11/2025; 8:00 AM

MLD/ZLD: Good to the Last Drop!

IWC Rep: Jane Kucera, MS, ChE, Nalco Water, an Ecolab Company, Naperville, IL

Session Chair: Wayne Bates, Hydranautics, Rockton, IL

Discussion Leader: Michael Preston, Kiewit, Lenexa, KS

Minimal Liquid Discharge (MLD)/Zero Liquid Discharge (ZLD) is a design philosophy to maximize wastewater recovery while optimizing CAPEX-OPEX costs. The key to successful MLD/ZLD is evaluating the cost/benefit of each technique for any specific facility. To understand how to proceed with such an evaluation, we begin our Session with an overview of MLD and ZLD design strategies, and ways to determine which strategy may be appropriate for your facility. We then cover unit operation process design for a specific industry—semiconductors—for ZLD. The remaining papers focus on a review of traditional thermal technology for ZLD add a new, novel desalination technology for low pH mining waste waters.

IWC 25-41: MLD vs ZLD Strategies - Which One Should You Choose?

Time:

Walter Kozlowski, Xylem Inc, Lemont, IL ; Patrick Regan, Solenis LLC, Wilmington, DE

This presentation will provide an unbiased perspective on both MLD and ZLD and how it impacts sustainability objectives, allowing the audience to fully understand the benefits and challenges of each. The potential impacts and obstacles of each strategy, including OPEX and CAPEX, will be reviewed. These impacts and obstacles include: flow sheet (and operational) complexity, water costs, sewer costs, energy costs, labor needs, environmental concerns, as well as equipment and civil requirements. Both Minimum Liquids discharge (MLD) and Zero Liquid Discharge (ZLD) are potentially viable pathways to achieve a facilities water-reduction objectives and support a sustainability strategy. However, both present somewhat unique advantages and disadvantages which are often overlooked during the planning stages. When viewed separately, MLD is more of a strategy, while ZLD is more of an objective. Many organizations get enamored with the concept of ZLD due to the attraction for branding purposes as well as potentially reducing environmental costs and concerns; this attraction can drive a facility towards ZLD without fully understanding the challenges to reach that objective, and ultimately may expend significant efforts before determining that it wasn't the best path for their situation. So, the decision to go ZLD should be examined carefully to ensure success from both a water and financial perspective. Often starting with a MLD strategy may ultimately lead to a ZLD objective, and starting this way ensures consistent progress and easier management of costs.
Time constraints will force a focus on only critical design considerations, building on specific examples and general equipment pathways. Overall, this presentation will allow participants to make more thoughtful decisions based on needs and drivers, rather than leading with commercial attractiveness.

Discusser: Andrew Mueller, Aquatech International, Hartland, WI

IWC 25-42: Upstream Treatment Strategies for ZLD Processes

Time:

Brian Lowes, Jacobs, Akron, OH ; Kyle Brunn, Jacobs

The use of zero liquid discharge technologies is increasingly popular at industries where heavy water reuse is required. Motivation, including working in water stressed areas combined with a high demand of water use, and individual environmental goals have pushed these industries to create a more reliable, resilient, and sustainable water supply by optimizing water reuse for their fabrication areas. Optimization of upfront water reuse technologies is particularly important when considering the high energy consumption required in ZLD systems.

The first case study highlights a proposed advanced water treatment plant (AWTP) for treating industrial wastewater combined with reclaim water to provide process water for an electronics manufacturer and other related industries. The new fabrication facility was identified to be constructed at the industrial park and the AWTP was conceived to provide feedwater to an ultra-pure water system for use in their manufacturing process. The AWTP will reduce demand on the water authorities potable water system and eliminate discharge of wastewater with high TDS and fluoride into the sanitary system. Zero liquid discharge (ZLD) was an overall goal of the AWTP. The AWTP was evaluated for 5MGD of reuse capacity.

The project included an evaluation of technologies capable of treating effluent from the manufacturer along with supplemental water from the local sanitary sewer effluent lagoon. Due to the high capital cost and energy demand for the ZLD process, minimizing the scale of the process was a primary goal. A lime softening/clarification system followed by UF/RO processes were evaluated next to the use of a HERO process to maximize water reclamation from the membranes. An innovated approach to pre-treating wastewater streams with a medium pressure membrane followed by a lime softening/clarification system and sea-water membrane system showed an increase in reclamation rate of net +3% from the previous layouts as it feeds to the ZLD. The additional reclamation resulted in significant cost savings in capital cost and energy use of a ZLD system.

Lessoned learned from the first case study led to implementation of a similar system to optimize water recovery at a similar electronics manufacturer's site. Waste streams sent to the AWTP were segregated into organic water streams and inorganic water streams to improve water quality for the high-quality water demands required for a UPW systems. A centralized ZLD consisting of a brine concentrator and crystallizer was included. Combined water streams for reuse totaled 7.5 MGD with considerations for future plant expansion.

Discusser: Suzette Puski, Stantec, Providence, RI

IWC 25-43: Zero Liquid Discharge Using Thermal Evaporation for Water Recovery and Waste Minimization - A Produced Water Management Case Story

Time:

Kristian Lindell, Alfa Laval Technologies, Lund, Sweden

The global focus on “net-zero” emissions includes many air emissions but is extended to the important net-zero goals to reduce the enormous consumption of fresh water depleting this life critical resource. One large potential solution to reduce fresh water usage is to provide industrial process water through the reuse of the wastewaters generated by industry itself. It is estimated that less than 3% of all industrial wastewaters in Europe are recovered and reused today, and for the worldwide it is expected to be even less. Reducing raw water intake can be achieved within the processes through internal recycle or even reused externally for certain cases such as irrigation of near-by farmland in arid areas of the country. Several different wastewater streams in the industry can be identified as candidates for recovery and reuse, for example cooling tower blow-down, scrubber blow-down, produced water from oil and gas, process water from fiberboard production, and even RO-reject streams from raw water treatment facilities

For low-TDS wastewater streams, typically 70 to 90% water recovery can be achieved using efficient and relatively cheap membrane technology. However, some wastewaters are already high in TDS or contain other impurities which makes membrane technology not applicable, and further, the RO-reject brine is typically too high in TDS to be discharged. Achieving ZLD or Minimum Liquid Discharge for the final water recovery, with the possibility of concentration and crystallization of salts, requires a final step using thermal evaporation technology.

One such example of this water recovery is a produced water application in Italy using evaporative technology to concentrate and ultimately crystallize the salts, recovering overall a total of 99% of the water. The produced water first passes through an RO stage then through a two-effect evaporation system to reduce steam usage. Over 100 ton/hr of produced water is sent through a RO system followed by thermal evaporation generating over 1100kg/hr dry salts (mostly NaCl). Technologies exist to minimize the typical fouling issues and can be tailored to the jobsite depending on utility availability. Steam can be used in multiple effects to reduce usage or where waste heat is available, this can be used to replace steam altogether. Mechanical Vapor Recompression can be used in areas where neither steam nor waste heat energy are available. Relative costs and energy usage for each of these options will be reviewed through the presentation.

Discusser: William Celenza, P.E. BCEE, Burns & McDonnell, Chicago, IL

IWC 25-44: Achieving MLD in Reverse Osmosis (RO) Reject Treatment using Electro-Ceramic Desalination (ECD)

Time:

Unnati Rao, Ph.D., Membrion Inc., Seattle, WA ; Mike Botros, Membrion Inc., Seattle, WA; Greg Newbloom, Membrion Inc., Seattle, WA; Joshua Summers, Membrio Inc., Seattle, WA; Roland George, Membrion Inc., Seattle, WA

As global industries intensify efforts to meet sustainability targets, innovative wastewater treatment technologies are becoming essential in reducing environmental impact and operational costs.

A global consumer chemical product manufacturer sought to meet internal net-zero wastewater goals by 2030 to minimize OPEX costs and municipal water supply burdens.

Focusing on reclamation of wastewater to improve overall plant recovery, this paper focuses on the execution and results of a successful pilot study conducted at the manufacturer’s facility to treat and recycle RO brine for reuse utilizing a novel Electro-Ceramic Desalination (ECD) membrane developed by Membrion, Inc. Key phases of the project included bench scale testing of representative wastewater samples and pilot demonstration. The results showed that ECD is capable of efficiently recovering >85% of the RO brine enabling its recycling back into the process while improving the overall plant recovery to 96%. This study highlights the potential of ECD membranes as a viable solution for industrial water reuse and sustainable wastewater management.

Discusser: Paul Brandt, P.E., Bruns & McDonnell, Kansas City, MO

Tuesday, 11/11/2025; 1:15 PM

Hydro Harmony Reclaimed - Tackling the Challenges of Reclaimed Water (Reuse 2)

IWC Rep: Derek Henderson, P.E., MSc, Duke Energy Corporation, Raleigh, NC

Session Chair: David Fulmer, Halliburton, Fulshear, TX

Discussion Leader: Brian Arntsen, Veolia Water Technologies & Solutions, Oakville, ON Canada

Water reuse isn't just an option; it's the foundation of sustainability for high-water consumers across industries. Yet, its widespread adoption faces significant hurdles. The success of any water reuse initiative hinges on a complex interplay of technological, ideological, social, and commercial factors. Modernizing infrastructure, securing upfront investment, and navigating complex regulations are major obstacles that often derail promising new technologies. This session dives deep into the unique water reuse challenges confronting the public transportation, automobile, and industrial sectors. Our speakers will unveil novel approaches and discuss models that effectively harmonize diverse challenges, varied contaminant profiles, and energy-intensive processes. These solutions will foster broader acceptance, promising resilience against water stress and firmly establishing water reuse as an indispensable practice for sustainable industrial growth.

IWC 25-45: Opportunities for Sustainable Water Recycle and Reuse in a Large Industrial Facility

Time:

Aaron Soleski, Nutrien, Carseland, AB Canada; Ryan Upshall, Nutrien, Carseland, AB, Canada

A large industrial nitrogen facility in Alberta, Canada has found innovative ways to manage their multiple water streams on site, over the life of the facility, which has allowed them to drastically reduce the volume of wastewater that needed to be treated and provided an additional benefit of reducing water draws from external sources.

The authors aim to share their learnings and opportunities to allow other similar users to challenge their process and look for simple reductions in their waste stream that result in significant volumes reduction over time. We aim to share how the site's approach to water sustainability emphasizes reducing freshwater intake through simple strategic reuse and efficient water management practices. Throughout the presentation of the paper, we will provide details regarding our non- proprietary changes and projects that have been executed and how they contribute to this reduction. Through a variety of methods including recovering a variety of blowdown sources, challenging and re-using what was once considered wastewater in other production areas throughout the plant and implementing simple but effective changes to their demineralizer systems operational and regeneration sequences. These gradual improvements have saved millions of liters of water usage on site on an annual basis and were implemented with minimal financial or operational impacts to the site. By continuing to challenge the status quo and implement innovative water reuse practices, the facility contributes to helping achieve the company's sustainability goals while enhancing operational resilience and efficiency.

Discusser: John Schubert, HDR, Sarasota, FL

IWC 25-46: Optimizing Water Recycle and Reuse at a Public Transportation Service Facility

Time:

Hamid Amini, Geosyntec Consultants, Costa Mesa, CA ; Padam Neupane, Geosyntec Consultants, Costa Mesa, CA

Our confidential client operates public transportation services (i.e., buses and trains) in one of the major metropolitans in Southern California. The client also owns and operates several facilities throughout the area which are used for servicing, maintaining, and cleaning the buses and trains. Each of these service facilities accommodate hundreds of vehicles each day, including washing on regular basis. Daily vehicles wash on such scale can quickly add water consumption volumes and costs. The client has implemented a recycle system at its facilities to treat and reuse the greater portion of the vehicles wash water. However, if these recycle systems are not monitored and maintained in good conditions, they can result in even more water consumption/discharge than the basic vehicle wash operation.

Geosyntec Consultants (Geosyntec) practitioners conducted a site study at one of the client facilities and noticed wastewater discharge is significantly higher than what is anticipated under normal conditions. Geosyntec conducted site investigations and water balance study, and identified operational flaws in the water recycle system. Geosyntec worked with the client to identify the faulty mechanical components and fix them, and to implement simple monitoring tools for monitoring future operations.

This presentation will be a case study and lessons learned. The presenter(s) will share their observations and solutions with the attendees, with the goal to improve our industry's ability to optimize water recycle and reuse.

Discusser: David Shin, Hydranautics, Oceanside, CA, USA

IWC 25-47: Navigating the Challenges in Automotive Water Systems

Time:

Rick Lancaster, Shelton Associates, Lancaster, PA ; Max Brefeld, Toyota Motor Corporation, Georgetown, KY

Water scarcity and environmental sustainability have become central challenges for automotive manufacturers, driving the need for continuous improvement in water management applications. A major automotive manufacturer, in collaboration with a consulting engineering firm, has led efforts to optimize water usage through innovative strategies that reduce consumption, enhance reuse, and generally improve established key performance indicators (KPIs). This paper explores the challenges and solutions in managing water systems amid evolving automotive industry demands.

A key challenge is reducing water consumption per vehicle as these targets are progressively driven lower. Despite 30+ years of improvements in water management practices, the automotive sector now faces additional complexities, including regulatory shifts, contaminants limiting reuse, and the industry-wide impact of electrification. Accelerating change points further complicates conservation efforts, requiring adaptable water treatment solutions as production methodologies evolve, while fluctuating water profiles further add more layers of complexity.

This paper presents tailored engineering solutions developed through specialized, cross-functional team activities. Case studies from multiple locations of the OEM's facilities are discussed. These examples include increasing the water recycling rate from 20% to over 80% at one facility. Flexible treatment designs, such as real-time phosphate saturation control and adaptable reverse osmosis (RO) systems, provide flexible and scalable solutions at multiple sites.

The outlined approach to process improvement leverages advanced engineering, data-driven analysis, and tailored process designs, and can serve as a model for sustainable water management practices.

Discusser: Daniel Hilson, SAMCO Technologies, Buffalo, NY

IWC 25-48: Reverse Osmosis System and Water Reuse in Steel Manufacturing

Time:

Tom Horn, Kleinfelder Water Technologies, Defiance, OH

The North Star BlueScope Steel facility located in Ohio uses water from Lake Erie in its manufacturing processes. Wastewater is then treated and returned to the Maumee River, which feeds back into Lake Erie. Noticing changes to both the incoming water quality and effluent quality, the client chose to explore more robust industrial water reuse options. The target of this capital project included an increase of 30+% in steel production for the facility with minimal increase in fresh water use.

