Monday, 11/4/2024; 8:00 AM

M1: Cooling Water: Less Water, Better Chemistry

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

Session Chair: Horace Gordon V, Bechtel Power Corporation, Reston, VA

Discussion Leader: Jillian Flanagan, P.Eng., Stantec, Halifax, Nova Scotia, Canada

Cooling water makes up a substantial amount of plant water use regardless of the industry and maintaining proper water chemistry is an important factor in ensuring equipment longevity and proper performance. This session explores two case studies on how cooling water was recovered to decrease overall plant water use. Additionally, the peracetic acid method of disinfection chemistry control with a novel method to monitor its effectiveness is discussed.

IWC 24-01: Southern California Data Center

Time: 8:10 AM

Nasser AlSultan, Geosyntec Consultants, Costa Mesa, CA ; Hamid Amini, Geosyntec Consultants, Costa Mesa, CA

Data centers need cooling tower systems to control the temperature in their server rooms. Water is used in cooling towers to reduce the temperature of the air via convection, i.e., contact water. To the extent feasible, a facility would recirculate the contact water in the cooling tower system to reduce its water footprint. Through the convection process, however, a portion of the contact water is lost due to drift and evaporation. Furthermore, after some cycles of recirculation (referred to as “cycles of concentration”), a portion of the contact water gets too concentrated with minerals and/or biological matter and must then be discarded as blowdown water. In essence, a data center will incorporate onsite cooling towers to manage the heat emitted by its computer systems, and these cooling towers need makeup water to manage the quality of the contact water.
Geosyntec Consultants, Inc. (Geosyntec) is assisting a confidential data center client with managing optimal water usage at their facility in Southern California. The local ordinance mandates use of purple pipe recycled water for cooling tower systems, unless proven infeasible. The scope for this specific process is to optimize water usage/recirculation cycle to (a) reduce the water footprint, (b) reduce short-term CAPEX and long-term OPEX costs, and (c) maximize the operational lifetime of the cooling tower system. Geosyntec is evaluating the potential impacts of using various water sources, including potable water, purple-pipe recycled water, facility-treated recycled water, and blended water, on the operational performance and maintenance demands of the cooling tower system.
Geosyntec is conducting a sensitivity analysis to evaluate the CAPEX and OPEX costs over variable Return of Investment (ROI) periods when using the various water sources. In this analysis Geosyntec is taking into account the water and potential impacts on the efficiency and longevity of the cooling equipment. The optimal use of potable and/or recycled water for the facility’s cooling tower system is being evaluated using water quality and cost-benefit analysis. The presentation will include the process of our water quality analysis and findings from the sensitivity analysis.

Discusser: Ryan Vargas, EAI Water, Livermore, CA

IWC 24-02: 95% Recovery treatment of Cooling Tower Blowdown in the automotive industry

Time: 9:00 AM

Tal Fabian, IDE Water Technologies, Kadima, Israel; Alex Drak, IDE Water Technologies, Kadima, Israel; Roi Zaken, IDE Water Technologies, Kadima, Israel

Due to water shortages, increasing regulations and related effluent discharge and makeup water costs, industrial facilities are required to manage their net water consumption in the most efficient way. In many cases, the major water consumer in an industrial facility are the cooling towers, which also produce the majority of wastewater as cooling tower blowdown (CTBD).
During the cooling process, the water is significantly concentrated inside the cooling towers (CT), resulting in effluents characterized by high scaling potential caused by Silica, Gypsum, Hardness and Alkalinity, as well as high biofouling potential resulting from the open nature of the cooling towers.
The straight-forward way for industrial facilities to save water is to efficiently treat the CTBD and reuse this in the cooling towers as makeup water. However, due to the challenging water composition of the CTBD, conventional membrane technologies are limited in achieving high water recovery.

An innovative high recovery membrane-based technology was developed by to achieve high recovery of CTBD, and reuse most of this as makeup, thus reducing the Operating Expenditure (OPEX) associated with cooling towers in a process plant.
The technology contains a single stage reverse osmosis system, with an integrated salt precipitation unit. This technology operates by recirculating the CTBD through an RO system, followed by a fluidized bed reactor (FBR) in which controlled precipitation of supersaturated sparingly soluble salts is performed. The paper will describe in detail the complex water chemistry considerations and the mechanism which minimizes chemical consumption.

This paper presents a detailed case study of a 775m3/day (150 GPM) MaxH2O Desalter commercial unit in an industrial facility in the automotive industry, which is designed to achieve above 95% recovery of the CTBD. The system will be operational in Q2 2024.
With conventional technologies, scaling of the membranes would have limited recovery to ~55-60%. At 95% recovery, the theoretical saturation indices (SI) reach LogSI ~3.2 and SiO2 SI ~ 1400%. Achieving such high recovery under the above conditions greatly assist in achieving the zero liquid discharge (ZLD) target by the facility.

Discusser: Victoria Oveson, DuPont Water Solutions, Edina, MN

IWC 24-03: Monitoring and Control of Peracetic Acid in Cooling Water Disinfection Applications

Time: 9:50 AM

Vadim Malkov, Hach, Loveland, CO ; Scott Tucker, Hach, Loveland, CO

Peracetic acid (PAA) is a strong versatile oxidant effective against a wide range of microorganisms; it is a good alternative to traditional water disinfectants. It is also effective in the presence of organic matter, making it a valuable tool for water disinfection. PAA is used in a variety of water disinfection applications, including drinking water treatment, wastewater effluent, in food processing and beverage production, and for cooling water systems to prevent biofouling and corrosion. From a water quality standpoint, cooling water disinfection may be the most representative among all applications for PAA monitoring and control.
PAA is generated in-situ by mixing acetic acid and hydrogen peroxide using a strong acid catalyst. Quantitative analysis of PAA residual is usually conducted with either amperometric or colorimetric methods and may present a challenge due to the varying ratio between hydrogen peroxide and PAA in the chemical feed.
A study conducted at a power plant encompassed monitoring of cooling water disinfected with PAA. The water treatment company feeds a small amount of bleach into the raw water for pre-oxidation of bulk water subsequently used in the cooling towers. Further, the bulk and makeup waters are disinfected with PAA to maintain the residual around 0.2 mg/L. Free chlorine residual normally stays below 0.1 mg/L before PAA is added, and all disinfectant concentrations are routinely measured with handheld analyzers using standard DPD methods for free chlorine, total chlorine, and PAA. The water treater was very interested in monitoring PAA online to optimize their process, therefore decided to measure total residual oxidant (TRO) since there was a mix of disinfectants in the water. The Hach CL17sc instrument using total chlorine (TC) DPD reagents and effectively measuring TRO in this application was utilized. The expected difference between PAA and TRO readings reflects the difference in molecular weight of chlorine (71) and PAA (76) which results in a standard multiplier (1.07). The matrix impact may influence this coefficient and should also be considered.
The recorded trends confirmed a correlation between the parameters and the value of process analysis vs. the grab sample technique. Experiments validating the sensitivity of the process analyzer, a comparison of the ORP readings (used for process control at the time) and the TC/TRO concentration vs. PAA pump feed rate were conducted. The test results and data analysis demonstrated the benefits of continuously monitoring TRO, reflecting the PAA concentration in cooling water.

Discusser: Patrick Regan, Solenis, Wayne, PA

Monday, 11/4/2024; 8:00 AM

M2: Going All in on Ion Exchange

IWC Rep: John Korpiel, P.E., Veolia WT, Wexford, PA

Session Chair: Rebecca Osteen, Southern Company,

Discussion Leader: Stephen Wheeler, ResinTech Inc., Camden, NJ

Join us for an exciting technical discussion on the applications of ion exchange to address water treatment challenges and to recover valuable resources. We will explore the use of ion exchange for cost-effective treatment of PFAS as well as for enhancing the circular economy through the resource recovery of valuable metals. Whether you have years of experience with ion exchange or are new to the game, this session offers a valuable opportunity to deepen your technical expertise, ask questions, and be part of an engaging and dynamic conversation.

IWC 24-04: RSSCT & RO/NF Testing on Treatment of PFAS Contaminated Groundwater & Implications to Full-Scale System Design

Time: 8:10 AM

Elaine Towe, P.Eng., Veolia Water Technologies & Solutions, Oakville, ON Canada; Sergiy Popov, Ph.D, Veolia Water Technologies & Solutions, Ashland, Virginia; Chris Scott, Veolia Water Technologies & Solutions, Trevose, PA

PFAS Regulations are continuing to evolve as increasingly comprehensive and restrictive. Accordingly, the treatment challenge is becoming more demanding, which requires robust treatment solutions that minimizes the total cost of ownership (TCO).

A component of meeting these demands often involves the execution of bench and/or pilot-scale results and applying these results to full-scale design in an expedited fashion but with dependable results.

This paper summarizes a series of bench-scale testing performed on PFAS contaminated groundwater. This includes Rapid Scale Small Column Testing (RSSCT) as well as testing with reverse osmosis (RO) and nanofiltration (NF) membranes. In addition to this testing of the groundwater, a secondary RSSCT study was performed on the RO concentrated groundwater. The overall study tested a total of five different media, included granular activated carbon (GAC), ion exchange (IX), and novel adsorbents. As well, five different high-pressure membranes (a combination or RO and NF membranes) were tested.

In our IWC series on PFAS, we have shared our experiences in the design, build, startup, and operation of large scale PFAS treatment systems. This paper is intended to focus on an example of bench-scale testing – the setup utilized, the PFAS treatment results obtained, and conclusions. It also includes the critical next step of how to use these results to assist with technology selection and how to apply these results to full-scale design. These discussions also include recognizing the inherent limitations of bench-scale testing and how to address them with the scale-up design process.

We hope the reader may be assisted by what we have learned.

Discusser: Tal Fabian, IDE Technologies, Kadima, Israel

IWC 24-05: Urban Mining: the Application of Exchange Resins

Time: 9:00 AM

Johanna van Deventer, Ecolab, Fontainebleau, South Africa; Don Downey, Ecolab, Paris, ON, Canada

Urban mining is defined as the process of recovering and re-using the waste produced by a city. Such waste includes a wide range of materials, from paper and plastic to electronics and spent batteries.
The increase in use of electric vehicles (EV's) will result in vast quantities of spent EV batteries. Recycling of the metals contained in these batteries is essential, both to minimise the environmental footprint of the EV industry and to ensure continued availability of the world's finite metal resources. Hydrometallurgical processing of spent batteries involves the separation of the outer plastic and aluminium sheeting from the black mass, followed by leaching of the black mass to solubilise the valuable metals, such as nickel, cobalt and manganese. Further separation and purification are required to produce high purity salts that is re-used to produce batteries.
The superior selectivity of ion exchange resins makes them exceptionally suitable for the removal of low concentrations of the target impurities, from a background of high concentrations of the valuable metal. Target impurities include copper, zinc, calcium, nickel, and cobalt. This paper discusses these applications in more detail.

Discusser: Zhendong Liu, LANXESS Corporation, Birmingham, NJ

IWC 24-06: Reducing the Life Cycle Costs of PFAS Water Treatment Through the Regeneration of Ion Exchange Resins

Time: 9:50 AM

Steven Becker, SciDev Ltd, Houston, TX

Granular activated carbon (GAC) and ion exchange (IX) resin adsorption systems are the two most prevalent technologies for treating PFAS in water and wastewater streams. Compared to GAC, PFAS-specific IX resins have a greater overall capacity and better adsorption of short-chain PFAS, although they may require more pretreatment to address co-contaminants or water quality parameters than comparable GAC systems. Capital costs of the two types of systems can be comparable, while the higher PFAS capacity, smaller volumes of media required, and reduced waste stream volumes offset the higher cost of the media and result in lower long term operational costs. The ability to regenerate and reuse IX resins can further reduce the long-term operational costs of PFAS treatment in groundwater and wastewater. This presentation will present case studies from wastewater systems in Australia as well as a comparative life cycle cost analysis performed on a 1,200 gpm PFAS water treatment system in the southwestern U.S.