Kleinfelder Water Technologies worked with BlueScope to upgrade its onsite equipment while minimizing the environmental impacts through water recycling options. Additionally, the client wanted to extend the operational lifespan of its cooling towers by avoiding frequent blowdowns. Kleinfelder provided 3D model and structural steel support design for the pipe racks around the equipment. We completed a 3D scan of the existing area, provided piping details for the steel piping, structural drawings, & a final 3D model with GA cuts.

To address these challenges, Kleinfelder proposed a comprehensive solution involving ultrafiltration and a two-stage reverse osmosis (RO) system. The client had an existing onsite water treatment system in place, which handled initial wastewater treatment of biologics and heavy metals. Kleinfelder designed and installed a two-stage RO system to further treat the wastewater, polishing it to a level suitable for reuse within the facility. The design also included hollow fiber membranes and a custom control panel design, with SCADA capabilities.

In addition to the design and installation of new equipment, Kleinfelder Water Technologies also provided preventative maintenance services to help ensure optimal performance of the system.

Discusser: William Celenza, P.E. BCEE, Burns & McDonnell, Chicago, IL

Tuesday, 11/11/2025; 1:15 PM

Taking the waste out of wastewater. Novel treatment approaches (Wastewater 2)

IWC Rep: William Kennedy, P.E., Stantec, Charlotte, NC

Session Chair: Zhendong Liu, LANXESS Corporation, Birmingham, NJ

Discussion Leader: Shannon Brown, HDR, Omaha, NE

The essence of wastewater treatment is taking the waste out of wastewater and making the treated water in compliance with ever-tightening discharge limits. While maintaining a stable operation is a high priority, engineers are also constantly looking for new ways to improve efficiency and productivity. This session covers many aspects of wastewater treatment activities, with a focus on novel treatment approaches. Several case studies will be highlighted, including an evaluation of new technologies for sulfate reduction, a novel biological mobile biofilm treatment, a unique design for a National Pollutant Discharge Elimination System (NPDES) permit, and an investigation of a biological treatment system upset.

IWC 25-49: Anatomy Of An Industrial Direct Discharge WWTP Toxic Shock Incident

Time:

William Celenza, P.E. BCEE, Burns & McDonnell, Chicago, IL ; Sean O'Mara, Burns & McDonnell, Chicago, IL; Vica Otrubina, Burns & McDonnell, Chicago, IL

Monday morning at 6 AM, a wastewater treatment plant operator collected the first WWTP “process” samples since late on the prior Friday afternoon. The operator noticed a strong odor and cloudiness in both the headworks equalization tank and first stage activated sludge tank samples. Microscopic analysis indicated the bacteria were inactive. The 24-hour composite samples collected the prior Saturday at the downstream outfall sampling location did not present any cloudiness or odor, but analytical results would not be available for several days.
By 8 AM on this Monday, the chemical released was identified as a diphenyl oxide and biphenyl mixture with microbe toxicity occurring for as low as a 1 mg/l concentration; and the source of the leak was identified as coming from a pump seal failure. By 10 AM a cloudy effluent was observed at the outfall sampling location, and the discharge was immediately shutdown. With the shutdown of the discharge, facility production was forced to be severely curtailed to prevent generation of wastewater.
The plant isolated the headworks Equalization Tank from the rest of the WWTP, and de-inventoried the wastewater containing a majority of the leak chemical into rented temporary tanks. When the leaked chemical concentrations no longer posed a threat to the biological system, a plan was developed to safely re-establish the biological system and restart the WWTP. To re-establish a healthy microbiological population, three tanker truck loads of activated sludge from a nearby direct discharge industrial facility’s waste activated sludge system were procured to re-seed the microbe population. The WWTP was operated in recirculation mode through the two-stage site activated sludge system and back to the headworks equalization tank with monitoring of the microbe activity along with food and nutrient ratios. Before effluent discharge from the outfall was re-established, the plant conducted sampling and analytical testing to determine the ability to comply with the discharge parameters listed in the NPDES Permit.
Presented here are the events that lead to the discovery of a toxic heat transfer fluid leak and the steps taken to isolate, remove, and perform an online restart of a completely mixed two-stage activated sludge tertiary treatment process for the removal of BOD, TSS, and O&G under a direct discharge NPDES permit. To prevent the recurrence of this incident the Facility performed a Cause Mapping (CM) exercise that included a list of options to be used as preventative measures.

Discusser: Julia Mercer, P.E., Newterra, Pittsburgh, PA

IWC 25-50: Investigating Removal Options for Tightening Sulfate Discharge Limits

Time:

Houston Flippin, Brown and Caldwell, Nashville, TN ; Melanie Blake, Brown and Caldwell, Boston, MA; Samantha Albert, Brown and Caldwell, Boston, MA; Rebecca Maco, Brown and Caldwell, Seattle, Washington; Krystal Perez. P.E., Brown and Caldwell, Seattle, WA

Sulfate limits are appearing on more effluent discharge permits. Industries are being challenged by this through an increasing number of sulfate pretreatment limits and direct discharge limits. This presentation describes alternatives considered on a project where the sulfate had to be reduced from 900 mg/L to 300 mg/L for a data center application. While this project was related to cooling tower blowdown, the findings are applicable to many sulfate removal projects. Technologies considered were barium precipitation, ion exchange, biological desulfurization, and nanofiltration (NF) with reject water treatment. NF reject water treatment considered ion exchange, precipitation with barium and lime, and offsite disposal. Critical success factors for the owner were minimal operations labor, operational simplicity, dependability and costs. Based on these factors, nanofiltration with reject water treatment was selected. Reject water was treated via gypsum (calcium sulfate) precipitation with treated water being blended back with permeate for final effluent discharge to the City sewer. This selection was supported by treatability data and extensive conversations with the chemical suppliers to define the antiscalant chemistry and dose management required to protect the membrane while minimizing the impact on precipitation. The chemistry recommendations and associated impacts varied widely depending on the chemical provider with some chemical providers requiring additional treatment steps. Results and application of this testing and these discussions will be presented along with the final treatment system configuration.

Discusser: Thomas Higgins, Ph.D., P.E., Worley Engineering, Saint Augustine, FL

IWC 25-51: Cost Effective Capacity Increase - Wastewater Treatment Intensification with a Hybrid, Mobile Biofilm Technology

Time:

Graig Rosenberger, Nuvoda, Raleigh, NC

The Mobile Organic Biofilm™ (MOB) process is a hybrid wastewater treatment approach that integrates mobile biofilms with suspended growth floc to enhance conventional secondary treatment. It utilizes a plant-based media, which offers a higher surface area per unit mass compared to plastic media in IFAS or MBBR technologies. This increased surface area promotes faster biofilm development and accelerates the formation of granule-like particles, improving BNR (biological nutrient removal) and secondary sludge settleability. Together, these factors contribute to increased overall treatment capacity.

The commissioning of this technology requires two main items- media addition and retention. Media is added to the bioreactor and the proliferation of dense biofilms begins. The media circulates freely within the entire secondary process and a situation is created where the benefits are realized in both the biological reactor as well as any secondary settling phases. To retain the media, a rotary drum screen is added on the waste line. This screen captures the media prior to solids handling and injects it back into the secondary process. This process can be commissioned without facility downtime, making for a quick and convenient start up.

As the biofilms mature, a portion of the biomass transitions from suspended growth to fixed growth. This change reduces the overall suspended growth inventory while increasing the concentration of biological activity within the existing reactor. As biofilms develop and thicken, they provide a stable environment that supports slow-growing organisms, such as those responsible for nitrogen and phosphorus removal. Unlike conventional biological wastewater treatment processes where extending sludge retention time (SRT) is necessary to maintain these organisms, attached growth allows them to thrive without requiring an older sludge age across the entire community of microorganisms.

This phenomenon, known as the decoupling of SRT, enables wastewater treatment facilities to achieve treatment intensification in the confines of existing infrastructure. Relying less on suspended growth, less biomass needs to be settled in secondary clarification phases, reducing the risk of washout events during periods of high influent flows. As a result, higher organic and hydraulic loadings can be managed with lower reactor volume. This increases overall capacity with less capital expenditure than adding additional tank volume.

This presentation will cover two case studies outlining characteristics of viable retrofit candidates for facility upgrades using this advanced mobile biofilm technology.

Discusser: Mayra Giraldo Carmona, P.E., Stantec, Alpharetta, GA

IWC 25-52: Finding Permitting Solutions to Engineering Problems: A Case for Regulatory Mixing Zones and Anti-Backsliding Exemptions

Time:

Monique Latalladi, P.E., WSP USA, Smyrna, GA

The U.S. EPA Technical Support Document for Water Quality-based Toxics Control issued in 1991 defines a mixing zone as “an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented. Regulatory mixing zones may be approved for industrial wastewater discharges that allow constituent concentrations in the effluent to exceed instream water quality criteria within an area near the surface waterbody discharge. A multiport diffuser system produces more rapid mixing and reduces the area and volume within the river needed for mixing to reduce constituent concentrations to within regulatory requirements. Mixing analyses are performed to support the design of multiport diffuser systems for the discharge of industrial wastewater to waterbodies, plan for treatment and effluent management requirements prior to discharge, and to support the application for a NPDES permit regulatory mixing zone through demonstration of compliance with State regulatory requirements.
For reissued NPDES permits, final effluent limitation determinations include an assessment of whether the revised effluent limitations are consistent with the Clean Water Act requirements and NPDES regulations, including those related to anti-backsliding. If the limitations are less stringent than limitations on the same pollutant in the previous NPDES permit, the permit writer then conducts an anti-backsliding analysis. The term “anti-backsliding” refers to statutory and regulatory provisions that generally prohibit the renewal, reissuance, or modification of an existing NPDES permit that contains effluent limitations, permit conditions, or standards less stringent than those established in the previous permit. There are, however, exceptions to the prohibition, outlined in CWA §402(o)(2), which provides that relaxed limitations may be allowed.
This paper will present a NPDES permitting example, mixing diffuser design, modeling software results that were prepared to support the permit application documents, and a summary of the exemptions and deciding factors for the regulatory decision on the permit application.

Discusser: Jared Sorensen, ClearStream Environmental, Riverton, UT

IWC 25-T6R: Prefiltration - Enhancing Purification and Protecting the Expensive Media

Time:

Billy Chu, Vytal Filtration Technologies
Address, Edmonton, Alberta Canada

Prefiltration is a foundational step in various filtration processes, with the primary aim of removing larger particulates and debris from fluids before they reach the primary filtration stage. This crucial technique acts as a barrier, protecting downstream filters from clogging and ensuring they can operate optimally.

The effectiveness of a prefiltration system is mainly dependent on understanding several key fundamentals, one of which is particle size distribution. By analyzing the types and sizes of particles in the fluid, practitioners can make informed decisions regarding the filtration technology best suited to their application. Larger particles in the feed can lead to rapid fouling of primary filters if not adequately removed beforehand. Therefore, a comprehensive understanding of particle size distribution aids in selecting the appropriate prefilter mechanism.

Another critical element of an effective prefiltration system is the selection of appropriate filter media. Different types of filter media have distinct characteristics, which influence their performance in various filtration scenarios. For instance, depth filters are designed to capture particles within a porous structure, allowing for greater dirt-holding capacity. On the other hand, pleated filters offer a larger surface area, which can increase flow rates and enhance the retention capabilities for smaller particulates. The choice of filter media will vary based on application needs, including the expected particle load, fluid viscosity, and pressure requirements.

System compatibility is an equally important consideration when implementing a prefiltration strategy. The prefiltration system must integrate seamlessly with existing processes and equipment. Factors such as pressure drop, flow rates, and temperature conditions must be assessed to ensure the prefilter will not negatively impact the overall filtration system's performance. A well-compatible prefiltration system contributes to consistent process reliability, making it a vital aspect of system design.

The benefits of implementing an effective prefiltration system extend far beyond simply protecting downstream filters. By efficiently removing larger particulates, effective prefiltration reduces the burden on primary filters, which, in turn, enhances the overall efficiency of the filtration process. This leads to an extended filter life—thereby decreasing replacement frequency—and results in lowered operational costs due to reduced maintenance needs. Moreover, maintaining a higher quality of the filtered output improves the integrity and reliability of the entire filtration process.

The concepts of prefiltration—ranging from particle size distribution and filter media selection to system compatibility—are vital for optimizing filtration systems. A thorough understanding of these fundamentals ensures better filtration efficiency, reduced maintenance, and improved overall process reliability.

Discusser:

Tuesday, 11/11/2025; 1:15 PM

Rare Earth Elements: Innovative Recovery and Processing Technologies for a Sustainable Future

IWC Rep: John Yen, Marmon Industrial Water, East Brunswick, NJ

Session Chair: John Peichel, Veolia Water Technologies & Solutions, Chaska, MN

Discussion Leader: Thomas Igou Ph.D., WaterTectonics, Everett, WA

Explore cutting-edge developments in rare earth element recovery and processing technologies, from mature water treatment adaptations to novel membrane solutions. This session showcases breakthrough approaches in extracting valuable materials from industrial wastewaters, acid mine drainage, and brine streams, addressing critical supply chain challenges while promoting sustainable practices. Join industry experts as they present details on solutions for the growing demand of essential elements.

IWC 25-53: Rare Earth Metals Recovery - Maturing Technologies

Time:

George Bainbridge, SAMCO Technologies, Buffalo, NY USA; Brad Buecker, Buecker & Associates, Lawrence, KS, USA

Rare earth elements are a critical part of many consumer products that rely on electronic components and energy storage. These include computers, communication devices, vehicles of all types, data centers, the list goes on and on. Extraction, purification, and concentration of rare earth raw materials are critical to an economical supply for customers. The supply chain of rare earth elements is currently influenced by numerous factors from geographical to physical to political. Increasingly, scientists are recognizing that rare earth metals are present in industrial wastewater streams such as those from coal ash ponds, mine tailings, and other processes. These sources could be enormously important for rare earth metal supply with the establishment of economical means to extract the valuable materials. This paper examines how the mature (for the makeup water treatment industry) technologies of reverse osmosis and ion exchange are being adapted to collect rare earth elements. The geopolitical implications of these developments could be profound.