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

Monday, 11/4/2024; 8:00 AM

M3: Power Wastewater Management in (Still) Changing Times

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

Session Chair: Krystal Perez, Brown and Caldwell, Seattle, WA

Discussion Leader: Rangesh Srinivasan, TetraTech, Cincinnati, OH

The power industry continues to be met with change. The most recent change is the newly finalized Steam-Electric Power Effluent Limitation Guidelines, which will require zero liquid discharge of flue gas desulfurization (FGD) wastewater, bottom ash transport water and combustion residual leachate for power plants that burn coal past 2034. Those plants that choose to instead retire or convert to another fuel will still be met with challenges. This session will dig into the details and share important insights in the management and treatment of power plant wastewaters that can support plants during these times of change. We'll hear about important considerations and trade-offs in management of flue gas desulfurization scrubber wastewater on biological treatment. Next, we'll learn about challenges related to selenium speciation and removal and how to optimize treatment. Finally, we'll dive into the details of managing power plant wastewater as plants work through converting from coal to natural gas fuel.

IWC 24-07: FGD Forced Oxidation Air System Operational Impacts On Biological Wastewater Selenium Removal Systems

Time: 8:10 AM

Adam Raker, Louisville Gas and Electric, Lagrange, KY

KEYWORDS: selenium, WFGD, biological, wastewater, oxidants, ORP
To meet EPA Effluent Limit Guidelines, many utilities have chosen to adopt one of two main treatment options. While there are several options available, the two most prevalent are ZLD and Physical/Chemical/Biological systems. The latter will be the subject of this discussion as it relates to WFGD operation, identifying issues and shifting operation paradigms.
With the drive to minimize stack SO2 emissions and produce high quality gypsum, the scrubbers and more importantly the oxidation air systems were design to that effect with little to no concern for excess oxidation air and its impacts on scrubber chemistry.
Entering into the ELG era with its increasingly tighter compliance limits, this coal fired utility opted for a scrubber waste water treatment system installed in two phases. A 750 gpm chemical/physical system was incorporated in phase 1 and had been commercially active for 4 years before beginning phase 2 to build and commission a bioreactor system for nitrate and selenium removal. Approximately 2 years of FGD and phys/chem operational data was collected and provided to aid in the design and setting performance expectations.
After a successful bioreactor seeding and acclimation period, performance testing began and proceeded for about 2 weeks. Once one of the two coal units returned to operation following a 4-week maintenance outage, the plant began to notice massive biomass failure in the biological system within 24 hours. This prompted a deep dive into the scrubber operations on both units and ultimately determined that TC1 was producing hypochlorites, persulfates, and sulfate radicals. Hypochlorites were found to be >1,000 ppm and persulfates tested up to 3,000 ppm. Scrubber liquor ORP readings were ranging from 550 – 800 mV and oxidation air flows were running ~60% higher than stoichiometric requirements. Once the source of the problem was identified the task of reacting to the current conditions and ultimately correcting the operational causes began.
This paper will discuss the findings and the corrective actions both in the short term and long term as well as local control of the scrubber chemistry and mitigation strategies prior to the bioreactors.

Discusser: Kenneth Chen, P.E., Brown and Caldwell, Las Vegas, NV

IWC 24-08: Selenium Removal with Ferric and Ferrous Iron in Physical-Chemical and Oxidation Reactions

Time: 9:00 AM

Ashley Jones, Stantec, Nashville, TN ; Mayra Giraldo, Stantec, Atlanta, GA; Adam Sutherland, P.E., Stantec, Nashville, TN; Bill Kennedy, Stantec, Charlotte, NC

Wastewaters from oil refineries, mining operations, and power plants face treatment challenges when complex species, such as reduced forms, of selenium are present. Various selenium treatment processes for these wastewaters have been developed to meet regulatory requirements set by the United States Environmental Protection Agency (EPA). Namely, biological reduction has been identified as the Best Available Technology Economically Achievable (BAT) for coal-fired power plants. Biological selenium reduction effectively removes selenite (Se(IV)) and selenate (Se(VI)) but becomes a less effective treatment for wastewaters containing reduced selenium species such as selenocyanate (SeCN) and selenosulfate (SeSO3). Removal of reduced forms of selenium will increase subsequent treatability of the wastewater and overall removal of selenium.
Two reaction methods, physical-chemical treatment via the iron oxyhydroxide process and oxidation treatment via Fenton's reaction, were tested in jars using Flue Gas Desulfurization (FGD) wastewater. Ferrous chloride (FeCl2) and ferric chloride (FeCl3) were both used as co-precipitants in physical-chemical treatment and oxidation treatment to test for removal of reduced selenium species. Jar tests identified differences in removal due to adjustments in chemical addition and pH. This paper compares the efficacies of reduced selenium removal for each reaction method and form of iron.

Discusser: Lisha Wu, Ph.D., HDR, Rosemont, IL

IWC 24-09: Water Challenges with Power Plant Conversion from Coal to Gas

Time: 9:50 AM

Kristen Jenkins, P.E., Kiewit, Lenexa, KS ; Allison Osborne, Brown and Caldwell, Houston, TX; Kelly Moody, Brown and Caldwell, Atlanta, GA

With energy transition drivers related to carbon dioxide emissions, many coal plants are converting to natural gas. The transition is challenging for coal plants from both a water permitting and water management perspective. Existing federal Effluent Limitation Guidelines (ELGs) required that bottom ash transport water (BATW) not be discharged. In addition, many coal fired plants have ceased discharge of Flue Gas Desulfurization (FGD) wastewater either because of the additional time that the ELG provided for implementation or driven by water quality-based effluent limits. Some plants recycle BATW in the FGD scrubber to allow for subsequent discharge. When the coal fired operations are discontinued, existing tankage and process units will contain BATW, FGD, and other wastewater that is no longer used for those operations and must be disposed of. The current coal-based process has evaporative losses of these wastestreams associated with heat generation heat which allows much of the water to be evaporated. Once the coal process is shut down, FGD and bottom ash operations will also cease, and the water associated with these activities will no longer be needed or consumed. Therefore, these waste streams must be managed by alternate means. Alternative management options can include treatment for direct or indirect discharge on a temporary basis, evaporation , hauling, and/or solidification. Discharging bottom ash handling water and FGD wastewater are especially challenging from a permitting perspective based on the current ELG, water quality standards, as well as anti-backsliding, especially if the facility currently does not discharge these streams. The ELG does not contain an option for resuming or temporarily discharging these streams after compliance with zero discharge has been attained. This paper will cover management and permitting options for bottom ash and FGD wastewaters, and identify challenges with each option.

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

Monday, 11/4/2024; 8:00 AM

M4: Water Treatment Project Delivery: Create a Gameplan for Success

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

Session Chair: Nicole Stafford, McKim & Creed, Pittsburgh, PA

Discussion Leader: Brian Stater, Bowen Engineering, Noblesville, IN

Efficient project delivery is key to making great engineering design projects come to life. This session will discuss the challenges and successes during the construction of water treatment plant upgrades at a pharmaceutical manufacturing facility, the accelerated delivery of a corrosion inhibitor program for a large water utility, and the importance of developing a trusting relationship between OEMs and prospective buyers for effective procurement and installation of equipment in the water/wastewater world.

IWC 24-10: Production expansion and changing discharge limits at Grifols Therapeutics, North Carolina, USA calls for wastewater treatment plant upgrades

Time: 8:10 AM

Aleah Henry, Veolia Water & Technologies Solutions, Oakville, ON Canada; David Auge, Grifols Therapeutics, NC; Brian Arntsen, Veolia Water & Technologies Solutions, Oakville, ON, Canada; Ryan Johnston, Veolia Water & Technologies Solutions, NJ

Grifols Therapeutics is a global healthcare company working towards improving health through development of medicines, diagnostic systems and hospital pharmacy products. Their state-of-the-art manufacturing facility in Clayton, North Carolina produces a variety of life saving plasma-derived medicines and other biopharmaceutical solutions used to treat both rare and chronic diseases in patients around the world.

The Clayton facility discharges wastewater to an on-site treatment plant. This treatment process initially consisted of a MBBR/DAF plant built in 2009. The plant's Industrial User Pretreatment Permit (IUP) for discharge in 2017 required effluent concentrations to meet BOD <800 mg/L, COD <1,500 mg/L, TSS <1,200 mg/L, TN <80 mg/L and TP <12 mg/L and had a maximum daily flow of 1.1 MGD. With plans to increase production capacity resulting in up to 2 MGD of wastewater, a new IUP was required, which would impose new discharge limits with a potential future TDS limit. As the new IUP limits are significantly more stringent (requiring effluent concentrations to meet BOD <125 mg/L, COD <250 mg/L, TSS < 80mg/L, TN <15 mg/L and TP <4 mg/L), the existing process would no longer provide an adequate level of treatment.

In 2021, Grifols embarked on a journey to upgrade their wastewater treatment facility to meet the more stringent effluent requirements and establish an operations and maintenance contract to guarantee long term performance. Veolia Water Technologies & Solutions proposed a MBR treatment system to ensure that consistent high rates of COD and TSS removal could be maintained and allow potential future expansion for treatment systems to meet TDS discharge limits.

Plant upgrades include pre-treatment screening, refurbishment of existing MBBRs (new media, screens and blowers), that act as an initial organic loading removal system, before going into the MBR system (anoxic and aerobic reactors followed by hollow fiber UF membranes) that will do further biological treatment to reach the discharge requirements. The scope also included a sludge storage and thickening system. Due to low influent wastewater nutrient content, Urea and Phosphoric Acid dosing skids were also included along with online remote biohealth monitoring. The plant was commissioned in the spring of 2023.

This paper will present key information related to the design of treatment process upgrades, overcoming design and commissioning challenges, start-up and performance of over a year of successful operation. Data, both biological and membrane, will be presented and discussed.

Discusser: Linea Miller, E.I.T., WSP, Cambridge, ON, Canada

IWC 24-11: Time and Money Saved with Collaborative Fast-Track Delivery on a Regulatory Driven Utility Scale New Corrosion Inhibitor Program

Time: 9:00 AM

Michael Soller, P.E., DBIA, Bowen Engineering, Indianapolis, IN ; Breann Cooper, Citizens Energy Group, Indianapolis, IN; Bruce L. Cooley, P.E., Bcee, Citizens Energy Group, Indianapolis, IN; Rebecca Slabaugh, P.E., Arcadis, Indianapolis, IN; Kevin Canida, Bowen Engineering, Indianapolis, IN

Water system owners need to assure their customers receive drinking water that complies with national water quality standards. Water systems in cities dating back centuries must assure the piping systems have corrosion protection to avoid leaching lead and copper into the water supply. A large water utility serving more than 1 million customers implemented a corrosion inhibitor program that was time sensitive for regulatory compliance, while simultaneously confirming which chemical provided demonstrated protection against corrosion for their regionally specific water sources. The owner describes the system background, number of potential customers affected by the need for corrosion protection and why the design-assist method of project delivery was chosen. The engineer describes what alternative chemicals were evaluated and the pilot testing results leading to the selection of a specific chemical and target dose. The contractor provides a detailed description of the fast-track delivery of three projects simultaneously within the program to achieve the business goals. Specifically, the procurement, design and construction innovations, schedule results, and operator involvement are described. Readers of this paper will understand how the collaborative nature of this program resulted in on-time, under budget delivery of these important compliance projects.

Discusser: Samantha Sheehan, McKim & Creed, Sewickley, PA

IWC 24-12: Getting the most from engaging your Water Treatment OEM

Time: 9:50 AM

Jay Harwood, Newterra, Scotland, Ontario Canada; Anthony Amendola, P.Eng., Newterra, Brockville, Ontario, Canada

Engaging water and wastewater equipment providers for estimates and proposals presents significant challenges that require a strategic approach. Original Equipment Manufacturers (OEMs), the firms responsible for designing and manufacturing treatment systems, operate with business models that necessitate careful management of resources and risk. OEM business models generally require them to spend their own overhead to develop and secure new business contracts which limits the time and effort they can spend supporting potential customers.
As demand in the industry intensifies and resources become scarcer, the pressures on OEMs to manage their efforts amplify.

This paper delves into the intricate dynamics between OEMs and prospective buyers, highlighting the inherent tension between the need for information exchange and the imperative to manage costs. Trust serves as the linchpin in this relationship, with both parties relying on each other to fulfill their respective needs: the buyer seeking a reliable solution, and the OEM seeking business opportunities. Achieving this delicate balance requires a nuanced understanding of the motivations and constraints on both sides.

Drawing on industry insights and experiences, this paper offers practical strategies for maximizing the value of engagements with OEMs and facilitating successful contracting. By diving into the insights of OEMs and providing actionable guidance for buyers, this paper aims to enable stakeholders to navigate the complexities of procurement in the water and wastewater sector effectively.

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

IWC M4 Reserve: Rebuilding a 19th Century Aqueduct While Maintaining 120 MGD of Flow Capacity

Time:

Kevin Canida, Bowen Engineering, Indianapolis, IN ; Paul Johnson, P.E., Citizens Energy Group, Indianapolis, IN; David Steiner, P.E., CMID, Indianapolis, IN; Jay Gibson, P.E., CHA Solutions, Indianapolis, IN; Michael Soller, P.E., DBIA, Bowen Engineering, Indianapolis, IN

The Central Canal Aqueduct, originally constructed in 1839 as part of the Central Canal system, has the capacity to supply 120 million gallons a day of water over Fall Creek to a primary water treatment plant, northwest of downtown Indianapolis, Indiana. The current structure has been in service since 1906 after being reconstructed five times between 1839 and 1906 due to floods and other disasters. In 2022, the Public Trust Water Utility undertook a project to repair and rehabilitate the 100-plus year old structure to extend the useful life of this single source critical infrastructure. This paper describes the progressive design and construction best practices the utility used to develop a functional design and how the final design was significantly different than originally envisioned. The engineer describes how the original rehabilitation concept was developed and why it was initially recommended. The Owner describes in significant detail the changes in the design and why the updated design improved the utilities immediate and long-term resiliency goals. The owner also describes the challenges and innovative solutions used to navigate permitting, and rehabilitation of the historic structure, while simultaneously assuring an uninterrupted supply of water to the city. The reader will understand how the contractor, owner, and designer team evaluated and implemented the constructed alternative. The contractor describes the cost trending and predictive schedules for three design solutions. The result is a description of the final design, construction, and commissioning of this phased project and how the goals for resiliency and future maintainability of this crucial water supply structure were met for the benefit of customers.

Discusser: n/a

Monday, 11/4/2024; 1:30 PM

M5: Next-Gen Water Treatment: Unlocking Lithium's Full Potential

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

Session Chair: Denney Eames, WaterTectonics, Everett, WA

Discussion Leader: Rena Bae, P.E., Stantec, Charlotte, NC

This session explores innovative water treatment technologies in lithium extraction and purification, with a focus on sustainable practices and technological advancements. Key topics include the role of lithium nanofiltration technology, energy reduction strategies from lithium brine mining, and addressing water issues in lithium battery production. Additionally, the session will cover novel techniques for extracting lithium from geothermal brines, including the use of thermally stable inorganic ion exchangers and advanced well stimulation methods.

IWC 24-13: Lithium extraction and purification schemes from brine streams – The key role of lithium nanofiltration technology

Time: 1:25 PM

Tirtha Chatterjee, DuPont Water Solutions, Wilmington, DE ; Denise Haukkala, DuPont Water Solutions, Salt Lake City, UT; Jordi Bacardit, DuPont Water Solutions, Tarragona, Spain, Europe

Global trends towards decarbonization and electrification necessitate lithium production from natural resources in an accelerated and sustainable way. According to the World Bank, in 2050 the global demand of lithium is expected to increase nearly 500% of 2018 levels. This increasing need cannot be supported by evaporation-based lithium recovery processes, which are 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) is a continuous process with a series of sorbent- and membrane- based technologies to extract lithium from chloride-rich natural brine resources. The DLE process is faster and sustainable (less chemical and water consumption) with a substantially smaller footprint demand. This process can be expanded cost-effectively to extract lithium from low lithium-containing resources.

Selective sorbent operation is the heart of the DLE process that separates lithium from most of the ions and enriches its concentration in the eluent. In addition, in the DLE process, membrane-based processes (such as ultrafiltration, nanofiltration, and reverse osmosis) are also utilized to purify (selective separation) and concentrate brine (dewatering) while maintaining a high lithium mass recovery. Ion-exchange resins are used for final purification before the lithium-rich brine undergoes final treatment to produce battery-grade lithium in carbonate or hydroxide form.

One key challenge in lithium recovery is the brine stream composition variation between geographic locations, and even from source to source within a single geography. In the first part of this work, we will focus on types of multi-technology DLE combinations as a function of brine chemistry and project context. Key design considerations and guidelines to position various unit operations in a DLE scheme to maximize productivity will be discussed.

In the second part, we will focus on lithium nanofiltration that plays a unique role to reduce multivalent impurities from post-sorbent eluent streams without compromising the lithium yield. This technology demands a combination of (a) high lithium and water permeability while maintaining a high selectivity, (b) robust element design to mitigate frequent scaling in high recovery operations, and (c) service-life durability under the operating and CIP conditions. The impact of (a) feed composition, (b) operating pH, and (c) extreme pH CIP on product performance will be shown. Pilot data will be presented to highlight long-term in-field performance. All results obtained here were from a commercial product designed for DLE nanofiltration by DuPont Water Solutions.

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

IWC 24-14: Sustainable Lithium: Lessons Learned in Chinato Reduce Energy Use in Lithium Brine Mining Applications

Time: 2:15 PM

Erik Desormeaux, Energy Recovery, San Leandro, CA ; Eric Kadaj, Energy Recovery, San Leandro, CA; Xuewen Zhan, Energy Recovery, China

Water is key at every step of the li-ion battery life cycle including during lithium extraction via brine mining. This paper discusses two project cases involving the use of two different novel reverse osmosis (RO) membrane processes utilizing energy recovery devices (ERDs) for lithium concentration and water reuse at two different salt lakes in China.

The first brine mining case will present the utilization of a novel osmotically assisted RO (OARO) system with ERDs to reduce the time, energy and cost for mining and purifying lithium salts as a high grade battery material input. This case is at a traditional brine mining facility utilizing evaporation ponds. The novel RO system improved the quality of the lithium salts and reduced the time for lithium concentration by half, helping the site both increase production and produce a higher quality lithium salt.

The second brine mining case will present the utilization of a novel ultrahigh pressure RO (UHPRO) system with a new type of ERDs rated for ultra-high pressure (up to 1740 psi) that was installed during a facility expansion. This second case is at one of the first commercial scale direct lithium extraction (DLE) facilities in the world and the permeate streams from the RO systems are reused within the DLE process. The addition of the UHPRO system helped the site operator reduce water use and energy use to reduce overall processing costs by an estimated 7%, while also reducing the site footprint compared to the thermal evaporator originally planned for the facility expansion.

Discusser: Lisha Wu, Ph.D., HDR, Rosemont, IL

IWC 24-15: Water Issues in Lithium Battery Production

Time: 3:20 PM

Thomas E. Higgins, Ph.D., P.E., Worley Group, St Augustine, FL ; Mary McLoud, Worley Group, Ft. Lauderdale, FL; Avijit Dey, Worley Group, Houston, TX

Zhendong has over 23 years of industrial experience in specialty chemicals. He earned a Ph.D. in Materials Science and Mineral Engineering from University of California at Berkeley in 2001, and an MBA from University of Delaware in 2010. He has authored 22 peer-reviewed papers and holds 22 granted U. S. patents.

Lithium batteries require cathodes and anodes. Processes for production of the cathodes requires numerous steps to produce precursor material before lithium is added to create the final cathode. Precursor processes can include precipitation of precursor metals from acid sulfate solution. In this process, selected metal ions such as Nickel, are precipitated from sulfuric acid solutions as hydroxides through neutralization with sodium hydroxide, producing a high pH sodium sulfate wastewater. Discharging this wastewater can be a regulatory concern, because of the high sulfate concentration.

Our paper will address sodium sulfate waste generation and treatment. Sodium sulfate is very soluble, up to approximately 500 g/L, and it is not feasible to precipitate it as a solid. Lime can be added to precipitate sulfate as gypsum. Precipitation of sulfate as ettringite is also problematic from sodium sulfate. In summary gypsum or ettringite are possible if but the sodium sulfate laden wastewater will be converted into a more concentrated sodium chloride wastewater.

Evaporation can be used to concentrate and generate a sodium sulfate solid product that is salable or at least non-hazardous for landfill. However, evaporation is capital and energy intensive, requires significant pretreatment to produce a product that is salable, and the market for sodium sulfate is limited.

A promising alternative to evaporation is salt splitting by electrodialysis, which can produce sodium hydroxide and sulfuric acid, both of which are used in the cathodic material production process. Electrodialysis produces dilute NaOH and H_2SO_4 which then must be re-concentrated for reuse. This is typically done by thermal evaporation but could be done with membrane processes. This paper will address the technology and pretreatment alternatives to generate byproducts that meet reuse requirements and how they can be implemented at battery precursor facilities.

This paper will present the challenges of ‘closing the loop’ for battery precursor wastewater. The NaOH produced can be readily used, but H_2SO_4 generation can be excessive for manufacturers that purchase metals as sulfate crystals. However, this could be mitigated by a shift to metal leaching instead which consumes H_2SO_4, closing the loop.

Discusser: Zhendong Liu, LANXESS Corporation, Birmingham, NJ

IWC 24-16: Extraction of Lithium from Geothermal brines using Thermally Stable Inorganic Ion Exchangers

Time: 4:10 PM

Jasbir Gill, Ph.D., Water Energy Solutions Inc., Naperville, IL

Crystalline acid salts of tetravalent metals such as zirconium and titanium have been known for a long time as inorganic ion-exchangers. Because of their high ion-exchange capacity, their good stability to acid and oxidizing solutions as well as to temperature and ionizing radiations, the potential uses of these materials were subject to intense investigations for separation and concentration of nuclear fission products. Zirconium phosphate has a layered structure, zirconium phosphate of α-type ($Zr(HPO_4)_2\ H_2O$) has layers in which the Zr atoms bond mono hydrogen phosphate groups, with the P-OH groups pointing in the interlayer region, alternatively below and above the main plane. Water molecules are located between the layers in six-sided cavities and form hydrogen bonds with the P–OH groups of the same layer. The interlayer distance of α-zirconium phosphate is 7.56 Å and the presence of protogenic–OH groups is responsible for its cation exchange properties. It has been reported in the literature that $Zr(HPO_4)_2{\cdot}H_2O$ can be converted into $Zr(HPO_4)_2{\cdot}5H_2O$ and other various inter-spacing water molecules and up to ϑ- $Zr(HPO_4)_2{\cdot}8H_2O$, 100% of the phase with an interlayer distance of 10.4 Å. Thus, by changing the inter-spacing, the material can be customized for inclusion and exclusion of specific ions based on hydrated ionic radii. The paper presents a review and ideas to develop an adsorbent/ion exchange material to selectively concentrate Lithium ions from a hot geothermal brine.

Discusser: David Donkin, UCC Environmental, Waukegan, IL

IWC M5 Reserve: Advancing Lithium Extraction from Geothermal Brine: A Novel Well Stimulation

Time:

Esteban Rodriguez, Solenis LLC, Wilmington, DE ; Esteban Rodriguez, Solenis LLC, Wilmington, DE

The growing demand for lithium, which is a key component in electric car batteries, has intensified the focus on identifying sources and optimizing extraction methods to meet the escalating needs of the electric vehicle (EV) industry. Geothermal brine represents a promising source of lithium in certain parts of the world, particularly in the Salton Sea area, due to its elevated lithium concentrations. Although extracting lithium from geothermal brine requires more research and development to attain economically viable extraction processes. For battery manufacturers, this new source of lithium represents an option that would require little capital investment and less maintenance of the resource. Additionally, it diversifies the supply chain, thereby reducing exposure to geopolitical vulnerabilities, and it allows companies that strategically diversify their lithium supply to position themselves competitively in the market by sourcing lithium domestically, thereby reducing the price and the dependance on imported resources. For geothermal well operators, the opportunity to partner with companies engaged in lithium extraction offers a range of economic, environmental, and strategic benefits, such as enhanced financing opportunities, improved environmental stewardship, and diversified revenue streams.