Discusser: Suzette Puski, Stantec, Providence, RI

IWC 25-54: Ready-to-ship dewatering cell unit for rare earth enriched AMD precipitate

Time:

Iuri Santos, Slippery Rock University, Slippery Rock, PA ; Zachary Houde, West Virginia University, Morgantown, WV; Hunter Vance, West Virginia University, Morgantown, WV; Nathan DePriest, West Virginia Water Research Institute,

Morgantown, WV; John Quaranta, West Virginia University, Morgantown, WV

Coal-derived acid mine drainage (AMD) treatment requires pH adjustment to neutralize acidity and precipitate dissolved metals before discharge to the environment. This process generates AMD sludge, which must be stored or disposed of properly, often in abandoned mines or ponds. Providing adequate storage capacity for AMD sludge is a challenge, particularly at remote sites. Dewatering is necessary to reduce sludge volume and associated costs for handling, transportation, and disposal. The AMD generated from pyritic coal has been found to have varying concentrations of rare earth elements (REE). Research has shown that REE recovery is possible using a patented two-stage selective precipitation process. The first stage produces an AMD sludge consisting of gangue metals and a second stage produces an REE-enriched hydraulic pre-concentrate (HPC).
Raw AMD from the study site yielded an average total REE concentration of 263 µg/L, which is average for the Appalachian region and, therefore, a candidate for REE recovery. This research developed a prototype, ready-to-ship, mobile dewatering cell for remote AMD sites. The cell is composed of a 4.8 x 2.1 x 0.9 meter trailer lined with multiple geosynthetics for filtration and panels embedded with wicking fibers for enhanced dewatering.
HPC was tested for filtration and hydraulic conductivity via column filtration tests (CFTs) using three geotextiles. Filtration efficiency was 79.2%, and the average hydraulic conductivity was 1.0x10-4 cm/s for the highest performing geotextile. A 3-layer liner was designed for the dewatering cell, composed of a 3-D drainage geosynthetic for exterior drainage, a woven geotextile (AOS 0.4 mm) for strength, and a non-woven geotextile (AOS 0.21 mm) for filtration. Wicking fiber panels were included in the cell interior for enhanced dewatering.
Field demonstration of the dewatering cell presented an average discharge rate of 0.15 liters per second (l/s) (std dev = 0.09) at a constant inflow rate of 2.44 l/s. Filtration efficiency during the field demonstration averaged 72.2% (std. dev=0.06%), with an average incoming total solids of 0.8% (Std. dev = 0.0016%), and average effluent total solids of 0.2%. Based on other projects, 0.2% solids in effluent can be considered 100% filtration efficiency. The field demonstration is currently in the dewatering phase. HPC dewatering potential will be evaluated in response to the internal wicking fiber panels.

Discusser: Curtis Wood, Mosaic Water Systems, Broomfield, CO

IWC 25-55: Lithium Recovery from Brine Stream: Introducing a Novel Reverse Osmosis Membrane to Achieve an Ultra-high Lithium Concentration

Time:

Tirtha Chatterjee, DuPont Water Solutions, Wilmington, DE ; Denise Haukkala, DuPont Water Solutions, Salt Lake City, UT; Brittany Fisher, DuPont Water Solutions, MN; Caleb Funk, DuPont Water Solutions, MN; Guillem Gilabert-Oriol, Tarragona, Spain Megan Low and Derek Mandel, Saltworks Technologies, BC, Canada, Richmond, BC, Canada

Global trends towards decarbonization and electrifications have created an extraordinary increase in lithium demand. Several studies report a demand – supply gap in lithium carbonate equivalent (LCE) ranging from 0.4 MM tone (Deutsche Bank report, 2021) to 1 MM tone (McKinsey report, 2022) by 2030. This gap cannot be met by incumbent evaporation-based lithium recovery process which is not cost-effective for low-lithium concentration resources. In addition, traditional processes are slow, need large footprints, have high chemical demand, and often are water negative.

Direct lithium extraction (DLE) has established itself as an alternative technology to extract lithium from chloride-rich brine in an efficient and economical manner, with potential reductions in energy and water consumptions compared to traditional processes. Process efficiency enables DLE to be applied even to recover lithium from relatively low-content resources such as Smackover and Geothermal brines, and O&G process waters. DLE is a continuous process where lithium is recovered through a series of purification and concentration steps and the latter primarily uses reverse osmosis (RO) technology. It is critical to maximize lithium concentration by RO as it reduces the brine volume needed for conversion from chloride to carbonate or hydroxide forms. Also, it lowers the transportation cost if the conversion plant is located away from the DLE plant.

Reverse osmosis technology offers solute-solvent selectivity. It concentrates all the ions (including lithium) in the reject/concentrate stream through dewatering. However, water-flow through the membrane depends on the difference between the applied feed pressure and trans-membrane osmotic pressure differential. As the RO products are rated for a maximum allowable operating pressure (driven by element constructions), the build of osmotic pressure on feed side limits the permeate volume (or recovery) and ion concentration factor in the reject stream. Therefore, to achieve a very high ion concentration factor in reject/concentrate, one needs a membrane with unique solvent and solute transport characteristics to optimize water recovery and ion passage.

In this paper, we will introduce a novel RO membrane and present transport properties of common mono- and multivalent cations and anions. Specifically, we will discuss the impact of ion concentration in feed, applied feed pressure, pH, and temperature on recovery and ion concentration factor in reject. Finally, using a synthetic lithium brine, a 4040-prototype pilot performance, conducted at Saltworks facility, will be shown including membrane durability and compaction data. All results obtained here were from an experimental product designed by DuPont Water Solutions.

Discusser: Denney Eames, P.E., WaterTectonics, Everett, WA

IWC 25-56: DLE Eluate Conditioning and Concentration Optimization: A Case Study

Time:

Haira Balaggan, Aquatech International, Canonsburg, PA ; Mahesh Bhadane, Aquatech International LLC., Canonsburg, PA; Arun Mittal, Aquatech International LLC., Canonsburg, PA

A Lithium Brine Conditioning, Refining, and Conversion Project was awarded by a confidential client to pilot and implement a system to produce battery grade lithium hydroxide monohydrate from Direct Lithium Extraction (DLE) process eluate. The upstream DLE operation shall process feed brine post the feed preconditioning steps. DLE process shall produce an eluate with a total dissolved solids (TDS) of 5-6 g/L and approximately 500 mg/L lithium content. The chloride based DLE eluate also contains hardness, boron, and additional impurities. Prior to downstream conversion and crystallization, the eluate requires multistep concentration and purification unit operations. To ensure the most cost-effective solution (in terms of both CAPEX and OPEX), various configurations and unit operations were evaluated.

To remove contaminants, nanofiltration, chemical softening, and ion exchange processes in various configurations were evaluated. For initial concentration, conventional RO was deemed essential in all cases, followed by either concentrate recovery reverse osmosis (CRRO™) or evaporation to enhance lithium chloride concentration prior to conversion and crystallization.

This paper explores system optimization by evaluating three distinct flowsheet options, considering both technical performance and economic feasibility. By comparing these options from a comprehensive perspective, the study aims to identify the most effective solution that balances technical requirements with economic viability, ultimately guiding decision making for this project's design and implementation as well as future DLE eluate conditioning and concentration projects.

Discusser: Adrian Brozell, Ph.D., LG Water Solutions, Torrance, CA

Tuesday, 11/11/2025; 1:15 PM

The Cooler side of Cooling - Tower Advanced Water Treatment

IWC Rep: Max Brefeld, Toyota Motor North America, Georgetown, KY

Session Chair: Wesley Sipe, P.E, Michael Baker International, Moon Township, PA

Discussion Leader: Horace "Quint" Gordon V, Bechtel Power Corporation, Reston, VA

Water is the progenitor of who humans are and how we became. Water is arguably the ideal heat transfer media. As good stewards, we need to conserve this media for the future. Our session concentrates on keeping the evaporative heat transfer process effective by reducing fouling and corrosion, hence conserving our resource. You will be introduced to novel and cutting-edge cooling tower treatment strategies that concentrate on scaling and corrosion reduction with the goals of reducing blowdown water volume and saving operational expenses.

IWC 25-57: Novel Cooling Water Treatment Program Provides Significant Water Savings and Operational Improvements

Time:

Bachan Ramharack, Solenis, Industrial Solutions, , ; Davi Pires Richetti, Solenis, Industrial Solutions, Latin America

A large petrochemical complex in Brazil sought to improve the management of its critical cooling water treatment systems. Throughput and profitability at this complex were severely hampered by cooling water system failures, including pitting corrosion and fouling, which resulted in costly unplanned shutdowns and shortened heat exchanger life. Additionally, there was an increasing demand for water savings based upon water availability concerns and the plant's sustainability goals.

Since late 2016, a tailored cooling water treatment program has been implemented to address these issues. An extensive assessment was conducted to determine the root causes of pitting corrosion and fouling. A heat exchanger monitoring program utilizing proprietary and advanced algorithm was also introduced. Based on these insights, the cooling water treatment program and the monitoring and control strategies were optimized, significantly reducing cooling system failures.

The next step was to maximize water savings by increasing cooling tower cycles without compromising the improvements in pitting corrosion and fouling control. Initially, cooling tower cycles of concentration increased from approximately 7 to 9 without significant changes to the cooling water treatment program. Further optimization efforts included simulations at a technology center to test system conditions at high cycles and to evaluate the effectiveness of various inhibitor chemistry. Based on this research, an innovative scale inhibitor blend was formulated and implemented. To accommodate frequent variations in make-up water chemistry, Tracker technology was integrated to dynamically adjust the program and maintain deposit control at 14 cycles without chemical overfeed.

As a result of these optimizations, the complex realized substantial water savings, reducing water consumption by approximately 750 m3/day compared to initial operations without compromising corrosion and deposit control. There has been no recent failure attributable to cooling water treatment. The predicted time to failure has increased from <4 years in 2017 to >20 years by 2022 and remains at >20 years at the current time.

The result at this facility is a prime example of the collaboration and innovation in solving complex operational challenges, delivering both operational and environmental benefits.

Discusser: Daniel Wilson, Kiewit, Austin, TX

IWC 25-58: Considerations for Fouling Mitigation in Cooling Water Systems: A Methodology for Increasing Operational Efficiency

Time:

Haley White, Ph.D., Bechtel, Reston, VA ; Horace "Quint" Gordon V, Bechtel, Reston, VA; Michele Funk, P.E., Bechtel, Reston, Virginia

The resurgence of nuclear power necessitates a fresh look at biofouling prevention in cooling water systems at power plants. Efficient energy production in power plants relies on effective operation of heat transfer systems. One key aspect of ensuring optimal heat transfer is mitigation of molecular, micro-, and macro-fouling. Fouling treatment can consist of physical and/or chemical strategies. First, an assessment of water quality and potential foulants through seasonal sampling is critical to bounding design values (e.g., total suspended solids ranges). However, understanding water biology is only one aspect of a successful fouling treatment program for power plant circulating water. Design complexity, operational complexity, safety, capital cost, operational cost, environmental impact, legislative compliance, and knowledge base should all be weighed. Here, typical system, structures, and components susceptible to marine fouling at nuclear plants are evaluated for biofouling prevention strategies, and a methodology for selecting a fouling prevention program for power plants is proposed. The results of industry research (EPRI, NRC, IAEA, EPE, etc.) on biofouling in cooling systems is presented. This framework for selection of the best strategy is then applied to the development of a nuclear power plant in a coastal construction site, with the assumption of once-through cooling in an area where mollusks and algae are major foulants. Attendees will gain an understanding of fouling control regimes when designing cooling water systems and application for optimal performance.

Discusser: Luis Suarez, Fluor, Houston, TX

IWC 25-59: Demystifying and Recognition of Direct and Indirect MIC Mechanisms and Contribution to Localized Corrosion in Water Systems

Time:

Edward Beardwood, Beardwood Consulting & Technologies Inc, London, Ontario Canada

The paper will discuss the finger prints associated with direct and indirect microbiological influenced corrosion (MIC); thus, allowing for the assessment for potential MIC activity that has influenced the corrosion rates and type detected. All fouling, except inorganic scaling from insitu and exsitu crystallization, lead to localized corrosion. As a result, many inspections of surface corrosion can be misdiagnosed as to the cause of such corrosion and the corrective action required for future avoidance. The paper will expose and define all the elements required to assess the cause of localized corrosion. This will provide water treatment personnel with the fundamentals associated with;
The various corrosion mechanisms associated with localized corrosion.
How to assess the types of corrosion in the water treatment industry.
How to assess the inferences of water, deposit and microbiological analysis as it relates to fouling and the forms of corrosion.
How to read coupons and metal specimen (pipes, tubes, fittings, etc.) surfaces and assign the cause of corrosion.
How to determine if the corrosion was initiated directly by MIC or influenced indirectly by microbiological activity (MBA), or MBA did not play a role although present (recall sterility of surfaces does not exist in the real world). This will be deduced from the following discussed in the paper;
What are the characteristics of MB within deposits and surface foulants.
What MIC looks like on surfaces and within surface deposits.
What to Test;
•Microbiological activity
•Inorganic elements
•Indirect organic elements via corrected to % moisture, corrected % LOI's and the IR of organic acids as noted are associated with EPS when the samples are derived from non-process waters (i.e., potable, pretreatment waters, cooling water etc. not P&P process waters)
The steps required to mitigate the type of corrosion seen.

Discusser: Ellie Bozzelli, ClearStream, Sandy, UT

IWC 25-60: Non-Phosphorus Cooling Tower Treatment improving heat transfer and reducing environmental impact at Gulf Coast refinery

Time:

Dan Harbs, Veolia Water Tech, Costa Mesa, CA ; Johnny Dorminey, Chevron Products Company USA, Pascagoula, MS

This paper will review the benefits of novel technology and present data from a case study of a large open recirculating cooling tower at a Gulf Coast refinery that was converted from a conventional phosphorus to non-phosphorus treatment. We will discuss the justification for this transition and the successful results and production benefits that this non-phosphate program has demonstrated.

For decades, cooling water chemical treatment programs have relied mainly on phosphorus-containing compounds for carbon steel corrosion inhibition. Although a cost-effective option when controlled within certain limits, the use of phosphorus can lead to calcium-phosphate deposition and exchanger fouling where cooling exchangers face high heat loads and elevated skin temperatures which are common in refinery cooling systems. Phosphorus being a nutrient for microbiological activity, it also drives algae growth on distribution decks and biocide demand in cooling systems. Moreover, in recent years, phosphorus has become the target of increasing environmental scrutiny resulting in regulators requiring many industrial facilities to drastically reduce the amount of phosphorus in their discharge streams.

Non-phosphorus programs have not been applied in the past due to potential high cost and use of heavy metals, such as Zinc, to achieve acceptable performance. The development of new non-phosphorus programs in recent years, driven by environmental and performance needs, has produced a new treatment program that is cost competitive and that can meet and exceed the corrosion protection performance of conventional phosphate-based programs. This novel technology is flexible enough to meet sustainability goals and asset corrosion protection, improving heat exchanger reliability without the risks of phosphate deposition or algae growth.