This paper introduces an innovative well stimulation technique that presents the potential to expand lithium extraction capabilities of geothermal reservoirs. This technique increases the permeability of the reservoir rock, which improves fluid flow rate, and consequently enhances lithium recovery rates. The case histories included in this paper describe examples of successful brine production enhancements that have increased production up to four times, which can move a project from not viable to viable.

Discusser: n/a

Monday, 11/4/2024; 1:30 PM

M6: PFAS 1: Game On

IWC Rep: Kristen Jenkins, P.E., Kiewit, Lenexa, KS

Session Chair: Mike Preston, P.E., Kiewit, Lenexa, KS

Discussion Leader: Francisco Barajas Rodriguez Ph.D., AECOM, Omaha, NE

The EPA has issued its first regulatory requirements on PFAS compounds and now it's game on. Municipal drinking water utilities across the US have a mandate and timeline to comply with the PFAS rules established in this initial regulation. There will be many treatment options and approaches to consider to find an economical solution for different local conditions. Industrial PFAS discharge regulations are anticipated by the end of 2024 and these initial rules should signal what can be expected. This Session will consider three different PFAS concentration technologies and one potential targeted PFAS destruction technology.

IWC 24-17: Experience with Foam Fractionation

Time: 1:25 PM

John Schubert, P.E., HDR, Sarasota, FL

In 2019, it was recognized that the conventional methods of PFAS removal from water as applied in the drinking water industry were not going to be applicable to many industrial streams and landfill leachate. A program was started to develop alternative methods for treating more contaminated streams. Out of this effort, a process was developed which was initially named froth flotation, as it was derived from common mining practices employed for ore processing. Following two rounds of successful lab testing, a pilot system was designed and built to take the process to client sites. Three pilot studies have been completed to date, which has allowed for continuous improvement of the process. However, even in the first day of full operation in the first pilot, the system has effectively separated PFAS from landfill leachate, meeting performance expectations. Additional pilot studies and a full scale installation are currently moving forward. This paper describes the pilot system and performance data from the first three pilot studies.

Discusser: Mohsen Ghafari, Ph.D., Xylem, Tewksbury, MA

IWC 24-18: PFAS Degradation and Defluorination of High TDS Wastewater via Continuous Hydrothermal Alkaline Treatment (HALT)

Time: 2:15 PM

Brian Pinkard, Aquagga, Inc., Tacoma, WA ; Sean Smith, Ph.D., 3M Company, Saint Paul, MN; Christopher Bryan, 3M Company, Saint Paul, MN

Hydrothermal alkaline treatment (HALT) is an emerging and industry-leading per- and polyfluoroalkyl substance (PFAS) destruction process that is uniquely capable of destroying ultra short-, short- and long-chain PFASs in high TDS wastewaters. HALT operates under subcritical water conditions (T > 300 ˚C, P > 20 MPa) with the addition of sodium hydroxide (NaOH), which raises the pH and drives PFAS destruction reactions via thermal decarboxylation and nucleophilic substitution reaction mechanisms.

A case study was performed applying the HALT technology to degrade and defluorinate a range of PFASs in a high total dissolved solids (TDS) wastewater stream. The wastewater was processed at a range of different HALT operating conditions to assess the degradation, defluorination, and F mass recovery for ultra short-, short-, and long-chain PFASs under relatively mild (low NaOH) HALT conditions. A pilot-scale continuous HALT reactor was employed, demonstrating that mild HALT processing is scalable and can be used to treat high TDS wastewater and commercially relevant throughputs.

Optimized conditions reveal near-quantitative defluorination (97%, ± 2%) and >99% F mass recovery with the pilot-scale HALT system, even at relatively low loadings of NaOH in the HALT reactor. Targeted PFAS analysis via LC-MS/MS, free fluoride quantitation via ion chromatography and 19F NMR spectroscopy, and total organofluorine (TOF) measurements via 19F NMR spectroscopy and combustion ion chromatography (CIC) were used to track treatment efficacy. This

multiple-lines-of-evidence approach shows good agreement between degradation and defluorination percentages at most HALT treatment conditions, indicating excellent F mass recovery. Perfluorocarboxylic acids (PFCAs) were highly susceptible to degradation and defluorination via HALT even under relatively mild treatment conditions, while perfluorosulfonic acids (PFSAs) were more recalcitrant.
Overall, the case study demonstrates that a continuous HALT system can be employed to achieve high degradation and defluorination of a myriad of PFASs, including ultra short- short- and long-chain compounds, from concentrated wastewater streams. The paper and presentation will discuss opportunities for further HALT process optimizations and improvements.

Discusser: James Scholl, Kiewit, Okemos, MI

IWC 24-19: A Multi-Year Analysis of a PFAS Treatment System in a Surface Water Discharge Application

Time: 3:20 PM

TJ Mothersbaugh, WaterTectonics, Everett, WA

Per- and polyfluoroalkyl substances (PFAS) are common in many firefighting foams. When a large fire burned at this industrial facility, 15,000 gallons of firefighting foam was used to suppress the fire. Although attempts were made to fully isolate and clean up the foam, their widespread use across the site during firefighting activities left residual PFAS on the surface and in the groundwater. When stormwater flows across the surface of the site, these PFAS compounds are mobilized to the discharge point and adjacent waters. Initially, tanks were mobilized to capture the impacted waters and haul them to an offsite disposal facility. Due to the high cost of this option, a treatment system was mobilized. This paper will discuss how treatment alternatives were evaluated, how the system performed, how the system was modified to accommodate larger surface flows and new groundwater flows over time, and what changes were made to minimize waste and maximize performance. Additional time will be spent discussing how effluent limits were determined, how the discharge was regulated under existing regulatory frameworks, and how the system was mobilized in a short timeframe with respect to a complex array of building code and site HSE considerations.

Discusser: Bridget Moyles, GHD, Allison Park, PA

IWC 24-20: PFAS Separation and Concentration through Wastewater Evaporation

Time: 4:10 PM

Travis Smith, P.E., Heartland Water Technology, Columbus, OH ; Michael Ditton, Heartland Water Technology, Bolton, MA

This abstract presents a study about per- and polyfluoroalkyl substance (PFAS) testing during leachate evaporation. Test results support a hypothesis that PFAS's affinity for water, along with the operational conditions of the system, results in concentrated PFAS remaining in the treatment process residuals. The investigation developed a PFAS mass balance, comparing laboratory testing data from multiple sites of both the infeed and residual. Through analytical techniques, field testing, and modeling this study concludes that through the evaporative process the vast majority of PFAS is contained in the residual. Overall, the findings contribute to the understanding of PFAS behavior during evaporative treatment. The results highlight evaporation as an important tool for on-site treatment of landfill leachate. By concentrating PFAS in leachate residuals, PFAS is safely contained within the landfill.

The study conducted multiple tests to develop and validate a mass balance. Data includes the mass balance of PFAS compounds, focusing on multiple PFAS compounds, targeted by those highlighted in regulatory developments such as RCRA and CERCLA, including PFOA and PFOS. The use of PFOA and PFOS as representative PFAS compounds is discussed, with a mass balance approach illustrating the concentration factor of the system during data collection (i.e., volume reduction), and the PFAS concentration levels in the raw leachate feed and residual samples.

The concentrations of PFOA and PFOS in the ambient air in the vicinity of the treatment system were tested, to evaluate potential dispersion and transport of PFAS emissions from the evaporation site. All PFAS tested were below detection limits in the ground level air sampling.

Testing results confirmed the vast majority of PFAS was retained in the liquid residuals. Ambient air tests near the concentrator show levels below laboratory detection limits for each parameter tested, confirming predictions from preliminary dispersion modeling that PFAS concentrations are well below currently published state ambient air limits.

This study demonstrates that the residuals and water vapor streams from the Heartland system are compliant with current and anticipated future regulations. Pre-treatment or post-treatment options are also available if warranted in the future. Destruction technologies such as high-temperature gasification are also available and are expected to be increasingly utilized to remove PFAS from the environment completely.

Discusser: Jord Yniguez, Ecolab, King of Prussia, PA

Monday, 11/4/2024; 1:30 PM

M7: Unlocking RO Advancements for Industry Success

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

Session Chair: Matthew B. Flannigan, Nalco Water, An Ecolab Company, Naperville, IL

Discussion Leader: John Peichel, Veolia Water Technologies & Solutions, Minnetonka, MN

Despite the first commercial production of reverse osmosis membranes occurring almost 65 years ago, advancements in RO membrane chemistry, construction, modeling, and deployment continue to evolve, broadening the application of the technology and improving outcomes. This session will explore important advancements in these areas and discuss the implications for end-users and the industry.

IWC 24-21: Review of Field Operation of Novel Zwitterionic RO Membranes

Time: 1:25 PM

Elke Peirtsegaele, ZwitterCo, Inc., Carpinteria, CA

Irreversible organic fouling and/or biofouling has proven to be a challenge for many reverse osmosis users. Though membrane manufacturers have been trying to address biological and organic fouling issues for several decades with fouling-resistant RO elements, the reliability of water treatment systems continues to suffer. These systems often deal with increased system downtime due to frequent membrane cleaning, decreased system performance, increased operating costs, and reduced membrane lifespan.

A new class of membrane material chemistry based on zwitterionic copolymers has demonstrated unprecedented performance in streams with elevated concentrations of high-fouling organic constituents. By integrating this novel chemistry with a polyamide brackish water RO membrane, zwitterionic RO elements can now enable improved performance in existing RO systems treating high-fouling streams including surface waters, wastewaters, and MBR effluents. This paper will discuss the science behind this novel polymeric membrane chemistry, the unique advantages of zwitterionic membranes, and operational data from the first installations on various high-fouling feed streams.

Discusser: Bojun Xu, Veolia WTS, Oakville, ON, Canada

IWC 24-22: From the Schuylkill River to Steam: Key Lessons of Utilizing Reverse Osmosis for District Energy

Time: 2:15 PM

Emma Wolff, P.E., MS, GAI Consultants, Pittsburgh, PA ; Zach Hollingsworth, Vicinity Energy, Philadelphia, PA; Michael Ancona, Vicinity Energy, Philadelphia, PA

District energy services in the City of Philadelphia, PA is provided by Vicinity Energy (Vicinity), which is a regulated utility that supplies steam and chilled water to over 400 customers and provides reliable heating/cooling thermal energy to approximately 100 million square feet of building space. Vicinity's primary production facility in Philadelphia previously produced demineralized water for steam generation solely via city water treated by a 60-year-old, manually operated mixed bed ion exchange treatment plant. In addition to the ion exchange systems nearing the end of their useful life, Vicinity was facing rapidly increasing water-production costs stemming from rising chemical and city water costs and higher chemical use due to decreasing city water quality. As part of Vicinity's commitment to sustainability and to reduce costs for their customers, Vicinity had a new 2,000 GPM reverse osmosis water treatment plant (RO WTP) constructed to produce most of the facility's demineralized water demand primarily via Schuylkill River water treated by ultrafiltration (UF), reverse osmosis (RO), and electrodeionization (EDI) processes. The conceptual design process for the new RO WTP started in 2020 and the plant was commissioned and became operational in early 2023. This paper will highlight design drivers key for successful implementation of RO treatment for district energy plants in general, as well as the site-specific challenges that impacted this RO WTP design approach. The authors will then demonstrate how these drivers impacted the design and operational control philosophy of the RO WTP installed at Vicinity's facility and cover key lessons learned from the transition to the new RO WTP from the older ion exchange treatment plant. Now that the facility has conducted RO treatment operations for 1 full year, metrics of the facility performance can be compared to initial project goals to demonstrate the sustainable savings realized and operational changes implemented (e.g. improved demineralized product water quality, reduced city water usage, reduced chemical usage).