Discusser: HG Sanjay, Bechtel Corporation

Tuesday, 11/11/2025; 8:00 AM

High-Performance Membranes: Real Results, Real Savings (Reuse 1)

IWC Rep: James (Jay) Harwood, ZwitterCo, Oakville, ON, Canada

Session Chair: Michael Bluemle, Ph.D., Solenis LLC, Wilmington, DE

Discussion Leader: Karen Budgell, P.E., WSP, Athens, TX

Driven by increasing water scarcity and tightening environmental regulatory standards, the demand for high-efficient, cost-effective water reuse solutions continues to grow. This session presents advanced membrane-based technologies for wastewater reuse and micropollutant removal. Examples of full-scale applications highlight significant, quantifiable savings in water usage, energy consumption and lifecycle costs, which provide actionable insights to engineers and end-users involved in the design and optimization of water treatment systems.

IWC 25-29: Development of New UF Membrane with Fine Pores for Wastewater Reuse

Time:

Susan Guibert, Toray Membrane USA, Poway, CA ; Shun Shimura, Toray Industries Inc., Shiga, Otsu, Japan

The goal of hollow fiber Microfiltration (MF) and Ultrafiltration (UF) membranes in the early 1990's was to remove chlorine resistant pathogens, such as cryptosporidium, from potable water sources. It was later discovered that MF/UF membranes also provide superior pretreatment to Reverse Osmosis (RO) membranes, compared to conventional sand filters.
Over the last 10-15 years, hollow fiber UF membranes have proven to be the technology of choice in Reuse applications. These are applications where municipal wastewater is converted to potable water. Typically, municipal secondary or tertiary effluent is treated by UF then RO then an Advanced Oxidation Process (AOP). UF membranes have been chosen over MF because they can achieve an order of magnitude higher log removal value of viruses than MF membranes, due to their smaller pore size.
In Reuse applications, as well as many other applications, RO fouling can lead to significant down time for cleaning and shortened RO membrane life. Often the fouling is caused by dissolved organics passing through the UF membrane and forming a conditioning layer on the RO membrane. This layer is made up of biopolymers, which provides a place for bacteria to attach and leads to biofouling of the RO membrane.
This paper will discuss testing of the next generation of UF membranes, which have even smaller, finer pore size which can reject these dissolved organics. The benefits of these new membranes include less downtime for CIP cleaning, reduced operating costs for cleaning chemicals, extended RO membrane life and reduced power consumption.

Discusser: Brett Thompson, P.E., ZwitterCo, Woburn, MA

IWC 25-30: Water Positive: Optimizing Membrane Performance to Restore More, Deplete Less

Time:

Mohannad (Mo) Malki, AWC (American Water Chemicals), Plant City, FL

Being Water Positive refers to an entity—be it a company, community, or individual—that goes beyond traditional water conservation to actively contribute to the sustainable management and restoration of water resources. The goal is to leave a positive impact on water ecosystems and ensure that more water is conserved and restored than is used or depleted. Achieving a Water Positive status involves adopting practices and technologies that reduce water consumption, improve water quality, and enhance water availability and treatment – such as water reuse – while also focusing on increasing water recovery.

Becoming Water Positive is often associated with increased investment and higher operational costs. However, this initiative seeks to establish agreements between various entities to offset water consumption by investing in water infrastructure and the operation of water treatment facilities, similar to the carbon offset model for CO2. The challenge, therefore, lies in managing CAPEX and OPEX effectively.

Aligned with this goal is the optimization of membrane recovery in reverse osmosis (RO) systems, a critical component in water reuse processes. This presentation will explore how improving recovery rates can significantly enhance water treatment, brine management and production. By doing so, entities can not only save substantial amounts of water but also contribute to broader environmental sustainability goals.

One case study will feature a demonstration reuse facility that increased its recovery from 80% to 85%, saving 37,000 gallons of water per day and reducing the concentrate volume by 29%. When fully operational, the plant is expected to save up to 11 million gallons of water per day.

Listeners will have a comprehensive understanding of how to implement these strategies in their own facilities. They will gain practical knowledge on improving membrane performance and setting actionable sustainability targets. The insights shared will be particularly valuable for those involved in the design, operation, and management of water reuse systems, as well as for sustainability leaders looking to make a positive impact on water resources.

Discusser: Pavani Silaparasetty, GHD, Boca Raton, FL

IWC 25-31: Evaporation Pond Sizing Considerations and Reuse Optimization

Time:

Bryan Hansen, P.E., Burns & McDonnell, Kansas City, MO ; Thomas Hope, Burns & McDonnell, Kansas City, MO

Development of a new combined cycle gas generation facility was established with a zero liquid discharge (ZLD) target using evaporation ponds as the final repository of plant generated wastewater. This paper will address how various wastewater streams were recycled to reduce total wastewater flows to the evaporation ponds such as evaporative cooler blowdown, heat recovery steam generator (HRSG) blowdown, demineralizer system backwash waste and reject flows, and miscellaneous plant drains. While the site had plenty of space available for evaporation ponds, directing less flow to the evaporation ponds will result in a smaller required pond size which is desirable to reduce the cost of the ponds. However, recycling wastewater streams comes at the cost of additional treatment and handling of those recycled streams and these costs need to be weighed against the cost of the evaporation ponds. The impact of recycling wastewater and the required treatment processes for each will be discussed along with the economic tradeoffs.

Sizing of the evaporation pond has to consider a number of factors including the following: the operating profile of the plant, the process wastewater flows as they vary with operating conditions, anticipated precipitation, natural evaporation, salinity of wastewater in the pond over time, anticipated temperature and salinity of wastewater entering the pond, surface area of the evaporation pond, storage volume in the evaporation pond, pond geometry, effects of wind, and pond average temperature over time. We will discuss how all these factors were considered in evaluating the required size of the evaporation pond and what margins were applied to be conservative in the evaluation.

Discusser: Lee Webb, P.E., WesTech Engineering, Salt Lake City, UT

IWC 25-32: Micropollutant Reduction and Wastewater Reuse via MBR

Time:

Matthew Rutherford, MANN+HUMMEL Water & Membrane Solutions, Goleta, CA ; Maximilian Werner, MANN+HUMMEL Water & Membrane Solutions, GmbH, Wiesbaden, Hessen, Germany; Sreenath Kariveti, MANN+HUMMEL Water & Membrane Solutions, GmbH, Wiesbaden, Hessen, Germany

Membrane bioreactors (MBRs) are increasingly used in water reuse and have potential for micropollutant/ antibiotic-resistant genes (ARG) removal, especially when used in combination with other technologies such as ozonation or activated carbon. Two cases will be presented in this paper to demonstrate this capability.

In case profile one, effluent from the final clarifier at a conventional activated sludge (CAS) wastewater treatment plant were dosed with two different powder activated carbon (PAC) products at concentrations of 9-18 mg PAC/L in a basin with an MBR product. More than ten pharmaceutical micropollutants and antibiotic-resistant genes were measured of the final effluent compared to the CAS final clarifier at the full-scale pilot plant from 2020-2023, showing a reduction of 80-90+% for the pharmaceutical micropollutants and up to a 3 Log Removal Value (LRV) for ARG.

In case profile two, an MBR + ozone process was investigated. Again, more than ten pharmaceutical micropollutants and antibiotic-resistant genes were measured for removal in over 0.22 - 0.78 of grams ozone (O3) per gram dissolved organic carbon (DOC). Removal efficiencies increased 50% to ~90% over the increased ozone concentration for micropollutants measured. In addition, up to a 3 LRV was achieved for ARGs.

Discusser: Rangesh Srinivasan, Ph.D, P.E., Tetra Tech, Houston, TX

Wednesday, 11/12/2025; 8:00 AM

PFAS Management – Removal and Destruction approaches (PFAS 2)

IWC Rep: Bradley D. Wolf, P.E., Berkeley Research Group, LLC, Pittsburgh, PA

Session Chair: Ashwin Thakkar, Aquatech International, Canonsburg, PA

Discussion Leader: Larry Gottlieb, ResinTech, Inc., Camden, NJ

Per-and polyfluoroalkyl substances (PFAS) management is going to be very critical and hence, this session will be a good overview with regards to separation and/or concentration of PFAS followed by various treatment approaches, i.e. electrochemical oxidation, multi-stage foam fractionation, hydrothermal alkaline treatment, etc. PFAS management for the various applications, i.e. landfill leachate, municipal wastewater, firefighting foam fractionation, etc. will be discussed in this session to explain how various separation and concentration technologies i.e. IX, RO membrane processes can be used ahead of any PFAS Removal and Destruction technologies.

IWC 25-61: In-Situ Generated Ferrate as a Treatment Reagent for PFAS-contaminated Landfill RO Leachate Wastewater

Time:

L. Keith McLeroy, Ecolyse, College Station, TX ; Vladimir Dozortsev, Ph.D., AMS, Sunnyvale, CA

With landfill operators facing increasingly stringent water quality regulations, managing per- and polyfluoroalkyl substances (PFAS) in leachate has become a critical issue for landfills striving to meet environmental standards and protect public health. Separation technologies, predominately reverse osmosis (RO) membrane filtration, have emerged as an effective PFAS concentration and purification solution. However, while these systems have been proven for PFAS removal, the rejected wastewater (concentrate) contains a significantly higher concentration of PFAS than the original leachate, making it crucial to manage this hazardous and toxic waste stream properly.
While ferrate (Fe+6) has the capacity to address a broad range of per- and polyfluoroalkyl (PFAS) compounds in wastewater and other water-based matrices due to its outstanding oxidizing power, synthesis difficulties and the inherent instability of bulk Fe+6 has made its application restrictive. However, now with the development of a proprietary Fe+6 generation system, ferrate can now be generated in-situ, on-demand electrolytically, providing a high-yield Fe+6 reagent sufficient for industrial implementation. The fully automated generation system produces a fresh Fe+6 reagent concentrate at site, with a high concentration (> 7000 ppm), that is scalable and capable of treating a broad range of PFAS-impacted waters to achieve treatment goals.

The ferrate generation system’s electrolytic process requires only three consumables: a sacrificial iron anode, a caustic

solution and electricity. The electrolytic approach is a one-step process in which the electrolyte is continuously fed into the electrolytic unit while the outflowing Fe+6 reagent is dosed into the treated flow. The ferrate generation system has an inline ferrate concentration monitor to ensure a stable Fe+6 generation process.

A study was undertaken at a water research facility in College Station, Texas to evaluate the electrogenerated Fe+6 as a PFAS treatment reagent in PFAS-contaminated landfill RO leachate wastewater. The study also investigated the effect of Fe+6 reagent doses on PFAS treatment efficiency. Supplementary, the effect of organic residual level in the leachate samples (TOC, COD and BOD) on PFAS removal efficacy was studied to optimize the PFAS treatment process. The evaluation showed that the advanced electrogeneration system could generate a Fe+6 reagent solution on-site and on-demand capable of effectively treating an extensive range of PFAS group compounds by 96.0% and oxidizing the residual organic residuals by an average of >85.0%. Results will be presented.

Discusser: Kristen Jenkins, Kiewit, Atlanta, GA

IWC 25-62: Relevance of AOF in PFAS Management – Challenges and Lessons Learned from an Applied Testing Laboratory Perspective

Time:

Devesh Mittal, Aquatech, Cannonsburg, PA

Aquatech is addressing the challenge of eliminating PFAS using its DE-FLUORO® technology. This innovative approach non-selectively destroys PFAS by sequentially breaking the carbon-fluorine bonds. The technology is currently implemented in several units at Aquatech's Applied Testing Laboratory. The laboratory has setup a Combustion Ion Chromatograph (CIC) to utilize EPA Method 1621 for analyzing Adsorbable Organic Fluorine (AOF) concentrations in PFAS samples to obtain real time testing results from the DE-FLUORO® units.

Aquatech will present the relevance of AOF and EPA method 1621 as a key performance indicator when conducting PFAS destruction. The presentation will compare relevant terms for measuring organic fluorine such as Extractable Organic Fluorine (EOF) and Total Organic Fluorine (TOF) with AOF and discuss the importance of specifically AOF for PFAS analysis. Since EPA method 1621 with use of AOF as a key performance indicator is new, not many laboratories/ research facilities are setup with CIC base testing. Aquatech implemented the CIC at our lab without much industry information available, much of the learning came from hands-on setting up, calibrating, and achieving repeatable results. The presentation will share challenges encountered and lessons learned from firsthand laboratory experience with CIC analysis of AOF, highlighting the significance of this research.

Discusser: Dave Ciszewski, Veolia, Bellevue, WA

IWC 25-63: Cutting the Chain: Innovation to Destroy PFAS in Sludge Dewatering Filtrate at the City of Tacoma Central Wastewater Treatment Plant

Time:

Somnath Mukherjee, Aquagga, Inc., Tacoma, WA ; Erika Houtz, ECT2; Lottie Franck, ECT2; Joel Baker, University of Washington; Emese Hadnagy, University of Washington

As conveyors of PFAS originating from distributed sources, wastewater treatment plants (WWTPs) represent collection points of per and polyfluoroalkyl substances (PFAS) to the environment. Multiple approaches can be used to achieve PFAS reduction in wastewater or WWTP residuals, including applying PFAS treatment to upstream, highly impacted dischargers; applying treatment selectively within the treatment plant to target highly concentrated streams; or treating the full effluent and/or biosolids. As part of this project, the team treated the highest concentration PFAS stream within the City of Tacoma's Central WWTP, the plant's anaerobic sludge dewatering filtrate, which is recycled back to the plant influent. A combined approach of filtration, multi-stage foam fractionation, and hydrothermal alkaline treatment (HALT) were used to remove and destroy PFAS in this isolated stream. Foam fractionation is a desirable approach in the WWTP context due to the presence of co-occurring salts and organics that can rapidly foul other PFAS treatment options like adsorptive media and membrane treatment. HALT has proven robust at destroying PFAS waste concentrates with complex background chemistry in many applications. Following treatability testing, the approach was field implemented onsite over a one-month period starting January 2025. For the foam fractionation portion, long chain PFAS such as PFOS and PFOA were completely removed, and under the best performing conditions, total PFAS were removed by 78%. Following primary fractionation and foamate concentration, an overall concentration factor of 371 was achieved. The primary and concentrated foamate were treated by the HALT process to destroy and mineralize the concentrated PFAS. Residuals from both treatment processes can be merged with existing streams within the plant. The combined approach of foam fractionation and HALT applied selectively to a high concentration stream can be used in conjunction with other targeted PFAS treatment approaches to remove and destroy PFAS leaving WWTPs. We will present information on the feasibility of adding these technologies to a WWTP.