Discusser: Mahesh Bhadane, Aquatech International, Canonsburg, PA

IWC 24-23: Thin Film Composite Reverse Osmosis Compaction and Relaxation

Time: 3:20 PM

Jishan Wu, UCLA, Los Angeles, CA ; Eric Hoek, UCLA, Los Angeles, CA

This research explores the capability of ultra-high pressure reverse osmosis (UHPRO) to supplant energy-intensive thermal desalination, offering potential cuts in energy usage and brine concentration costs by up to 50%. Notwithstanding, the performance of commercial RO membranes significantly degrades under ultra-high pressure due to intense membrane compaction and embossing. We thoroughly examine the effects and mechanisms of this composite membrane deformation at both active and support layers. We also introduce a groundbreaking RO membrane design with exceptional compaction resistance. These newly developed bilayer composite membranes demonstrate remarkable compaction resilience under ultra-high pressures - up to 200 bar - thereby positioning RO membrane-based brine concentration as a contender to thermal methods. Unlike traditional RO membranes, which lose up to 45% water permeance at 200 bar due to physical compaction, these innovative membranes retain 85-90% of their original water permeance at the same pressure. Moreover, the novel membrane exhibits a thickness reduction of less than 15%, in stark contrast to the over 40% thickness reduction seen in conventional composite membranes. Beyond their impressive compaction resistance, the best performing novel membranes deliver salt rejections surpassing 99% for NaCl solutions with concentrations of up to 200,000 mg/L.

Discusser: Christopher Kurth, Aqua Membranes, Eden Prairie, MN

IWC 24-24: Revolutionary 36-MIL Ultra Low Differential Pressure Feed Spacer Minimizes Fouling

Time: 4:10 PM

Younghoon Ko, LG Chem, Ltd., Seoul, Republic of Korea; Eugene Rozenbaoum, LG NanoH2O, LLC, Torrance, CA; Soo-Hyun Kim, LG Chem, Ltd., Seoul, Republic of Korea; Yasushi Maeda, LG Chem Japan Co., Ltd., Tokyo, Japan; Alvaro Lagartos, LG NanoH2O, LLC, Barcelona, Spain

Minimization of energy consumption and fouling in RO operation has been the focus of research in the past years. The differential pressure (dP) is one of the key performance indicators of a reverse osmosis system. Higher dP caused by membrane fouling increases the energy cost of operation and could cause damage to membranes. Therefore, reducing it and preventing its rapid increase during operation benefits CAPEX and OPEX.

A spiral-wound reverse osmosis module comprises several so-called envelopes connected to a permeate collection tube and separated from each other by a feed spacer. The primary function of the feed spacer is to separate two membrane envelopes allowing the feed stream to freely flow between membrane leaves while creating a turbulent flow to minimize concentration polarization on the membrane surface. This component of the membrane module construction has a key role also in energy consumption since it directly affects the crossflow hydrodynamics in the element. In addition, it could

also affect fouling behavior and cleaning efficiency in a membrane system operation.

In general, dP depends on the feed spacer geometry: mesh size, thickness, strand diameter and angle. Understanding and optimizing these parameters are necessary to improve its design and membrane performance. In this paper, we will present results of the development of a revolutionary 36-mil low dP feed spacer that minimizes flow disturbance, fouling rate and pressure losses without increasing concentration polarization. Extensive Computational Fluid Dynamics (CFD) modeling was performed with various spacer geometries to verify hydrodynamics. The new spacer delays the onset of fouling during system operation, reduces the fouling rate, and improves chemical cleaning efficiency.

This paper will explain the importance of each design parameter of a feed spacer and its effect on feed pressure and fouling growth. In addition, several examples of real RO operation using the new spacer will be presented demonstrating the advantages of lower operating pressures and reduced fouling rate.

Discusser: Joe Tamburini, AWC Water Solutions, Englewood, CO

Monday, 11/4/2024; 1:30 PM

M8: Industrial Wastewater – Tackling Treatment, Optimization and New Challenges

IWC Rep: Jay Harwood, Newterra, Oakville, ON, Canada

Session Chair: Jaron Stanley, WesTech Engineering, Inc., Salt Lake City, UT

Discussion Leader: John Van Gehuchten, MS, P.E., Honor Engineering, Pittsburgh, PA

Industrial wastewater treatment is challenging. Various industries like semiconductor, food, power, petrochemical and mining are addressing their wastewater treatment needs through creativity and innovation. Treatment includes water reclamation and reuse, changing technology, operational optimization, and trace constituent removal. Water is an important and limited resource and treatment of wastewater is an essential part of a sustainable solution.

IWC 24-25: Preliminary Technical Assessment for Wastewater Reclamation to Feed UPW Lines

Time: 1:25 PM

Matthew Kovic, Isle Group, Jupiter, FL ; Carles Crespo, Isle Group, Milan, Italy; Antonia Frisia, Isle Group, Lausanne, Switzerland; Magela Odriozola, Isle Group, Utrecht, Netherlands

As global water sustainability becomes an increasingly critical issue, innovative approaches to wastewater reclamation are essential. This project responds to the challenge of an international semiconductor manufacturer plan to nearly double its production capacity, necessitating a robust wastewater recycling strategy to meet its water security and sustainability goals. Specifically, the focus is on conceptualising a treatment train to reclaim wastewater treatment plant effluent for manufacturing purposes, with a particular emphasis on feeding ultrapure water (UPW) lines.

The methodology adopted in this paper was divided into three phases: The fisrt phase evaluated the intake flows and water qualities for a new wastewater reclamation plant based on UPW requirements and discharge limits. The second phase involved a preliminary overview of the process flow diagram integrating current and future wastewater treatment plants with the proposed reclamation plant. Key suppliers were consulted for initial input on costs and chemical and energy consumption. Lastly, a high-level cost assessment was performed (Capex, Opex, and Totex (TCO) of the treatment train), and finally, the technology implementation roadmap for the pilot phase was developed.

The paper's outcome presented an innovative conceptual design for the wastewater reclamation plant, leveraging advanced treatment technologies. This included using a creative solution as an oxidant and coagulant, followed by an innovative ceramic membrane solution. This pre-treatment was designed to protect reverse osmosis (RO) systems and ensure optimal performance, followed by innovative advanced oxidation technology for IPA, and TPH removal, contaminants that could damage UPW systems.

The findings demonstrated that, through the designed treatment train, reclaimed water could meet UPW feed requirements, and the discharge would comply with future permit discharge limits. The pilot and full-scale installations were forecasted to achieve the necessary removal efficiencies at minimised costs. Two scenarios, average and worst-case, were considered for discharged wastewater quality, highlighting the importance of WWTP optimisation to meet discharge limits.

The conclusions recommend initiating an industrial pilot with a 50 m3/h capacity, feeding water to utilities to allow for extended operational monitoring. This step is crucial before considering reclaimed water in UPW lines. Additionally, the treatment train must be optimised and piloted without an advanced oxidation process (AOP) to determine if TOC, IPA, TPH, etc..conditions can be met to avoid the significant cost impact of AOP. The recommendations emphasize the need for piloting and optimizing various treatment steps to ensure the most cost-effective removal of contaminants.

Discusser: Daniel Wilson, Kiewit, Austin, TX

IWC 24-26: Conversion of Dissolved Air Floatation System to Suspended Air Floatation System Helps Dairy Facility Maintain Wastewater Treatment Targets during Production Increase

Time: 2:15 PM

Joshua Reed, Brown and Caldwell, Boise, ID ; Dillon Allen, Chobani, Twin Falls, ID; Dominic Pontarolo, Brown and Caldwell, Boise, ID; Houston Flippin, Brown and Caldwell, Nashville, TN; Michael Mecredy, Brown and Caldwell, Nashville, TN

A dissolved air floatation system (DAF) was used for primary wastewater treatment by Chobani at their production facility, located in Southern Idaho. The facility produces a variety of milk and oat-based products including Greek Yogurt cups, flip-cups and creamers among others. Process wastewater produced from clean in place procedures, product change flushes and other sources are collected and treated through a recently upgraded wastewater treatment facility. The facility consists of both primary and secondary treatment before discharge to the local POTW. The primary DAF units clarify process wastewater by using dissolved air to float suspended matter from the wastewater. Due to increases in production at the processing facility, the total suspended solid (TSS) and total chemical oxygen demand (COD) wastewater loads greatly increased, necessitating an upgrade to the primary treatment system. Alternatives were reviewed to upgrade the system including installing additional similar sized DAF units and replacing the existing DAF units with larger equipment. However, a DAF to suspended air floatation (SAF) retrofit was selected. The SAF was selected due to its reduced capital costs, low impact to ongoing operation of the primary treatment system, the ability to maintain the capacity to operate as a DAF unit in emergency situations and a small footprint. The SAF differs from the DAF process by using a gas/liquid emulsion to float suspended matter from the wastewater. The existing DAF body was retrofitted to incorporate the SAF equipment including the installation of a small inline mixer, chemical dosing programming changes, and installation of the emulsion generation system. The retrofit was completed in 2022 and has been in continuous operation since. The newly installed SAFs have increased removal rates to approximately 92% for TSS and 65% for COD compared to 77% for TSS and 55% for COD in the DAFs.
This paper will present background on the SAF technology including technical aspects of how it differs from a DAF, other locations where SAFs are being used successfully, and an operational comparison between the previous DAF units and the new SAFs. Topics of comparison will include removal efficiency across the units, chemical consumption, power and water demands, and overall costs to operate the equipment. Lessons learned during the design, installation, startup, and operation of the new SAF units will be discussed. Critical design values, infrastructure requirements, and required equipment to retrofit the exiting units will be also discussed.

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

IWC 24-27: Evaluation of Iron-Based Media for Selenium Removal from Water

Time: 3:20 PM

Paul Togna, Envirogen Technologies, Inc., East Windsor, NJ ; Robert Loken, Envirogen Technologies, Inc., Kingwood, TX

Several technologies are available to treat selenium. The water chemistry and the concentration and form(s) of selenium dictate the most effective treatment option. For example, biological treatment is effective at reducing oxidized forms of selenium (SeO3-2 and SeO4-2) into particulate elemental selenium (Se0), which can be filtered, but is not effective for treating selenocyanate (SeCN-), the predominant form of selenium in refinery sour water stripper bottoms. As another example, the form of selenium can change from selenite (SeO3-2) to selenate (SeO4-2) when coal ash is disturbed, making chemical precipitation, which is effective at removing selenite, ineffective once the selenite is oxidized.

Iron-based media, including zero-valent iron (ZVI) and sulfur-modified iron (SMI), have found increased use for removing selenium from aqueous streams such as CCR leachate, mine water runoff, and petroleum refining wastewaters. These iron media remove selenium and other oxyanions via reduction reactions and adsorption mechanisms. They come in a wide range of specifications that affect performance and cost for the end user. The purpose of this study was to understand and compare the performance of several iron-based media formulations, including their ability to remove selenium (selenate), fluidization characteristics that impact treatment vessel size, iron attrition rates, and the impact of chloride and sulfate. Selenate was chosen for testing because its removal rate is the slowest among the selenium species since it is the most oxidized. We have developed a flexible, up-flow, fluidized media treatment system (Advanced Metals Removal System) that can utilize multiple iron-based media formulations regardless of media size and density.

Phase 1 of the evaluation involved Isotherm and Kinetic Testing to measure the extent and rate of selenate removal for five ZVI media formulations. Three of the five ZVI media were chosen for continued evaluation in Phase 2 at elevated sulfate and chloride concentrations along with a sulfur-modified iron (SMI) media which has a catalytic agent to speed up the selenium reduction reactions. After the Phase 2 testing, fluidization bed expansion experiments were conducted on the four media.

The evaluated iron-based media demonstrated substantially different hydraulic behavior and selenium adsorption performance, especially regarding sulfate inhibition. The SMI media was most sensitive to sulfate but appears to be the best choice for removing selenate from waters containing less than 800 mg/l of sulfate due to its overwhelmingly faster sorption rate versus the ZVI media tested. For higher sulfate applications, the ZVI media is preferred.