Discusser: Kevin Dufresne, P.Eng., Geosyntec Consultants, Guelph, ON, Canada

IWC 25-64: Electrochemical Approaches for PFAS Removal and Destruction

Time:

Thomas Igou, Ph.D., WaterTectonics, Everett, WA ; Dora Chiang, Ph.D., P.E., Jacobs, Atlanta, GA; Qingguo (Jack) Huang, Ph.D., University of Georgia, Griffin, GA

Electrochemical water treatment approaches continue to offer advantages over traditional chemical- and biological-based techniques, including in-situ generation of coagulants and/or oxidants, low treatment footprint, straightforward process control, and reduced generation of sludge. Further, the relatively stable inflation-adjusted cost of electricity and increasing share of renewables within the domestic energy grid have advanced the value proposition for electrified treatment trains both in terms of economics and sustainability. Although electrochemical oxidation (EO) has been investigated thoroughly for PFAS destruction, less information is available within the scientific literature describing electrochemical coagulation (EC) for PFAS removal - either as a standalone process or as pretreatment prior to EO within integrated EC-EO treatment trains. EC typically uses iron or aluminum sacrificial electrodes – when current is applied across the electrodes, several processes occur simultaneously including, (a) metal cation dissolution, (b) evolution of hydrogen gas, and, (c) generation of hydroxide ions. Dissolved metals then react with hydroxide ions, creating metal hydroxides that entrain and adsorb contaminants. Hydrogen gas evolution then enables contaminant

removal by floatation in addition to floc settling. Although protons are generated during EC, they are rapidly consumed by dissolved oxygen resulting in net-zero pH throughout the overall reaction. EC does not require addition of counterions (e.g., FeCl3, KAl(SO4)2) and adds negligible acidity compared to chemical coagulants.
Recent studies suggest EC conducted with iron, aluminum and zinc electrodes can achieve meaningful removal of PFAS, especially long-chain varieties, via adsorption to EC-generated metal hydroxide flocs. The bench-scale work performed to-date, although promising, faces fundamental engineering challenges to improve technology readiness level for robust performance in real wastewaters. In this paper, we update and contextualize the existing body of literature around EC and EC-EO for PFAS treatment, and present the results of in-house bench-scale EC and EC-EO experimentation using Fe, Al and Zn electrodes and boron doped diamond (EO).

Discusser: Ashley Jones, Stantec, Nashville, TN

Wednesday, 11/12/2025; 8:00 AM

Modeling for Today's Water Treatment Challenges

IWC Rep: Michele Funk, P.E, Bechtel Corporation, Reston, VA

Session Chair: Donna Murphy, DuPont Water Solutions, Wilmington

Discussion Leader: Jaron Stanley, WesTech Engineering, Salt Lake City, UT

Simulating a water treatment process can help with design of new systems or optimization of existing ones. Modeling can be used to predict performance under various types of streams or conditions and it can assist in the strategy for managing those streams for reuse. This session will look at how modeling is addressing some of today's water treatment challenges and present case studies on topics from Hardness removal for Direct Lithium Extraction, Wastewater mapping for capacity optimization and water reuse, continuous scaling and corrosion assessment for cooling tower management and pushing traditional boundaries on scaling for achieving optimal recovery in Dynamic RO systems.

IWC 25-65: Thermodynamic Modeling of Water Softening for Direct Lithium Extraction: Predictive Insights and Process Optimization

Time:

Leslie Miller, OLI Systems, Reston, VA ; Mallory McKaskill, OLI Systems, San Diego, CA; Hikaru Yakushiji, OLI Systems, Nara Prefecture, Japan

Water softening is a critical pretreatment step in Direct Lithium Extraction (DLE), directly influencing both process performance and economic viability. Scaling and fouling from calcium, magnesium, and silica can severely impact downstream unit operations, making precise softening control essential. Chemical softening methods, such as the addition of lime and soda ash, are widely employed to precipitate calcium and magnesium ions, thereby reducing water hardness. These methods are effective in mitigating scaling issues; however, the underlying thermodynamic phenomena governing these reactions are complex and can lead to unintended operational challenges, including precipitation variability and inefficiencies in chemical dosing.

This paper explores thermodynamic modeling techniques for water softening, evaluating their ability to predict scaling tendencies, optimize reagent consumption, and enhance overall process stability. We compare different modeling approaches, examining their accuracy in forecasting precipitation behavior, reaction kinetics, and equilibrium conditions under varying brine compositions. By integrating these models into DLE process simulations, we assess their broader impact on extraction efficiency, chemical costs, and plant reliability.

A key case study is presented, demonstrating how a company implemented real-time monitoring and control of softening chemistry to mitigate process fluctuations. By leveraging online water quality sensors and predictive modeling, they significantly improved system reliability, reduced chemical consumption, and minimized variability, leading to enhanced downstream performance. These results underscore the importance of advanced modeling and control strategies in optimizing water softening for lithium recovery.

This study highlights how thermodynamic predictions and data-driven control strategies can transform brine pretreatment, offering a pathway to improved process efficiency, lower operating costs, and greater sustainability in DLE operations.

Discusser: Garth Parker Jr., Ph.D., DuPont Water Solutions, Oaks, PA

IWC 25-66: Modeling Cyclical Water Balances with Ion-Association Chemistry Tools

Time:

Thomas Hope, Burns & McDonnell, Kansas City, MO ; Maaz Ahmad, Burns & Mcdonnell, Denver, CO

Water balance modeling is a critical tool for understanding and optimizing water processes in industrial and municipal systems. This study presents a time dependent water balance model designed to determine the concentration of constituents within a cyclical system over a specified period of time. The model was developed using an 1st order ordinary differential equation, which was solved numerically using finite difference methods and Euler's method to track constituent accumulation and dilution dynamically.

The methodology involves constructing a computational framework that accounts for inflows, outflows, and internal recycling within a proposed facility. By integrating the mass balance principles with time-dependents, the model provides predictive insights into system performance under various operational scenarios. The results from this water balance model were then used to develop specifications for a water treatment system tailored to the process requirements.

Sensitivity analyses were conducted to assess the impact of changes in input water quality, process conditions, and operational parameters on constituent concentrations. The findings indicate that using a time-dependent water balance approach enhances decision-making for water treatment system design, optimizing performance and regulatory

compliance before facility construction begins.

This research contributes to the broader understanding of dynamic water balance modeling and its application in process-driven industries. The study's predictive capabilities offer valuable insights for engineers and decision makers in designing water treatment systems for facilities in the planning and development phase. The paper will present technical development of water balance modeling, supported by computational simulations and data-driven analysis, and will be followed by discussion on further applications and refinements in time-dependent modeling approaches.

Discusser: Arash Karimi, Worley Consulting, Calgary, AB, Canada

IWC 25-67: Navigating Industrial Wastewater: Process Mapping for Reuse and Optimization

Time:

Shannon Brown, HDR, Omaha, NE ; Soraya Laghmari-Bouzidi, Bayer, Leverkusen, Germany

Wastewater mapping is fundamental for assessing operating industrial wastewater treatment facilities when reviewing system capacity, planning for capital upgrades, and / or considering major process improvements or operational changes. Proper wastewater mapping methodology includes stream characterization, water balance, grouping of streams, and review of treatment operations and options. By applying this method, cost-effective water management opportunities can become apparent that may have been overlooked during system construction and / or expansion. Unfortunately, this detailed mapping approach has not been passed down readily within the wastewater process engineering discipline. This paper will be used to provide a detailed overview of wastewater treatment mapping for industrial applications.

Key findings from wastewater mapping of a full-scale, operating wastewater treatment process that treats water from industrial manufacturing of crop protection chemical products is provided as a case study. Wastewater treatment process influent and process stream characterization was performed to identify opportunities for treatment process improvement and water reuse. As the site location is prone to flooding, surface water handling was of specific interest. Based on this work, significant future opportunities for water reuse and surface water management were identified, which could also improve site wastewater treatment process operations.

Discusser: Bridget Moyles, P.E., GHD, Allison Park, PA

IWC 25-68: Predicting and Achieving Optimal Recovery in Dynamic RO Systems

Time:

Samantha Fowler, Kurita America Inc., Salt Lake City, UT ; Matt James, Kurita America Inc., Orlando, FL; Sara Pietsch, Kurita America Inc., Carlsbad, CA

Dynamic reverse osmosis (RO) systems are becoming increasingly popular due to the growing demand for higher recoveries and the treatment of more complex waters. The hydraulic principles behind these systems provide an opportunity to push the traditional boundaries of recovery by utilizing scale formation inhibition time. However, the complex nature of many feedwaters poses challenges for conventional scale prediction programs and monitoring approaches.
This paper presents laboratory-scale mini-RO and pilot testing that has informed the development of new dynamic recovery antiscalant dosing strategies. The updated dosing, integrated with predictive software, enables higher recoveries for slower-forming scales such as clay and silica, while maintaining control over faster-forming scales such as calcium carbonate.
Practical operational guidance is provided for successfully operating dynamic RO systems in response to specific water challenges. This includes the use of different monitoring strategies, such as brine pH or conductivity, to identify actual end-of-run limits, as opposed to relying solely on mass-balance-based methods.
Field experience has shown that systems running near their maximum theoretical recovery can be pushed beyond safe limits due to variability in feedwater quality or improper operation. This paper provides guidance on when additional laboratory testing may be necessary to validate software predictions and assess the impact of feed fluctuations. These strategies have been successfully implemented onsite, across various industries, to optimize RO performance without exceeding system capabilities.
In summary, this paper will use data from lab, pilot, and full-scale systems to guide accurate prediction of maximum system recovery and key operational parameters for optimal performance.

Discusser: Pengpeng Qi, Xylem, Buford, GA

Wednesday, 11/12/2025; 8:00 AM

Power Wastewater

IWC Rep: Rebecca D. Osteen, Southern Company, Birmingham, AL

Session Chair: Keith Ambrose, P.E., Electric Power Research Institute (EPRI), Charlotte, NC

Discussion Leader: Rena Bae, P.E., Stantec, Houston, TX

Join us for an exciting technical discussion on the latest and greatest innovations in wastewater treatment for the power industry. We will explore novel techniques and approaches to treating power plant wastewaters such as combustion residual leachate (CRL) and flue gas desulphurization (FGD) wastewater. Whether you have years of experience in power plant wastewater treatment or are curious to learn more, this session offers a valuable opportunity to deepen your technical expertise, ask questions, and be a part of an engaging and dynamic conversation.

IWC 25-69: Combustion Residual Leachate Treatment Systems Under the 2024 Effluent Limitations Guidelines

Time:

Dallas Torgersen, WesTech Engineering, LLC, Salt Lake City, UT

The 2024 revisions to the Environmental Protection Agency's Effluent Limitations Guidelines (ELGs) for steam electric power plants impose stringent discharge requirements on combustion residual leachate (CRL). Facilities that will stop burning coal before 2035 must treat CRL for arsenic and mercury before discharge. Facilities that will remain operational in 2035 and beyond must achieve zero liquid discharge (ZLD).

This paper provides an overview of the regulatory framework and considers possible CRL treatment system configurations. There are several possible treatment schemes that may be considered for treatment of arsenic and mercury before discharge for non-ZLD systems. Where ZLD is required, that system may be a stand-alone system dedicated to CRL or combined with other waste streams such as flue gas desulphurization (FGD) wastewater which will also be required to be ZLD.

To illustrate compliance strategies, this paper presents real-world case studies that are available, as well as proposed conceptual designs for new systems that have not yet been implemented. By examining both proven and conceptual solutions, this paper aims to provide options to consider for compliance with the 2024 ELGs with a focus on technology selection.

Discusser: Carson Brown, Southern Company, Birmingham, AL

IWC 25-70: Bench-Scale Investigation of Dissolved Metals Removal from CCR Leachate Contaminated Groundwater Using Iron-Based Media in a Permeable Reactive Barrier

Time:

Krystina Mair, EIT, WSP, Cambridge, ON Canada; Kathryn Falk, P.Eng., WSP, Cambridge, ON, Canada; Bruce Weilinga, Ph.D., WSP, Tacoma, WA; Cody Johnson, P.E., WSP, Merrimack, NH

In 2024, WSP conducted a series of bench-scale investigations of several iron-based media including Granular zerovalent iron (ZVI), Granular ferric oxyhydroxide (FeOOH), and FerroBlack®, to treat Coal Combustion Residual (CCR) leachate contaminated groundwater from a coal and natural gas fired electrical generating station located in the North Central United States.
There is a growing need for groundwater treatment in remediation efforts as the quality of groundwater is often impacted by natural and anthropogenic sources. A traditional method, known as pump and treat, involves pumping contaminated groundwater to the surface for treatment using air stripping, activated carbon, chemical precipitation, and a variety of other treatment methods, depending on the contaminants of concern. While effective and adaptable for the removal of contaminants in remediation efforts, it can be an energy-intensive and costly effort, especially in larger scale operations. Permeable reactive barrier (PRB) treatment methods offer in-situ treatment of ground water – they're installed underground – as water passes through, contaminants can be removed by the reactive media.
WSP conducted treatability testing to evaluate the effectiveness of treatment media for removal of dissolved metals including arsenic, boron, lithium, molybdenum, selenium, and thallium from groundwater under an in-situ PRB remedy. While scientific literature can provide information on potential media, bench and column studies using Site soil and groundwater were needed to ensure that the media will be effective under Site-specific conditions and to evaluate the hydraulic residence time (HRT) needed to achieve the target contaminant removal rate, which is a crucial variable for determining PRB dimensions.
This paper will present and discuss the results from 17 benchtop trials using a column study to evaluate three popular PRB media.
Prepared By:

Krystina Mair, EIT, CAPM Katy Falk, P.Eng
Process Engineer in TrainingSenior Environmental Engineer

Reviewed By:

Bruce Wielinga, Assistant Vice President, Chemical Science, and Cody Johnson, Lead Consultant, Environmental Engineering

Discusser: Derek Henderson, P.E., Duke Energy, Raleigh, NC

IWC 25-71: Achieving FGD ZLD by Softening and Evaporation/Crystallization in a Cooling Tower System

Time:

Thomas Higgins, Ph.D., P.E., Worley Engineering, Saint Augustine, FL ; Kevin Say, P.E., Orlando Utilities Commission, Orlando, FL

Orlando Utilities Commission (OUC) operates the Stanton Energy Center. The plant is a zero-liquid discharge (ZLD) facility.

OUC uses reclaimed wastewater for Coal and gas fired generator cooling towers. Cooling tower blowdown is treated in falling film and forced circulation crystallizing evaporators, producing a salt cake that is landfilled, and distillate, which is reused.

The coal fired boilers flue gas is treated with a flue gas desulfurization (FGD) system. The scrubber system evaporates water and generates a gypsum/ calcium sulfite slurry which is dewatered and disposed of in an on-site landfill. FGD purge water, coal pile runoff, and non-cooling tower wastewater drain to a series of recycle ponds, which provide water for FGD makeup and other uses. Approximately 100 million gallons of wastewater can accumulate in this pond system.

Currently excess water is evaporated in the FGD systems, and salts and some water disposed with the gypsum/calcium sulfite waste. When units are closed or partially or fully converted to gas, less or no gypsum will be produced and an alternative means of getting rid of salts and water is needed.