Discusser: Shannon Brown, Woodard & Curran, St. Charles, MO

IWC 24-28: Restoring Performance of RO Membranes with Severe Scaling from Contaminated Tailings Pond Water Source using Specialty Cleaners

Time: 4:10 PM

Amit Sankhe, H2O Innovation, Vista, CA ; Sara Alves, H2O Innovation, Vista, CA; Gregory Sato, H2O Innovation, Vista, CA

Tailings Water contaminated with mining waste undergoes RO treatment to make it safer for return to the environment. Some of this treated water is recycled for use in the mill, reducing the volume of water needed to be withdrawn from the environment for mill activities significantly. Since upgrading the system, it has treated up to 1000 m3/hr, producing high quality water that is well below the applicable environmental quality guidelines.
This RO system was experiencing several performance issues, mostly fouling and scaling related, that would result in low normalized permeate flow and cleanings every 1-2 weeks with generic cleaners. A third-party membrane autopsy was performed to understand the foulant composition. This paper will discuss the autopsy results in detail and will also address the selection process of an appropriate specialty cleaner based on the foulant composition, foulant location and plant design. The performance recovery after cleaning with specialty high, low and silica-specific cleaners will be discussed and compared to historic data of the system when cleaned with generic cleaners.
For remote locations, such as the case at this site, specialty cleaner selection is often influenced by several factors. Ergonomics, ease of use, extreme storage conditions and transportation are seldom used as a criterion for chemical selection but were considered in this specific case during the chemical selection process. Finally, savings by reducing

system downtime through more effective and less frequent CIPs will be emphasized. Although fouling is often an unavoidable part of RO water treatment, the benefits and advantages of specialty cleaners for this specific case study are highlighted through the abstract.

Discusser: David Stanek, Westech Engineering, Salt Lake City, UT

Tuesday, 11/5/2024; 8:00 AM

T1: Emerging Challenges in Boiler Chemistry

IWC Rep: Colleen Scholl, P.E., HDR, Whitewater, WI

Session Chair: John Dorminey, Chevron, Pascagoula, MS

Discussion Leader: Aizaz Ahmed, Nova, Calgary, Alberta, Canada

This session aims to share best practices, case studies, and technical insights related to boiler water treatment and steam system reliability in various industrial settings. Papers touch on effective collaboration across organization to treat challenging boiler water applications, overcoming equipment design limitations to improve steam purity, evaluating film forming amine alternatives for condensate treatment, and adapting boiler treatment programs to boiler water pretreatment upgrades.

IWC 24-29: Considerations When Changing BFW Quality to Industrial Steam Generators & Waste Heat Boilers

Time: 8:10 AM

Robert Bryant, Nalco Water, an Ecolab Company, Missouri City, TX

Steam production is central to the petroleum refining and chemical manufacturing industry. Steam generators and waste heat boilers are used to cool plant processes, and steam is used for various purposes, from heating the process to driving turbine-driven pumps and compressors. Maintaining the reliability and energy efficiency of the steam generators and waste heat boilers can significantly impact these facilities' production rates and energy costs. Conversely, steam generator failures can reduce production rates and unscheduled unit outages.

This paper will discuss things to consider when BFW (boiler feedwater) quality changes occur. Contingency plans are often discussed regarding what to do regarding makeup water or condensate contamination. However, upgrading the makeup water pretreatment scheme can also significantly change the BFW and these are some paramteters that should be considered. Overall, upgrading makeup water quality should be a positive for your steam cycle equipment, but there are some potential pitfalls to avoid. The topics discussed in this paper will help you to protect your preboiler and steam generation equipment.

Discusser: Edward Beardwood, Beardwood Consulting & Technologies Inc., London, Ontario, Canada

IWC 24-30: Evaluation of a Sulfur Recovery Unit (SRU) Waste Heat Boiler (WHB) Steam Separator Performance, Boiler Chemistry & Steam System Reliability

Time: 9:00 AM

Christopher Day, Chevron Technical Center, a Division of Chevron U.S.A. Inc., Houston, TX

High steam quality is needed to protect against fouling, corrosion, and equipment damage in steam systems. Carryover from boilers can lead to water hammer damage, erosion fouling and corrosion of valves, piping, relief valves, heat exchangers and steam turbines. Robust design of steam drum separator internals is critical to minimizing boiler carryover and maintain high steam quality.
Boiler carryover from sulfur recovery unit (SRU) waste heat boilers (WHB) was impacting steam, condensate, and boiler feedwater quality. SRU load changes increased the WHBs steam generation rate, promoted steam carryover and lowered steam system reliability. Both plugging and erosion was observed in steam system components.

The original WHB SRU boiler scale inhibitor phosphate-based treatment carried over into the steam system created valve stem, piston and cage salt deposits, contributed to erosion of valve seats. The carryover also started to increase phosphate levels in the condensate and boiler feedwater interconnected into the high-pressure steam system feeding turbines. If continued, there was high potential for turbine erosion / corrosion damage.

The original SRU boiler steam drum had a slotted dry tube steam separator outlet collector pipe and was retrofitted with double vane bank demisters to remedy the steam carryover as steam rates increased. Additional inspection and analysis revealed issues with the steam drum steam separator double vane bank steam demisters retrofit and led to another iteration of design changes. In the interim, the boiler water chemistry was changed to an all-polymer treatment to reduce scaling and fouling risks.

This paper explores the original physical steam drum and steam separator design and boiler water chemistry, discusses the shortcomings of the early steam drum internals modifications, and presents proposed changes and modifications needed to improve steam separator performance and steam system reliability. Design parameters for the steam drum, steam risers and steam separation equipment were evaluated and matched with observations to explain physical damage and performance gaps. An HTRI model of the WHB was also developed to evaluate WHB circulation ratios and the impacts of potential modifications to steam separator and WHB performance.

Discusser: Elise Barbot, ExxonMobil, Spring, TX

IWC 24-31: TLE Water Quality: Leveraging Cross-Organizational Collaboration to Improve Chemistry Control and Increase Steam System Reliability

Time: 10:10 AM

Jacob Tilley, Veolia WTS, Prairieville, LA ; Anna Akker, ExxonMobil; Carl Peterson, Veolia

A Transfer Line Exchanger (TLE) is used to rapidly cool steam cracking furnace effluent while generating high pressure steam. Due to extreme conditions present in the TLE's and potential for challenging water circulation, the TLE's often experience steam drum chemistry reliability issues. Poor steam drum chemistry can lead to furnace equipment damage and downstream turbomachinery issues, ranging from inefficient operation to potential ethylene cracker shutdown. Therefore, maintaining TLE water chemistry control is a vital component of overall ethylene plant reliability.
Water chemistry quality control can be complex due to shared ownership and responsibility within an operating organization and with a water chemistry partner. Building a successful partnership relies on having standard, agreed upon quality control practices, effective collaboration, and clear communication between teams.
This paper intends to discuss, with a case study, how cross organizational troubleshooting can be leveraged to improve TLE reliability through tightened chemistry control and efficient, collaborative response to upset events.

Discusser: Edward Beardwood, Beardwood Consulting & Technologies Inc., London, Ontario, Canada

IWC 24-32: Application of Film Forming Substances

Time: 11:00 AM

Dale Stuart, Chemtreat, Glen Allen, VA ; Robert Jeffers, ChemTreat, Ashland, VA

Film forming amines (FFA) have been around for a few decades. The use of the second generation FFA olyelpropanediamine (OLDA) has shown that its application results in significantly lower iron residuals in systems that otherwise operate at several hundred times the EPRI limit. However, concern over cation conductivity generated during the application has generated interest in non-amine film forming substances. Replacement of FFA in applications has shown mixed results. Observations of surface wetting are sometimes used as a surrogate for iron data to judge success of the program. However, research has shown that lower contact angles of filmed surfaces have generated similar electrochemistry results suggesting the contact angle of water droplet formation is not a good gauge of protection. In application, the presence of water droplet formation in drums does not always ensure iron falls within EPRI limits. The presence of higher than iron specification is also an indication of corrosion occurring.

Discusser: Gregg Robinson, Solenis LLC, Wilmington, DE

Tuesday, 11/5/2024; 8:00 AM

T2: Water for the Energy Transition – Focus on Hydrogen and Carbon Capture – without 'blue' there can be no 'green'

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

Session Chair: Andrew Hodgkinson, Worley, Clifton Hill, VC, Australia

Discussion Leader: Juvencio Casanova, Veolia, Houston, TX

Without water, there can be no hydrogen. Burgeoning demand for green hydrogen requires hitherto unthinkably large quantities of ultrapure water. How will this be done in practice? What are the implications for treatment processes? Wastewater? Carbon capture in the huge tonnages in prospect also depends critically upon reliable supply and management of water and salinity. This session will the address big picture issues and also delve into some important details in these key energy transition enabling technologies - water for green hydrogen and carbon capture.

IWC 24-33: Water Considerations for Hydrogen and Carbon Capture

Time: 8:10 AM

Keith Ambrose, Electric Power Research Institute (EPRI), Palo Alto, CA ; Kirk Ellison, Electric Power Research Institute (EPRI), Charlotte, NC

Electric utilities, public entities, and multinational corporations are seeking affordable pathways to large-scale decarbonization by 2030, and net-zero carbon by mid-century. Two important sets of technologies in the power industry to achieve decarbonization are low-carbon energy carriers (e.g., hydrogen) and carbon capture. One of the most critical considerations for accelerated adoption of these carriers and technologies is water. Due to the current lack of commercial low-carbon technologies deployed across the industry, coupled with water scarcity constraints in many regions, evaluating water considerations for these technologies is increasingly important for successful future deployments.

This paper will discuss the role of water in hydrogen production and carbon capture systems. It will review the water withdrawal, consumption, and discharge rates for these low-carbon technologies. Cooling water is a major component of these technologies; the paper will detail estimated water withdrawal rates, consumption (evaporation) rates, and discharge (cooling tower blowdown) rates for cooling water systems. Sensitivity analyses will show how modifying cooling system parameters will impact overall water usage rates. High-purity water is required for hydrogen production via electrolysis; recommended water treatment system configurations and estimated water usage rates for various water sources will be considered. Wastewater treatment systems will likely be required to manage wastewater (e.g., cooling tower blowdown, reverse osmosis reject, carbon capture quench water) from these technologies. In particular, carbon capture systems produce hard-to-treat amine-based wastewater which must be managed. Considerations for alternative water sources, various cooling technologies, and wastewater management will be presented.

Discusser: Ken Martins, Stantec, Reno, NV

IWC 24-34: Economic Considerations for Optimizing the Balance of Water Efficiency and Water Stewardship in Clean Hydrogen

Time: 9:00 AM

Jesse Toepfer, Stantec Consulting, Inc., Fairfax, VA

At the intersection of community, creativity, and climate change, the hydrogen market space is gaining traction as a preferred alternative energy source. As of 2022, North America dominates the estimated $183-billion-per-year global market with a 38 percent share. While the prospects of hydrogen may seem bright, there are some significant challenges ahead. One of the most important challenges is water.

Regardless of the method of production, hydrogen production is a water intensive process, and generally requires ultrapure water (UPW). Treatment trains to produce UPW can be complicated depending on the quality of the source water, but typically involves disinfection, ultra- or micro-filtration, degasification, ion exchange, electrodeionization (EDI), and reverse osmosis (RO). In some cases, the ratio of water consumed to hydrogen produced can be as high as nine-to-one, and this does not even account for cooling, transportation, non-process related service water, or discharge treatment. All aspects of the hydrogen energy train (from sourcing to production to transportation to end use) bear large water footprints. This paper will compare the economic considerations of (1) reclamation, (2) recycling, and (3) reuse as viable methodologies to minimize water footprint and consumption for electrolytic [clean] hydrogen production processes. Using a hypothetical model plant and as a function of best [commercially] available technology on a per thousand gallons basis, the methodologies will be screened in terms of (1) unsubsidized treatment cost, (2) incremental rate of return, (3) payback period, (4) and lifecycle costing.