During periods of high net rainfall water levels rise in the ponds. If the plant's units are not operated at sufficient capacity factors, FGD scrubber evaporation and gypsum disposal are limited.

Worley and OUC developed a water model (IWC 21-34) that predicts water levels in the ponds as a function of power generation and rainfall. The model indicated that if 200 gpm of recycle pond water was diverted to the cooling tower evaporator system, then the ponds could be sequentially decommissioned.

The chemistries of the cooling towers and recycle ponds are significantly different. The cooling tower water is dominated by calcium, sodium and sulfate. The recycle pond water is dominated by magnesium, sulfate and chloride. The plant cannot treat a mixture of cooling tower blowdown and recycle pond water due to severe scaling potential in the evaporators by glauberite (sodium calcium sulfate). However, our proprietary evaporator model showed that the recycle pond water could be fed to the brine plant if the water was softened and treated in separate evaporators. The softening plant has been constructed and is currently in startup. Data from operation of the softening plant and evaporator system will be presented in the proposed paper.

Discusser: Shiladitya Basu, Stantec, Houston, TX

IWC 25-72: Dynamic Micro-granular Adsorptive Filtration (DmGAF): A Fouling-Resistant, Low-Cost Pretreatment for Zero Liquid Discharge in FGD Wastewater

Time:

Jinjian Wu, MicroHAOPs Inc., Seattle, WA ; Nathan Cai, MicroHAOPs Inc., Seattle, WA; Mark Benjamin, MicroHAOPs Inc., Seattle, WA

Zero Liquid Discharge (ZLD) treatment plays an important role in enabling regulatory compliance, water sustainability, and pollution mitigation for power and mining industries. However, widespread adoption is still hindered by high capital and operational costs, primarily due to energy-intensive thermal or membrane-based concentration processes. Pretreatment optimization is a critical strategy to enhance efficiency and reduce costs by minimizing fouling, improving recovery, and stabilizing downstream operations. This study introduces a transformative chemical-free and clean-in-place (CIP)-free separation process featuring an innovative water-solid contact mechanism, offering a potential pathway toward economically viable ZLD.

The Dynamic Micro-granular Adsorptive Filtration (DmGAF) process is an innovative filtration process that addresses fouling challenges inherent in conventional filtration processes. DmGAF employs a dual-layer design: a flexible macro-porous support fabric overlain by dynamically deposited engineered, ultra-fine particles. This configuration forms a self-renewing filtration layer that effectively removes suspended solids while maintaining stable effluent quality. Accumulated solids are periodically removed via automated shedding/cleaning process, which completely removes both the captured solids and the deposited particle layer due to the use of a highly flexible support fabric, enabling cyclic operation without irreversible fouling. This innovation streamlines pretreatment by eliminating complex chemical dosing, multiple settling and filtration stages, and inconsistent performance associated with traditional systems.
A DmGAF pilot system was deployed at a power plant to treat flue gas desulfurization (FGD) wastewater characterized by extreme variability in suspended solids (turbidity 12–7,830 NTU). The system consistently achieved consistent high solids removal with an average effluent turbidity of 0.18 NTU and 95.5% water recovery while operating at pressures below 15 psi across 81 cycles (35 days). No irreversible fouling developed, despite operating with no chemical additions and no CIP steps throughout the study.
In a second application, a scaled-down DmGAF unit treated chemically softened FGD wastewater (1,050-1,350 mg/L suspended solids; 2,930-3,070 NTU turbidity). The system produced effluent with turbidity <0.5 NTU at operational pressures under 9 psi for a repeated cycles, demonstrating robust performance under high solids loading.
The DmGAF technology has proven effective in treating high-strength, high-solids waste streams such as FGD wastewater, delivering exceptional effluent quality, low energy requirements, and fouling-resistant operation. A quick cost analysis shows, as compared to a conventional pretreatment process, DmGAF can save 46.6% and nearly 50% on capital and O&M cost, respectively. By enhancing pretreatment reliability and reducing operational complexity, this innovation holds significant potential to improve the economic feasibility and operational stability of ZLD systems.

Discusser: Katie VanderEspt, Electric Power Research Institute, Brooks, KY

IWC 25-W3R: Zero Liquid Discharge Solutions for FGD Wastewater: Keeping Coal Power Plants Viable and Compliant

Time:

David Stanek, Westech Engineering, Salt Lake City, UT ; McKale Grant, Stantec Consulting Services, Inc.,, Nashville, TN; Bill Kennedy, Stantec Consulting Services, Inc, Charlotte, NC

Wastewater discharges from coal-fired power plants release substantial volumes of pollutants into water bodies throughout the United States. These pollutants can pose serious health and environmental risks, as many are capable of persisting in the environment for extended periods. This paper introduces an innovative approach tailored specifically for coal-fired power plants, focusing on the integration of Zero Liquid Discharge (ZLD) technologies to provide a Flue Gas Desulfurization (FGD) wastewater solution that is safe, reliable, environmentally compliant, and economically feasible.
The proposed strategy focuses on achieving compliance with the stringent 2020 Effluent Limitation Guidelines (ELGs) established by the United States Environmental Protection Agency (EPA). By incorporating state-of-the-art treatment methods, this approach aims to minimize pollutant discharge while optimizing by-product management. Performance evaluations demonstrate improvements in operational efficiency and cost-effectiveness, offering a practical and environmentally compliant solution that supports the continued viability of coal-fired power plants in an increasingly regulated landscape.

Discusser:

Wednesday, 11/12/2025; 8:00 AM

Sustainable Water and Energy Strategies for High-Tech Industries

IWC Rep: Dennis K. McBride, Burns & McDonnell, Kansas City, MO

Session Chair: Krystal Perez, P.E., Brown and Caldwell, Seattle, WA

Discussion Leader: Dennis Fink, Brown and Caldwell, Walnut Creek, CA

As the demand for high-tech industries continue to grow, the need for sustainable water and energy solutions becomes increasingly pressing. This session highlights innovative strategies and technologies that address the unique challenges of water and resource use in data centers, semiconductor manufacturing, and battery manufacturing. Join us to explore practical approaches for optimizing water efficiency, reducing energy consumption, and enhancing operational performance across high-tech facilities.

IWC 25-73: Comparing Energy Efficiency, Water Usage, and Economics of Data Center Cooling Options Including Zero Liquid Discharge

Time:

Ziyi Fang, Saltworks Technologies, Vancouver, BC Canada; Brandon Sparrow, Saltworks Technologies, Richmond, BC

Data center power demands are growing substantially, driven by the rise of AI and cloud computing. Goldman Sachs Research estimates that 67 GW of additional global data center workload will be added by 2030. Energy demands within a data center are divided between computation and cooling loads, with the two main cooling options being: (1) higher-energy 'dry' cooling and (2) lower-energy 'wet' cooling.

Dry cooling uses refrigeration cycles, with 30% of the data center's power directed toward cooling. The 'wet' option reduces cooling energy demand to 10% of the total power load by utilizing atmospheric evaporative cooling through cooling towers or swamp coolers. The energy savings of wet cooling are both significant given data center development is often constrained by power availability. However, wet cooling consumes water, which introduces costs, increases process plant complexity, and may face stakeholder opposition.
While geography, water, power, and corporate philosophies influence the cooling technology decision, dry and wet cooling can be compared in terms of water use, energy, and economics.
Fully leveraging wet cooling globally could result in up to 13 GW of power savings, enough to power a city of 4 million people, but this comes at the cost of increased water consumption. A 200 MW wet-cooled data center with a typical water use effectiveness (WUE) ratio of 2 consumes 10,000 m^3/day of water. Adopting cooling water treatment, blowdown recycling, and zero liquid discharge (ZLD) can reduce water consumption by ~40%, down to 6,000 m^3/day. This paper presents an economic comparison of dry versus wet cooling, including an analysis of water reuse and ZLD for the wet cooling option. It also explores how cooling water cycles can be extended and water consumption reduced by softening or treating inlet water with reverse osmosis. Chemical additives can extend cooling cycles but may complicate blowdown water treatment, which can be managed with downstream techniques.
This paper utilizes data from industrial cooling tower blowdown pilot projects to present treatment pathways that enable water reuse in wet cooling systems. It presents process pathways to increase water use efficiency in wet-cooled data centers, with three levels of water recovery, including ZLD, and provides an economic comparison of dry versus wet cooling options. It demonstrates that wet cooling provides a significant economic and energy advantage at scale, with ZLD offering compelling economics at a specific scale where added complexity and cost lead to long-term energy and water savings.

Discusser: Brandon Yallaly, Carollo Engineers, Inc., Boise, ID

IWC 25-74: Alternative Feed Sources for Direct Evaporative Cooling Systems

Time:

Anthony Zamarro, P.E., CDM Smith, Boston, MA ; Audrey Karl, CDM Smith, Hartford, CT

The proliferation of data centers, both in North America and globally, has led firms to seek out new sources of water for direct evaporative cooling (DEC) systems. DEC systems consume less energy than other cooling technologies, but require significantly more water as a process input. Additionally, when a DEC system is used to cool buildings, occupants can be exposed to droplets of water generated by the system.

Designers are looking toward new sources of water for DEC systems including sources that require significant treatment before use. These include wastewater effluent from municipal treatment plants and brackish sources.

This paper will outline the status of nationwide regulations that establish standards for treatment for DEC systems, which are a patchwork depending on applicable regional jurisdiction. In addition, a review of different corporate standards for DEC feed water including those published by the manufacturer. A review of treatment trains for challenging source waters will be presented including treated municipal wastewater effluent and brackish sources.

Discusser: Stephanie Ishii, Hazen and Sawyer, Tampa, FL

IWC 25-75: Exploring a semiconductor reclaim wastewater treatment plant operational optimization

Time:

Sessouh Akowanou, Fluor, Phoenix, AZ

Semiconductor facilities producing 40,000 wafers per week have an average water consumption of 4 to 5 million gallons of water daily. The consumption of water at this magnitude presents significant challenges, particularly for communities with limited water resources. To mitigate these challenges, the industry is investing significant capital in reclaim facilities equipped with zero liquid discharge to ensure environmental compliance and operational sustainability.
This paper discusses the challenges and opportunities faced by a hypothetical wastewater reclaim facility for a high-volume manufacturing semiconductor site through operational optimization.
This study investigates strategies for reducing water consumption both within process units and across the entire facility. These strategies encompass chemical consumption minimizations, sludge dewatering system optimization, ion exchange bed reconfiguration, regeneration frequency reduction as well as stream reconfiguration within the ion exchange and reverse osmosis units for the judicious reuse of water and a direct cost saving on the zero liquid discharge side of the facility.
The study's findings highlight the importance of critically reassessing water usage within an established industry in light of evolving demands and technologies, and the significant improvements that can be achieved in doing so.

Discusser: Audrey Karl, CDM Smith, East Hartford, CT, USA

IWC 25-76: Advanced Water Treatment and Brine Minimization: Integrated Approach for Sustainable Battery Manufacturing

Time:

Tal Fabian, IDE Water Solutions NA, Carlsbad, CA ; Roi Zaken Porat, IDE Water Solutions NA, Kadima, Israel; Alex Drak, IDE Water Solutions NA, Kadima, Israel

Water scarcity, stringent regulatory frameworks, and rising costs associated with water intake and wastewater discharge compel industrial facilities to adopt comprehensive and sustainable water management strategies. This paper presents a case study of one of the most advanced integrated water reclamation facilities globally, demonstrating substantial reductions in water intake and brine discharge through innovative technologies and process optimization.

The advanced water treatment system discussed encompasses multiple streams, including Cooling Tower Blowdown (CTBD) and brine from the facility's existing Reverse Osmosis (RO) systems, which initially utilize reclaimed municipal water sources. The core objective is minimizing high-salinity brine volume to significantly reduce discharge expenses. The integrated and innovative treatment solution includes ferric coagulation and clarification pretreatment, ultrafiltration (UF), Brackish Water Reverse Osmosis (BWRO), followed by the proprietary MaxH2O Desalter technology designed to achieve over 95% recovery, thereby substantially minimizing brine volume.

Additionally, the facility utilizes waste heat for driving an evaporation process, further reducing brine volume economically and sustainably. The paper will detail the journey of commissioning this integrated system and share operational data gathered from the first few months of operation, offering practical insights into complex chemistry management, operational challenges, and strategies for performance optimization.

Early operational data underscores environmental benefits, positioning this facility as a benchmark for industrial water sustainability and near-zero liquid discharge achievements.

Discusser: Bill Bratt, P.E., Woodard & Curran, Marietta, GA

IWC Exhibitors

Alphabetical

Abtech Industries

Booth #: 113

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At Abtech Industries, we are pioneers in advanced water filtration media, pushing the boundaries of innovation and performance. With a relentless focus on scientific advancement and technological excellence, we integrate next-generation filtration media with proven third-party solutions to create high-performance, cost-effective, and scalable water treatment systems.

Alfa Laval Inc.

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Alfa Laval is a leading global provider of first-rate products in the areas of heat transfer, separation and fluid handling. With these as its base, Alfa Laval aims to help enhance the productivity and competitiveness of its customers in various industries throughout the world. We define their challenges and deliver sustainable products and solutions that meet their requirements – mainly in energy, the environment, food and the marine industry.

American Water Chemicals (AWC®)

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AWC® specializes in membrane treatment solutions tailored for Reverse Osmosis (RO), Nanofiltration (NF), Microfiltration (MF), and Ultrafiltration (UF) systems. Our portfolio includes high-performance, super-concentrated antiscalants, cleaners, biocontrol agents, and specialty treatment products, backed by proprietary digital tools such as Proton® for predictive scaling control and Smooth Operator for continuous system monitoring. With over 30 years of experience, we help industrial and municipal customers conserve water, reduce OPEX, and optimize membrane performance.

Amiad Water Systems

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Amiad Water Systems is a world leader in water treatment and filtration solutions, and for 60 years has devoted its passion and commitment to developing a comprehensive line of water filtration systems for applications in the irrigation and industrial markets. Our products are integrated into the core of water filtration and treatment systems such as membrane protection, wastewater treatment, potable water treatment, cooling systems and seawater filtration and are built for efficiency and reliability.

Apex Water + Process

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Apollo, Aqua Treat, Guardian CSC, and Weas Engineering, now unified as Apex, redefine industrial water and process solutions. We blend high-level expertise with a local, tailored approach to customer service. Beyond just being a provider, we forge true partnerships, ensuring the performance and reliability of your water systems. With Apex, expect more than solutions—expect a commitment to problem-solving and value at every turn.

Applied Membranes, Inc.

Booth #: 204

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Since 1983, Applied Membranes Inc (AMI) has provided water treatment and reuse solutions worldwide. For over 42 years, we've designed and built both pre-engineered and custom systems—ranging from hundreds to millions of gallons daily. We are the largest specialty membrane roller with deep expertise. Solutions are designed, built and tested in our ISO 9001:2015-certified, UL Listed facility in Vista, CA. We offer a large inventory, private labeling, after-sales support, and tailored solutions for diverse applications.

Aqua-Aerobic Systems, Inc.

Booth #: 207

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Aqua-Aerobic Systems is an applied engineering company specializing in adaptive water management solutions including aeration/mixing, biological processes, cloth media filtration, membranes, oxidation/disinfection and process control. Since 1969, the company has served the water and wastewater industry by providing both municipal and industrial customers around the world with advanced technologies and treatment solutions that easily adapt to changing demands.

Aquatech

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Aquatech helps global leaders solve complex water and minerals challenges through advanced technologies in desalination, water reuse, and zero liquid discharge. With innovation spanning membranes, performance chemicals, digital solutions, and lithium refining, Aquatech delivers smarter, more sustainable processes. Backed by four decades of expertise and thousands of installations in over 60 countries, we accelerate progress toward water security and critical mineral sustainability worldwide.

Aria Filtra/Aquafine

Booth #: 311/313/410/412

Contact:

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Fax:

E-mail:

Website: www.trojantechnologies.com

Aria Filtra, a division of Trojan Technologies, specializes in advanced water filtration solutions. With over 30 years of experience, we offer reliable membrane-based systems to tackle complex water challenges. Our solutions ensure high-quality water for municipal and industrial applications, enhancing operational efficiency and reducing costs. Aquafine, another division of Trojan Technologies, will join us in the booth. Aquafine provides robust and reliable UV solutions for industrial and commercial markets.

AST Filters

Booth #: 213

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AST designs and manufactures a wide range of filters utilizing Bead Filter technology which focuses on treatment simplification and consolidation of unit operations, combining both mechanical and biological filtration in a single unit. The resulting benefits of process consolidation include a smaller footprint, lower maintenance, and reduced capital / operational expenses. AST serves the municipal, industrial, and agricultural markets providing efficient treatment solutions to meet any discharge requirement.

Atlantium Technologies

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For more than two decades, Atlantium Technologies has helped to ensure water safety with its innovative HOD™ (Hydro-Optic Disinfection) UV technology and novel approach to performance, monitoring, and control. Atlantium's superior, environmentally friendly water treatment solutions ensure stable, efficient, and dependable production. With thousands of full-scale installations for leading brands in various industries globally, we’re committed to consistently meeting our customers' water quality needs, ensuring pure results.

AWC Water Solutions Ltd.

Booth #: 215

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AWC designs and manufactures water and wastewater treatment systems for a variety of municipal and industrial applications.

We have over 40 years of history and we have designed, manufactured and delivered over 500 water and wastewater treatment plants across North America and internationally.

AWC is headquartered in Langley, British Columbia, Canada, with a satellite office in Calgary, Alberta and a network of remote operators and experts across North America.

We are headquartered in Langley, British Columbia, Canada, with a satellite office in Calgary, Alberta and a network of remote operators and experts across North America.

Bowen

Booth #: 300

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Bowen is a self-performing water, wastewater and industrial contractor delivering Design-Build, EPC and Traditional projects throughout the US. Bowen is a leader in Industrial Water, CSO, ELG, and CCR, PFAS, PFOS and PFOA, and trace metal constituent removal. We serve Private, Public and Municipal clients by striving to be the most Resourceful, and Responsive construction company anywhere, all with the goal of bringing you the best Results on your project.

Brown and Caldwell

Booth #: 407

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Brown and Caldwell is a full-service environmental engineering and construction services firm with more than 50 offices and over 2,300 professionals across North America and the Pacific. For more than 75 years, our creative solutions have helped municipalities, private industry, and government agencies overcome their most challenging water and environmental obstacles. We’re employee-owned and bound by a shared purpose to unlock the potential of water for our clients, our communities, and our environment.

ChemTreat, Inc.

Booth #: 501

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ChemTreat is one of the world's largest providers of water treatment products & services. We develop customized programs with sustainable solutions to improve operating efficiencies, minimize expenditures, reduce carbon footprints, and improve energy and water management delivered through the most experienced sales and service team in the industry.

ClearStream Environmental

Booth #: 206

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ClearStream is a process separations equipment company with focus on physical/chemical and biological processes. We manufacture clarifiers, thickeners, lime softeners, biotreaters, oil/water separators, DAFs, SBRs, digesters and jet-aeration. We service applications in municipal water and wastewater, power, mining, chemical, petroleum, food, pulp & paper, steel, geothermal, AMD and most other industry process separation areas.

Compass Water Solutions

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CECO Environmental is a leader in technology-driven environmental and equipment solutions, focusing on industrial water and wastewater management. Our brands, Compass Water Solutions, Peerless, Kemco Systems and DS21, provide engineering consulting and manufacture tailored solutions deployed globally. Emphasizing sustainability and efficiency, CECO brands advance industrial water and wastewater filtration, separation, heating and process water treatment. From industrial water and wastewater, produced water and potable water packages, CECO brands protect the environment and industrial equipment.

Cooling Technology Institute

Booth #: 713

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Website: https://www.cti.org

The mission of the Cooling Technology Institute (CTI) is to advocate and promote the use of all environmentally responsible commercial cooling technologies. CTI works hard to present a forum that unites manufacturers, suppliers, and owners and operators with a single voice dedicated to the benefits of different cooling technologies worldwide. CTI encourages education on new technologies, the development of codes, standards and guidelines, independent performance verifications and certification programs, research, and technological information exchange.

Danfoss High Pressure Pumps

Booth #: 202

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Danfoss, a global leader in energy-efficient mechanical and electronic innovations, simplifies modern life and supports decarbonization across industries. Danfoss High Pressure Pumps, a division of the Danfoss Group, delivers high-pressure pumps and energy recovery devices for SWRO and Water Reuse applications. Our solutions offer fresh water to a thirsty world, ensuring cost savings and reducing CO2 footprint with industry-leading efficiency and reliability.

David H. Paul, Inc.

Booth #: 404/406

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David H. Paul, Inc. (DHP) is a renowned reverse osmosis water treatment training and consulting company with a rich history dating back to 1988.
DHP's serves a diverse range of industries and sectors, including semiconductors, power generation, pharmaceutical, oil and gas, desalination, food and beverage, and more. Their expertise extends to various water treatment technologies, including Reverse Osmosis (RO), Microfiltration (MF), Ultrafiltration (UF), Nanofiltration (NF), and many others.

De Nora Water Technologies

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De Nora is a leading global supplier of water and wastewater treatment technologies, designed to offer users a range of advantages that ensure the ongoing and efficient operation of their facilities. From cooling water and contact water treatment to the reduction of toxicity and COD from wastewater, De Nora has it covered.

Our ClorTec/MIOX on-site chemical generators, Capital Controls ozone generators and, DE NORA TETRA filtration systems, provide peace of mind to our customers worldwide.

DuPont Water Solutions

Booth #: 301/303

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Strengthening our partners. Solving water challenges. Companies, communities, and homes around the world choose DuPont Water Solutions to help make water safer and more accessible. Industries and markets count on us to become more efficient; to make food more nutritious; and to offer more effective pharmaceuticals. Our innovation and collaboration with the world’s best water experts enable ecosystems of innovation to deploy vital technologies in new, market-shaping ways.

Ecolab, Purolite™ Resins

Booth #: 203/205

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Purolite is a leading developer, manufacturer and supplier of ion exchange, adsorbent and specialty resins. Headquartered in Pennsylvania, USA, we have ISO 9001 certified manufacturing facilities in the USA, China, and Romania and operate five R&D centers

---

ECT2

Booth #: 607

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ECT2 (www.ect2.com), a Montrose Environmental Group company, offers technology for removing challenging water and vapor contaminants like PFAS and 1,4-dioxane. They offer a proprietary approach, using synthetic resins and resin regeneration, to manage PFAS cost-effectively. Clients around the world rely on ECT2's systems for industry-leading uptime and efficient contaminant removal.

Elemental Scientific

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ENCON Evaporators

Booth #: 210

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ENCON Evaporators is a global leader in industrial wastewater minimization, providing advanced evaporators, dryers, and other wastewater treatment technologies designed to significantly reduce wastewater volume and disposal costs. With over 1,600 facilities worldwide using ENCON systems, our solutions efficiently evaporate the water component from water-based waste streams, cutting hauling and disposal volumes by up to 99%—and in some cases, even more.

Energy Recovery

Booth #: 106

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Energy Recovery (Nasdaq: ERII) is a trusted global leader in energy efficiency technology for the water treatment industry. Building on our pressure exchanger technology platform, we design and manufacture reliable, high-performance solutions that generate cost savings, increase energy efficiency, and reduce carbon emissions across several industries. Energy Recovery delivers flexible solutions across a wide range of flow rates and pressure levels that make wastewater treatment simple, easy, affordable, and sustainable.

Environmental Energy Services (EES)

Booth #: 312

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EES offers innovative technologies for the power industry: CoalTreat® for slag mitigaton of coal-fired boilers; Delta CO, O2 and NOx analyzers; KLeeNscrub® precipitant for total Hg remediation. KLeeNwater™ to maximize water reuse and meet ELG limits; STEP Combustion for burners, gas conversions, SNCR and SCR, combustion/burner tuning and more.

FEDCO Pump

Booth #: 707/709

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Fluid Equipment Development Company, LLC or FEDCO is a global leader in the design and manufacture of fluid machinery solutions. Founded in 1997 with a focus on hydraulic equipment for reverse osmosis we have developed cutting-edge energy recovery turbochargers and centrifugal pumps. Today, we are combining our cutting-edge equipment with our expertise in membrane processes to deliver the next generation of reverse osmosis system designs.

Federal Screen Products

Booth #: 603

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Federal Screen is a custom manufacturer and fabricator of wedge wire screens, delivering high-quality products and unmatched customer service. With over 25 years of experience, we provide filtration solutions that help lower operational and maintenance costs for mineral processors. Through advanced manufacturing capabilities and exceptional engineering, we produce screens in a variety of configurations and slot sizes to meet your specific application needs. We specialize in media retention nozzles, vessel internals, strainer baskets, support grids.

Geosyntec Consultants

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Geosyntec's water and natural resources practice is a collaborative group of nationally recognized scientists and engineers dedicated to balancing built and natural environments. Their practice specialties represent many disciplines, including geomorphology, ecology, biology, statistics, construction management, computer science, and engineering. Our practitioners are at the forefront of policy analyses, regulatory compliance, and technology applications that promote sustainable water resources management and ecosystem restoration.

Graver Technologies LLC

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Graver Technologies, LLC serves the industrial filtration, separation and purification needs of companies around the globe. We offer a broad selection of high performance specialty ion exchange resins, proprietary adsorbents and filtration products for the most demanding application environments. Our products are used to efficiently remove particulate and soluble contaminants from a broad range of fluids and gases to solve our customers' most challenging problems.

Grundfos Pumps

Booth #: 403

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Grundfos pioneers solutions to the world's water and climate challenges and improves quality of life for people. As a leading global pump and water solutions company, we promise to respect, protect, and advance the flow of water by providing energy and water efficient solutions and systems for a wide range of applications for water utilities, industries, and buildings.

H2O Innovation

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From our founding more than 20 years ago, innovation is what has driven the organization. H2O Innovation is a complete water solutions company focused on providing best-in-class technologies and services to our customers. Our activities rely on three pillars: i) Water Technologies & Services, ii) Specialty Products and iii) Operations & Maintenance. Through innovation, we strive to simplify water.

HACH

Booth #: 514

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Since 1933, Hach® has led the industry in developing innovative solutions to help our customers analyze their water more efficiently and more effectively.

Today, Hach products can be found around the globe in a wide range of lab, field, and in-process uses in municipal and industrial facilities. Hach analytics solutions are designed to give operators and managers confidence in the many decisions they make to ensure compliance, and improve energy efficiency.

Howden, A Chart Industries Company

Booth #: 212

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Howden & ChartWaterTM

INTRODUCING at IWC: Howden ExVelTM eMVR Turbo Fans. Howden offers the broadest depth of experience in vapor compressors for MVR. Our turbo fans and centrifugal compressors backed by decades of experience from thousands of installations.

ChartWaterTM delivers proven and sustainable solutions from Chart Industries (Engineered Cryogenic Tanks for Liquid Gas Storage), BlueInGreen (Oxygenation, CO2 pH Control, Odor Control, Ozone Dissolution), AdEdge (Arsenic, Iron, Manganese, PFAS, Nitrates, Chrome, UPW), and Howden aeration blowers.

IDE Water Solutions NA

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IDE Water Technologies is a global leader in the design, development, and implementation of advanced water treatment and desalination solutions. With six decades of expertise, IDE specializes in providing sustainable, high-performance, high-recovery solutions for large-scale projects across various industries, including municipal water supply, industrial processes, and energy generation.

Johnson March Systems, Inc.

Booth #: 101

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We fabricate custom, skid-mounted systems. More than 1,000 projects across 50 countries.

•Chemical Feed Systems: bulk storage tanks and pumping skids for injecting chemicals
•Sampling Panel: sampling & analyzing water, steam, condensate, hydrocarbons
•General Service Pumps: large centrifugal pumps with suction & discharge piping, valves, instruments,
•Chlorination Systems: Chlorine Dioxide, Gaseous Chlorine, Electrolytic Chlorination

Justeq LLC

Booth #: 605

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Justeq07 is an oxidizing biocide unlike any other that produces bromine within slime. Justeq07 saves users money and is the best biocide for cleaning and maintaining cooling towers. Plus, much less Justeq07 is needed to maintain a system than any competitor product. Justeq07 is much less corrosive, is compatible with supplemental chemicals, has a shelf life of one year, and requires no additional equipment. Contact us today to learn more.

KAAM Group Co.

Booth #: 515

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KAAM Group provides complete water treatment solutions and bulk chemical delivery logistics. By combining technical expertise with reliable service, we help clients optimize plant performance and extend equipment life. Our integrated approach to chemical handling and treatment solutions ensures safe, efficient, and sustainable operations for the power generation industry.

Kurita America

Booth #: 507

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Kurita America helps our customers stay competitive by using our industry experience and expertise to combine chemical, equipment, engineering, and service into a customized, integrated solution. Focusing on transforming how water solutions are designed and delivered, we have a passion for creating imaginative solutions that conserve natural resources for a more sustainable world.

LANXESS Corp.