Discusser: Liron Ophek, IDE Technologies, Kadima, Israel

IWC 24-35: The Role of Clean Water for a Robust and Reliable Production of Green Hydrogen

Time: 10:10 AM

Jordi Bacardit, DuPont Water Solutions, Tarragona, Spain; Matt Roth, DuPont Water Solutions, Wilmington, DE

The global pursuit of more sustainable sources of energy and mobility is transforming our economy. Hydrogen has emerged as a promising vector due to its versatility as a fuel or feedstock.
Hydrogen can be produced by several methods from different feedstocks, but the most sustainable technology is termed Green Hydrogen, in which the Hydrogen is produced from water by renewable energy powered electrolysis. Electrolysis is the process of electrically splitting the water molecules into hydrogen and oxygen gas. There are various types of electrolyzers, and they all rely on high purity water. This work will focus on proton-exchange membrane (PEM) electrolyzers. PEM electrolyzers installations require continuous supply of water. Additionally, around the electrolyzer water is recirculated in large recirculation loops, which also require continuous polishing.
The water quality and dynamic water chemistry have a direct influence on the lifetime of the electrolyzer membrane, electrodes, and catalysts that make up the electrolyzers, and as a result the overall efficiency of the operations. It is critical that water quality is well understood and managed to ensure efficient operation and maximize the lifetime of the components.

This work will focus on the following aspects:
- From water to hydrogen basics: principles, flows and technology outlook.
- A critical view on the water quality specifications vs production costs; durable and reliable water quality is critical to have an efficient operation.
- A holistic view on the design of water treatment solutions: potential treatment schemes and their technoeconomic aspects.
- Understanding water contamination: source, role, and treatment.
- The role of enhanced ion exchange resin-based mixed bed polishers as a reliable and cost-effective tool to achieve a robust electrolyzer operation.

Discusser: Alexander McDonald, XRI, Houston, TX

IWC 24-36: Special Ion Exchange Resin Process for Treating Process Water in PEM Electrolysis for Green Hydrogen Production

Time: 11:00 AM

Hans-Juergen Wedemeyer, LANXESS Deutschland GmbH, Cologne, Germany; Zhendong Liu, Ph.D., LANXESS Corporation, Birmingham, NJ

Green hydrogen is produced by electrolysis of water utilizing a surplus renewable energy source such as wind, hydropower and solar. It is a clean energy with zero green house production. Among the different electrolysis cells, Proton Exchange Membrane (PEM) is very popular due to its high current density, compact design, lower operating temperature and very pure hydrogen product. The water used in PEM electrolysis must be very pure to avoid membrane deposits, electrode corrosion and catalyst fouling. Ion exchange resin demineralization is an important way to produce the ultrapure water, but the high water temperature in the green hydrogen production process can cause resin degradation (especially the anionic resins), resulting in capacity loss and high total organic carbon (TOC) release in the process water.

In this paper, we introduce a new ion exchange resin demineralization process to effectively control the TOC release from the anion resins by placing the single bed strong basic anion (SBA) before the strong acid cation (SAC) bed so that the released TOC can be captured without generating too much burden to the downstream mixed resin bed. This configuration is different from the conventional SAC-->SBA-->mixed bed design. Since the feed water has been pretreated with low hardness ions, the risk of metal precipitation on the SBA resin bed is low. In addition to the special configuration, the resins are also specially made with low TOC release potential. The paper compares the performance of two configuration schemes, and shows the configuration of SBA-->SAC-->mixed bed is able to produce a water with 18 Mohm.cm, <10 ppb TOC and < 2ppb fluoride ion at 50 degree Celsius for the green hydrogen production process.

Discusser: Kaitlyn Clark, Ecolab, Philadelphia, PA

Tuesday, 11/5/2024; 8:00 AM

T3: Emerging Water Challenges and Opportunities in the Energy Industry

IWC Rep: Brandon Delis, EPRI, Charlotte, NC

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

Discussion Leader: Mark Owens, UCC Environmental, Waukegan, IL

The growth of emerging energy technologies, such as carbon capture, green hydrogen, and lithium-ion batteries, has increased water demand and created water sourcing challenges. Like thermal power generation plants, these developing industries require water streams of varying quality for cooling, steam generation, and direct process usage. This session provides project examples of water conservation, wastewater treatment, and lithium extraction, while examining the potential impact of decarbonization technologies on the design and operation of industrial plants.

IWC 24-37: Energy Transition Water Needs – Operational Implications and Resolutions

Time: 8:10 AM

Kathryn VanderEspt, Electric Power Research Institute, Louisville, KY

As the industry moves towards a net-zero carbon goal by 2050, decarbonization technologies such as carbon capture and hydrogen generation will likely be installed across the globe. Research on these technologies focus mainly on their effectiveness at reducing or eliminating carbon-based air emissions, but do not consider other environmental aspects such as water usage. Carbon capture units have been shown to potentially double a plant's cooling needs, and electrolysis requires large amounts of raw water to produce a high-purity water feed for hydrogen production. How would these additional water demands physically change a plant's lay-out? How would this impact permitting and siting of plants?

This paper will utilize calculated water usage rates for carbon capture and hydrogen technologies (IWC 2024 Abstract: EPRI-Ambrose) to determine how plant operations are expected to be impacted. This paper will discuss the energy transition's potential implications for plant structures and plant development, such as intake structures as well as pollutant and thermal discharges. It will look at impacts from both a currently existing plant aspect, as well as impacts for a planned plant project. This paper will focus on water-related aspects but will also include discussions on broader environmental-related considerations that must be addressed for successful implementation of low-carbon technologies, such as land use, resource utilization, and waste generation. Afterwards, resolutions for meeting these discussed complications will be suggested, such as the utilization of alternative water sources and considerations to make for this use.

Discusser: Kenneth Chen, P.E., Brown and Caldwell, Las Vegas, NV

IWC 24-38: Dealing with Ammonia in Wastewater from Carbon Capture Projects

Time: 9:00 AM

Dave Guinta, Burns & McDonnell, Kansas City, MO ; Ali Khan, Burns & McDonnell, Kansas City, MO

Carbon dioxide (CO2) capture at fossil-generating stations and industrial facilities is of growing interest due to government funding as well as company decarbonization goals. An important, but often overlooked, aspect of CO2 capture projects is the infrastructure needed to support the supply, treatment, and discharge of water.

For post-combustion CO2 capture, an initial step of the process is flue gas cooling using direct contact cooling. This initial cooling step becomes a key contributor to the overall CO2 capture process water balance. Depending on flue gas moisture content, ambient conditions, and the target gas temperature this cooling step can vary from demanding a demineralized quality makeup to producing more than 1,000 gpm of condensate. Constituents in the recirculating water will also vary depending on what is in the flue gas which is highly dependent on the original fuel source, any air quality control systems utilized, and what (if any) chemicals are added to the direct contact cooling process.

This paper will focus on the fate of ammonia through the CO2 capture process and methods to mitigate and treat the ammonia concentrations in the wastewater streams. Ammonia slip from Selective Catalytic Reduction (SCR) systems at natural gas combustion facilities will absorb into the direct contact cooling recirculating water stream. A discussion of potential options to limit ammonia concentrations in the upstream flue gas will be included in this paper, along with options to treat / remove this ammonia once it is absorbed in the recirculating water system. While specific project data cannot be shared due to confidentiality, water quality, flow rate, and technology information will be presented that is representative of a CO2 capture project at an existing natural gas fired combined cycle power plant. Options to estimate the water quality of this stream early in the planning process will also be highlighted, as this can be a significant challenge for Owner's who do not have the benefit of data from an existing CO2 capture plant or pilot. Challenges unique to this application will be highlighted, along with pros and cons of potential solutions to treat the ammonia in the wastewater generated in a post-combustion CO2 capture facility.

Discusser: Jack Ma, UCC Environmental, Waukegan, IL

IWC 24-39: Full Scale Comparison of Multimedia and Ultrafiltration for Pretreatment to Reverse Osmosis

Time: 10:10 AM

William Sellerberg, P.E., Con Edison, New York, NY ; Gary Thorn, P.E., Con Edison, New York, NY; Joe Habib, Wigen Water Technologies, Chaska, MN; Joseph Kelly, DuPont, Tully, NY; Jordan B. Cancel, Con Edison, New York, NY

In the spring of 2021, Consolidated Edison of New York began construction to revamp a 12.6 MGD water treatment system. The system is comprised of two identical and independent 6.3 MGD trains to produce low conductivity water used to generate steam for New York City. The original design used multimedia filtration (MMF) as pretreatment for reverse osmosis (RO) followed by electrodeionization. The upgrade replaced the MMF with an ultrafiltration (UF) system to improve RO life and recovery. RO recovery was improved by adding a third stage and recycling a percentage of concentrate to the raw water tank when water quality permits.

The project occurred in phases. Train A remained in operation as Train B underwent demolition, construction and equipment start-up, followed by Train B, and finally the addition of the 3 rd stage to the RO trains. This paper documents the temporary side-by-side performance of two different pretreatment filtration technologies (MMF and UF) which simultaneously received the same influent water. The performance of Train A and Train B are compared, including parameters
such as cartridge filter change out frequency and RO cleaning interval. MMF and UF filtrate water quality are compared using online instrumentation, grab samples and on silt density index (SDI) measurements.

The paper additionally quantifies the volume of water conserved through the increased RO efficiency and partial concentrate recovery. The results highlight both a clear sustainability benefit as well as a compelling financial return.

Discusser: HC Liang, Ph.D., Pchem, BQE Water, Vancouver, BC, Canada

IWC 24-40: Lithium Extraction using Lithium Aluminum Double Hydroxide: A Kinetic Model-Based Optimization

Time: 11:00 AM

Leslie Miller, OLI Systems, Reston, VA ; AJ Gerbino, OLI Systems, Parsippany, NJ

Layered double hydroxides (LDHs) are emerging as a promising material for direct lithium extraction (DLE) from various feedwaters. This paper presents the development of a kinetic model for the adsorption mechanism of the layered double hydroxide (LDH) DLE process. The model incorporates chemical speciation, activity coefficient model, rate-limiting steps, and the assumption that the rate of lithium extraction is controlled by the diffusion of lithium ions through the LDH layers.

A thermodynamic database was developed for LDH media in which the Li and Cl adsorption sites are incorporated as a single molecular exchange reaction. The LDH media is simulated as an uncharged unit cell group with a single atomic vacancy. Lithium fills the vacancy and the chloride enters the interstitial space to balance the charge. We use literature data to back-calculate the LDH formula weight (e.g. mass per vacancy) and the adsorption coefficients (K). We also used time-dependent experimental data to regress kinetic coefficients. The thermodynamic database was then used in process simulation to optimize a LDH DLE process for the efficient extraction of lithium from a variety of brines.

The kinetic model was validated against experimental data, and it was found to accurately reproduce the effects of the various operating parameters on media performance. The simulation results suggested that it is possible to apply a media producer’s lab data to a thermodynamic-kinetic simulation tool to design, scale up, and optimize a LDH DLE plant. The simulation tool can then evaluate the impact of process variability on the media performance without the need for additional experimentation.

Discusser: John Schubert, HDR, Sarasota, FL

Tuesday, 11/5/2024; 8:00 AM

T4: IWC’s First Ever Food and Beverage Session

IWC Rep: Lyndsey Pence, ZwitterCo, Inc, Los Osos, Ca

Session Chair: Anthony Amendola, P.Eng., Newterra, Burlington, ON, Canada

Discussion Leader: Bill Malyk, WSP, Cambridge, ON, Canada

The Food and Beverage industry, including agriculture, accounts for ~70% of the freshwater consumption of the world. Now more than ever due to environmental regulations, internal sustainability/ESG objectives, and consumer demands, Food and Beverage companies are looking at ways to minimize water use in their production facilities, as well as reuse water for both direct and indirect purposes.

In this first ever Food and Beverage Technical Session in IWC history, the speakers will discuss regulatory impacts related to wastewater treatment and water reuse in the Food & Beverage industry, and share strategies and case studies to help the industry overcome challenges and concerns with implementing solutions to solve this very important need.