Booth #: 103/105

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LANXESS is a leading global ion exchange resin manufacturer and solution provider for water treatment and liquid purification. For more than 80 years our Lewatit® ion exchange resins and adsorbers have been used in numerous industries to treat and purify water and other liquid media. In addition, we offer a range of Bayoxide® iron oxide adsorbers for various water treatment applications.

Lexcru Water Tech Pvt Ltd

Booth #: 615

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LEXCRU WATER TECH (ISO certified company) one of India's fastest-growing names in the water purification industry. We're RO parts manufacturer — we're the people behind the parts that power reliable, high-performance RO systems across India, Europe, Africa and East Asia. What We Manufacture:
Booster Pumps | NSF-Certified Membranes | Inline Filters | Activated Carbon | RO Components | RO Systems - Domestic, Commercial & Industrial | Softeners | FRP Vessels.

LG Chem

Booth #: 612/614

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LG Water Solutions, a division of LG Chem, manufactures NanoH2O seawater and brackish water reverse osmosis (RO) membrane elements based on the breakthrough Thin-Film Nanocomposite (TFN) technology. TFN technology improves membrane performance by embedding benign nanomaterials on the membrane surface and increasing flux without compromising salt rejection.

LG NanoH2O BWRO membranes are engineered to lower OPEX through the intrinsic anti-fouling and durable membrane properties resulting in a lower total cost of plant ownership.

Lignetics

Booth #: 714

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Lignetics Group Inc. is dedicated to sustainability, producing 100% natural products by upcycling wood waste. Lignetics is a trusted industrial partner, providing sorbent pellets and other solidification products, wood flour, biopolymer additives, wood by-products and toll manufacturing services, in addition to producing consumer products in heating, cooking, animal bedding and cat litter. Lignetics boasts an annual pelleting production capacity of 2 million tons, upcycling over 5.2 billion pounds of wood residuals in 29 facilities nationwide.

MANN + HUMMEL Water & Fluid Solutions

Booth #: 405

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MANN+HUMMEL Water & Fluid Solutions is a global membrane manufacturer that delivers membrane and filter solutions to meet customers' water and process needs.

In business for more than 50 years, we offer the widest range of membrane products, including microfiltration, ultrafiltration, nanofiltration, and reverse osmosis in flat sheet, spiral-wound, and hollow-fiber configurations, as well as MBR technology for treatment of water and wastewater.

The company is headquartered in Wiesbaden, Germany with locations in the USA,

Marmon Industrial Water

Booth #: 200

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Marmon Industrial Water (a Berkshire Hathaway company), delivers full life cycle water treatment solutions that help industrial operations optimize water supply, maximize uptime and reduce costs. From mobile systems to engineered equipment and aftermarket services, we solve your toughest water challenges with over 80 years of proven experience.

METTLER TOLEDO

Booth #: 201

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Mettler-Toledo Process Analytics is a global leader in process and pure water monitoring instrumentation used in Power applications, offering systems for the measurement of Conductivity, pH, ORP, dissolved oxygen, Sodium, and Silica. Our products for power applications offer intuitive user interfaces with intelligent diagnostics, simplified maintenance, and low cost of ownership. METTLER TOLEDO's innovation continues with our new 2850Si Silica analyzer, a compact 3-in-1 analyzer with silica and phosphate measurement with an integrated multi-stream sequencer.

Monroe Environmental Corp.

Booth #: 211

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Monroe Environmental designs and manufactures environmental products for water and wastewater treatment and air pollution control. Our systems include circular clarifiers and thickeners, lamella plate clarifiers, API oil/water separators, mobile clarifiers (rentals), air strippers, wet scrubbers, mist/dust collectors, WESPs, carbon adsorbers, and quench towers.

MPW

Booth #: 100

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MPW Industrial Services offers a variety of Industrial Cleaning, Industrial Air, Water Treatment, and Facility and Environmental Services to thousands of clients throughout North America.
MPW has one of the largest fleets of mobile water equipment in North America. Process technologies include demineralization/deionization, reverse osmosis, media filtration, ultrafiltration and clarification. MPW's mobile systems are designed to accommodate challenging water supply conditions and meet the most demanding produced water purity levels.

Newterra

Booth #: 506

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Newterra designs, engineers, manufactures, and services environmental, water and wastewater treatment solutions that assure great performance, superb reliability, and the highest value to renew precious ecosystems. Newterra offers a broad portfolio of reliable, trouble-free technologies and outsourcing support for global municipal and industrial customers across diverse applications, including drinking water, industrial process water, wastewater, stormwater and remediation.

Nuvoda

Booth #: 712

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Nuvoda™ is a team of passionate engineers driving innovation in sustainable, plastic-free biotechnologies that are redefining intensification of wastewater treatment. Our focus is on engineering, developing, and delivering state-of-the-art mobile biofilm technologies (MOB Process) that unlock new possibilities for process intensification.

Nuvoda delivers practical and proven solutions that help municipalities and industries achieve more with less. Our MOB Process enables increased treatment capacity, improved effluent quality, and lower operating costs—all without costly infrastructure expansion.

OLI Systems

Booth #: 504

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OLI Systems specializes in water chemistry simulation solutions for industries including chemical processing, oil and gas, energy and water treatment. Our solutions help engineers and scientists predict and optimize chemical processes by simulating complex chemistry. OLI Systems' tools assist in designing and troubleshooting processes, improving efficiency and reducing environmental impact.

Organo Corporation

Booth #: 415

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Organo Corporation is a global comprehensive water treatment engineering company founded in 1941. We provide advanced pure and ultrapure water systems, wastewater treatment solutions, and proprietary water treatment devices for a wide range of industries such as electronics, power, and pharmaceuticals. With over 70 years of tireless dedication to water, Organo will serve as a valuable partner company to the industries that create the future.

Parkson Corporation

Booth #: 305

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Parkson is a leading provider of equipment and advanced solutions in water and wastewater treatment. We design, engineer and assemble products with advanced screening, aeration, biological, clarification, filtration, ENR, pumping, and biosolids thickening solutions for both municipal and industrial applications. We have a highly trained field service and aftermarket team capable of completely rebuilding aging equipment or retrofitting equipment to include the latest technological advancements. In addition, our Water Research Facility can provide laboratory analysis.

Pureflow Filtration & Ozone Divisions

Booth #: 710

Contact: Don Pollard

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Founded in 1973, Pureflow Filtration Division is an original equipment manufacturer specializing in advanced water treatment systems for municipal and industrial applications. Our comprehensive portfolio of technologies includes:

- Ultrafiltration
- Coagulation/Oxidation Filtration
- Ion Exchange
- Biological Filtration
- Adsorptive Media Filtration
- Ozone Generation
- Advanced Oxidation (UV-Peroxide / UV-Ozone)

Quantrol Inc.

Booth #: 214

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Stocking Distributor / Manufacturers Sales Representative of water treatment equipment. Quantrol represents equipment manufacturers with high quality product standards, including Advantage Controls, Myron L, Stenner, Seko, OBL, Pyxis, J.L. Wingert, Carlon Meter, Peabody Engineering as well as our own line, Quantrol Filtration Products.

ResinTech, Inc.

Booth #: 401

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Website: www.resintech.com

Manufacturer/supplier of ion exchange resins, activated carbon, and selective media for water and wastewater applications. Selective medias are available for removal of nitrate, arsenic, organics, heavy metals, chlorine, and ammonia. Standard line includes resin for softening and deionization. The Aries equipment line includes filter cartridges filled with carbon, resin, or custom blends. Automatic laboratory DI water systems are available for low flow rate high purity water production.

Saltworks Technologies

Booth #: 512

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Saltworks delivers intelligent, truly modular systems for industrial desalination and lithium refining. Our off-site constructed, standardized plants are robust, fully digitized packages that lower total installed costs and accelerate deployment. We deliver solutions to global blue-chip clients across semiconductors, data centers, automotive, energy, and more. Our technologies enable selective contaminant removal, ultra-high water recovery, MLD and ZLD, and help recycle water and valuable materials while lowering operating costs.

SAMCO Technologies

Booth #: 601

Contact: Robert Bellitto

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E-mail: sales@samcotech.com

Website: www.samcotech.com

Custom module skid mounted water, waste and process separation systems. Pack Bed high efficiency demineralizers, reuse, condensate and brine conditioning. Biological and waste water filtration. Membrane processes and high efficiency reverse osmosis, UF and MF systems.

Stantec

Booth #: 104

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Stantec is a global engineering and consulting firm as well as the world’s largest international wastewater consultancy according to the most recent engineering Engineering News-Record (ENR) rankings. Our team provides multi-discipline engineering, design, and regulatory compliance services to a wide variety of industries including Power, Micro-Electronics, Mining, Food and Beverage, Oil & Gas, and manufacturing.

Swan Analytical USA

Booth #: 700

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At Swan Analytical Instruments, we develop and manufacture highly precise water analysis instruments that reliably detect even the smallest amounts of undesirable contaminants. Our instruments help our customers identify and efficiently remove contaminants at an early stage. In doing so, we protect valuable equipment and contribute to the sustainable optimization of industrial processes.

THERMAX Inc.

Booth #: 604

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Thermax is an engineering company that helps business enterprises perform competitively and sustainable in global markets. The Chemical business offers synergy to the entire spectrum of Thermax's energy and environment businesses. Thermax Chemical portfol

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Toray Membrane USA

Booth #: 701/703

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Toray Membrane USA, Inc. manufactures membrane elements for various membrane technologies (RO, NF, UF, MF, MBR). Toray offers membrane configurations in spiral-wound, hollow-fiber, and flat sheet or plate and frame membrane bioreactor units used in many industries, namely water, wastewater, pharma, dairy, and food and beverage processing.

UCC Environmental

Booth #: 704

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UCC Environmental (UCC) is a global leader in environmental solutions for solids handling, wastewater treatment and pollution control technologies. Since 1920, UCC has been committed to the design, supply, construction, and maintenance of world class systems precisely engineered to better serve utility and heavy industry providers.

UET Water - Universal Environmental Technologies Inc.

Booth #: 706

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UET Water is a USA-based designer and manufacturer of advanced water treatment systems with a team that has over 35 years of expertise. We specialize in custom reverse osmosis (RO), desalination, ultra-high-pressure RO, high-recovery, Mobile packages, and low-energy membrane solutions. Our portfolio also includes wastewater reuse, MLD/ZLD, ultrafiltration, and ceramic UF. UET builds flexible, private-label skids and turnkey systems for EPCs, contractors, and resellers, delivering proven performance, competitive packages, rapid engineering, and full lifecycle support.

Univar Solutions

Booth #: 702

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Univar Solutions brings the world of chemicals to your doorstep. With more than 25 years of industry experience, our broad portfolio of solutions for water treatment includes pH adjusters, enzymes, flocculants, coagulants, dechlorinators, and disinfectant

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Veolia

Booth #: 500

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Veolia Water Technologies is the world leader in water and wastewater treatment. Veolia combines years of experience and expertise with innovation to offer technological solutions. Projects vary in size and complexity, from advanced projects to engineering and equipment procurement, to service and chemical contracts. When designing solutions, the focus is always on specific customer goals, which may include low operating costs, water conservation, optimized design for existing footprints or the recovery of valuable resources.

V-Systems / Infrastructure Dynamics

Booth #: 511/513

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V-Systems, based in Pittsburgh, PA, is a leading distributor of commercial, industrial, and municipal equipment, including boilers, pumps, water and wastewater treatment systems, fire protection, utility vehicles, as well as skid-mounted prefabricated solutions. Partnering with top manufacturers, we deliver reliable, high-performance products that keep critical operations running efficiently. With deep technical expertise and a commitment to service, V-Systems provides end-to-end support, from engineering assistance to commissioning, ensuring dependable, long-term results for every customer and project.

Water Purification Supplies

Booth #: 310

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Water Purification Supplies is leader in providing complete line of professional water treatment systems and components of the highest quality at competitive prices.
In business for more than 20 years, we are committed to keep large inventory in Florida-USA, so we can deliver on the same day.

WaterTectonics

Booth #: 510

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WaterTectonics delivers integrated water treatment solutions through turnkey design, equipment, and service packages. We develop systems for TSS, metals, pH, oils, bacteria, PFAS, and more. Our offerings include treatability, engineering, packaged systems, rentals, installation & training, and parts & service programs. We serve customers in construction, industrial stormwater, remediation & cleanup, process water, mining, oil & gas, and water/wastewater markets.

Watson-Marlow Fluid Technology Solutions

Booth #: 112

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Since 1956, we have been making some of the most innovative fluid management solutions in the world. Thousands of companies employ our technologies to manage processes and manufacture products that touch the lives of people every day.
We have helped thousands of process and maintenance engineers on every continent to solve their fluid management challenges.
We partner with you, providing access to a global network of industrial engineers and supplying more than our proven technologies.

WesTech Engineering, LLC

Booth #: 600/602

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WesTech Engineering is an ISO 9001-certified Swire Water company with half a century of experience renewing water resources to help communities thrive. We provide liquid-solids separation solutions for municipal and industrial process applications – including treatment for surface waters, drinking water, groundwater, wastewater, and industrial process water. From mobile-equipment and temporary treatment systems to full plant ownership and operations, and responsive aftermarket services, our proven solutions will meet your specific needs while maximizing your plant.

Wigen Water Technologies

Booth #: 411/413

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Wigen Water Technologies is a leading manufacturer of water treatment systems for industrial, municipal and water reuse applications. We manufacture the complete range of membrane systems from MF/UF to NF/RO. We also manufacture ion exchange, pressure filter, EDI and GAC systems enabling us to provide fully integrated high purity water treatment solutions.

WSP

Booth #: 400

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WSP is a world-leading engineering and professional services consulting firm. We leverage our global scale and local expertise to deliver remarkable projects that bring positive change. We inspire, guide, and collaborate with our clients across over 100 sectors and 180 services. No matter the challenge, our teams envision future possibilities and bring them to life through technical know-how and innovation.

Xylem

Booth #: 611/613

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Xylem innovates and collaborates with utilities, industrial manufacturers, building operators, and communities, to protect and optimize water. We are committed to driving sustainable impact by ensuring our connected technologies and solutions support our customers and the communities they serve, to tackle the water challenges that matter most to them. From innovative, leading-edge research to proven solutions on the ground we can provide total water management for customers throughout the industrial and municipal landscape.

ZwitterCo

Booth #: 606

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ZwitterCo is the global leader in membrane solutions for challenging separations, helping industries treat complex wastewater, purify water for reuse, and maximize efficiency in food processing applications. The company leverages its breakthrough zwitterionic chemistry to build membranes with unprecedented fouling resistance, overcoming the longest-standing limitation with conventional filtration. Manufacturers in more than 20 countries across food and beverage, agricultural, and industrial sectors rely on ZwitterCo's membranes to achieve their most ambitious sustainability & growth targets.