IWC 24-41: Advancing Water Reuse Within the Beverage Industry

Time: 8:10 AM

Norton Fogel, GHD, Farmington Hills, MI ; Peter Capponi, GHD, Atlanta, GA; Paul Bowen, GHD, Clemson, SC; Therese Mazure, PepsiCo, Bradenton, FL; Paula Kehoe, San Francisco Water, San Francisco, CA

Water is essential to the beverage industry as it is used in every facet of it, from cultivating ingredients to dispensing and serving beverages to consumers. Without sufficient water, beverage companies cannot produce their products. Water supply, quality, demand, and wastewater generation are meaningful in this sector. Complex water challenges have motivated corporate personnel, regulators, consulting engineers, equipment and technology providers and consumers to seek and develop solutions to help the beverage industry optimize water usage and operate sustainably. Toward this end, water reuse offers a compelling opportunity for beverage manufacturers: by recycling water for non-ingredient (or non-product) purposes onsite, beverage manufacturers can minimize water demand and wastewater volumes, elevate operational efficiencies, reduce costs, and achieve sustainability goals.

A diverse group of action leaders and partners developed and published a white paper under the Water Reuse Action Plan, a national program coordinated by the United States Environmental Protection Agency, in March 2024. The action leaders and partners identified five priority challenges, promising solutions, and tactics to enable water reuse at beverage manufacturing plants over near, medium-, and long-term time horizons. Near-term tactics comprised developing a glossary of terms for stakeholders in beverage manufacturing, to improve stakeholder communication, and a flow chart of how to use the Hazard Assessment Critical Control Point framework, a risk assessment approach that informs regulatory decision-making, for water reuse in beverage manufacturing. A medium-term strategy included organizing outreach events, such as summits, focused specifically on water reuse in beverage manufacturing to help resolve public perception issues. Another medium-term tactic is to develop a technical guidance document to inform treatment and monitoring designs, abating some engineering challenges resulting from current regulatory gaps. In the long term, commissioning intentional demonstration plants to test ideas and inform industry best practices can clarify important decision points and enable the uptake of water reuse systems at beverage manufacturing plants.

In this paper, we will summarize follow-on activities that have taken place since the publication of the white paper and seek feedback from the 2024 International Water Conference attendees for consideration in the next phases of this work.

Discusser: Anthony Zamarro, P.E., CDM Smith, Boston, MA

IWC 24-42: Comprehensive Reuse at Bush Brothers Facility

Time: 9:00 AM

Houston Flippin, Brown and Caldwell, Nashville, TN ; Michael Mecredy, Brown and Caldwell, Nashville, TN; Joe Wong, Brown and Caldwell, Walnut Creek, CA; Charlie Gregory, Brown and Caldwell, Atlanta, GA; Terry Dockery, Bush Brothers & Company, Dandridge, TN

The Bush Brothers Plant in Dandridge, Tennessee produces canned vegetables and bean products and is located on more than a 1,000 acres cattle farm. All waste food products are collected and used as part of the cattle feed along with the hay grown on the property. All wastewater from the facility was historically treated using anaerobic biological treatment and applied as irrigation water on the cattle farm to grow a hay crop.
The county where the plant is located had a severe drought leading to water scarcity challenges in 2014. During this drought, the plant had maximized all potential water supply options including its ability to withdraw groundwater and its allocation with the County potable water supply system. Further, the pasturelands soil where wastewater was applied was found to have increasing nitrogen concentrations. The water supply limitation was an impediment to future production goals. In response, our team partnered with Bush Brothers to design and install a new water reclamation facility that improved biological nutrient removal, which allowed continued agricultural reuse of the treated effluent, and also produced water suitable for reuse as utility water at the plant (cooling tower makeup and boiler makeup water). Overall, the project resulted in 100 percent beneficial reuse of the water and reduced the plant water consumption by 30 percent.
Our paper will share the important design details of the water recovery system and its unique anaerobic treatment process that maximizes organics removal followed by a biological nutrient removal activated sludge treatment system incorporating ultrafiltration. This combined treatment produces an unprecedented 99.7 percent COD removal. We will share our results in speciating the biological treatment effluent TOC (> 10 mg/L), which was shown to be hydrophilic and suitable to feed to the reverse osmosis system without further treatment (a significant process savings). This work has wide ramifications due to the misconception that all TOC fouls reverse osmosis membranes.
The Bush Brothers Water Reclamation Facility has been successfully operating for over 6 years and has won over 6 awards for engineering excellence, including the Design-Build Institute of America National Merit Award in 2018 and the Water Environment Federation Industrial Water Quality Achievement Award in 2022. A summary of facility learnings and operational performance data will be provided in our paper.

Discusser: Otto Morales, P.Eng., Stantec, Fredericton, NB, Canada

IWC 24-43: Impact of new Part 432 ELG regulations on the Meat Packing Industry

Time: 10:10 AM

Brian Mulinix, HDR, Omaha, NE

Meat and poultry processing industries are a vital component of our country's food supply and safety. Due to the nature of animal harvest processes, wastewater flows and loadings can have a significant impact on receiving water bodies as a direct discharger and municipalities who receive and process these wastes as an indirect discharger. Originally established in 1974 and modified in 2004, EPA has published major modifications to 40 CFR Part 432 Meat and Poultry Products Point Source Category. These regulations will impact how current and future facilities are operated and incorporate three key modifications. These include: 1) reduction of total nitrogen effluent from daily average of 134 to 12.4 mg/L, 2) addition of total phosphorus effluent for daily average of 0.772 mg/L, and 3) establishing pretreatment standards for indirect dischargers for parameters of BOD, O&G, and TSS. Additional impacts that are being considered include high chloride wastes, reduction of fecal coliform limit, and the addition of E. Coli disinfection limit. This paper will review regulation impact for existing and future facilities. Additionally, several case study analyses for direct and indirect dischargers will be presented on how these facilities can achieve lower effluent limits.

Discusser: Dominic Pontarolo, Brown & Caldwell, Boise, ID

IWC 24-44: Novel Zwitterionic Membranes Enable High-Strength Food & Beverage Wastewater Treatment & Reuse

Time: 11:00 AM

Christopher Roy, ZwitterCo, Woburn, MA ; Andrew Hunt, ZwitterCo, Woburn, MA

The application of zwitterionic membranes to treat increasingly challenging wastewater streams and generate valuable coproducts and clean water for reuse continues to expand with more successful pilot demonstrations in the Food & Beverage wastewater segment. This paper focuses on the award winning and patented zwitterionic membrane chemistry that is immune to irreversible organic fouling and its application in meat and poultry wastewater treatment. It will also touch base on the recent expansion of the zwitterionic platform material chemistry to the reverse osmosis space and the expanding commercial install base of the zwitterionic superfiltration technology.
This paper is a follow-up to previous papers presented at IWC in 2023 and 2022: “Full-Scale Implementation of Novel, Zwitterionic Membranes for Water Reuse in High-Strength Wastewaters” (IWC-23-44) and “Driving High Recoveries in Water Reuse Applications with Novel, Zwitterionic Membranes” (IWC-22-13). It serves as a check-in on applications and installations presented in these previous papers as well as an expansion of wastewater applications and the technology into additional Food & Beverage applications.

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

Tuesday, 11/5/2024; 1:30 PM

T5: Water Innovation for Sustainable Resource Management: From Circular Economy Solutions to Clean Water Act Compliance

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

Session Chair: Otto Morales, P.Eng., Stantec, Fredericton, NB, Canada

Discussion Leader: Donna Murphy, Dupont Water Solutions,

Exploring the Frontiers of Water Management: From Reimagining Wastewater as a Source of Critical Minerals to Optimizing Energy Efficiency in Water Pumping, and Achieving Clean Water Act Compliance through Advanced Ozonation Techniques. This comprehensive overview delves into cutting-edge strategies that revolutionize resource recovery, energy conservation, and water quality enhancement, paving the way for a sustainable future.

IWC 24-45: Novel Deposit Sensor Technology for Proactive Insights into Deposition Stress for Cooling Water Systems

Time: 1:25 PM

Aarthi Narayanan, Nalco Water, an Ecolab Company, Naperville, IL ; Joseph Bopp, Nalco Water, an Ecolab Company, Naperville, IL; Joanna Brown, Nalco Water, an Ecolab Company, Naperville, IL; Alexander Pearson, Nalco Water, an Ecolab Company, Naperville, IL

With the recent shift to using reclaimed and more challenging water sources and the desire to minimize water usage, there is a compelling need for advanced technologies to monitor the dynamic water source in cooling water systems. This combined with other factors such as smaller staffs, tighter budgets, need for faster responses without dedicated resources warrants a technology that can not only monitor the deposition stress of the cooling tower but also provides recommendations that can be acted upon. With these challenges in view, industry has been trying for several years to develop a simple, accurate deposit monitoring technology that can not only detect several types of deposits but also differentiate between the deposit types. This paper provides an overview of various deposit monitoring technologies, outlines how this novel deposit sensor delivers technical results and provides a deeper dive into real world applications of this technology in the cooling water systems.

Discusser: Nicole Stafford, McKim & Creed, Pittsburgh, PA

IWC 24-46: Saving Energy by Pumping Water Using Permanent Magnet Motors & Drives

Time: 2:15 PM

Brendan Watson, Grundfos, Monroe, GA ; Courtney Tripp, Grundfos, Lenexa, KS; Samantha Perez, Grundfos, Lenexa, KS

Pumps, which are integral to water movement and treatment processes, account for 25% of all electricity consumed by industrial electric motors. Yet, these are often overlooked opportunities where companies can make significant strides toward reducing their carbon footprint and achieving net zero targets. In fact, it is estimated that 4% of global emissions could be saved in the water sector. One of the biggest opportunities for energy savings lies in improving the efficiency of the motors and drives powering pumps.
By integrating permanent magnet motor technology and variable speed drives with high-efficiency pumps, 37% of pump energy consumption can be saved in an array of applications, including boiler feed, water transport, reverse osmosis, and wash and clean applications. This paper will discuss how permanent magnet motors and variable speed drive technology work and how they are able to offer increased process optimization and efficiency, when combined. Additionally, by integrating a built-in PID loop controller and a design that reduces harmonics, further optimizations is possible. A case study from a whiskey distillery where energy consumption by their pumps was reduced by 40% and their boiler gas usage was reduced by 6% will be included to illustrate the potential of these technologies to improve sustainability.

Discusser: Daniel Hilson, SAMCO Technologies, Buffalo, NY

IWC 24-47: Wastewater Toxicity Reduction by Ozonation to meet Clean Water Act Requirement

Time: 3:20 PM

Robert Newton III, De Nora Water Technologies, Sugar Land, TX ; Elizabeth Wong, De Nora Water Technologies, Singapore, Singapore; Alex Bettinardi, De Nora Water Technologies, Milan, Italy; Abby Momorella, De Nora Water Technologies

The Clean Water Act requires control of “Whole Effluent Toxicity” (WET) testing wastewater and its discharge into the environment. WET is the total toxic impact on aquatic organisms from a wastewater source. Wastewater effluents can be required to meet the (WET) standard. Industrial facilities can produce wastewater with various pollutants, and as a result have a toxicity above the Clean Water Act requirements.

Ozone water treatment can reduce industrial wastewater effluent toxicity. Pilot testing of ozone treatment combined with toxicity testing can determine if ozone is a viable treatment option. This testing will also provide the necessary engineering data to design and estimate the cost of the ozone solution.

Viability of using ozonation to reduce WET of a chemical plant wastewater was studied.

Two species (Pimephales promelas and Ceriodaphnia dubia) were chosen to evaluate Tuc (chronic toxicity units) in accordance with « Short Term Methods For Estimating The Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms, Fourth Edition» (October 2002. United States Environmental Protection Agency. Office of Water, Washington, D.C., EPA 821-R-02-013).

The TUc of on-site samples from WWTP were >16 for Pimephales promelas survval, >16 for Pimephales promelas growth, 8 for Ceriodaphnia dubia survival, 8 for Ceriodaphnia dubia reproduction.

The goal was to achieve the reduction of at least 50% of the toxicity value of the effluent.

Batch testing was first conducted in laboratory to confirm effectiveness of ozonation to reduce the chemical plant WWTP effluent toxicity. Ozonation significantly eliminated toxicity of WWTP effluents, with reduction rates of 50% on Pimephales promelas survival, 100% on Pimephales promelas growth, 100% on Ceriodaphnia dubia survival and 50% on Ceriodaphnia dubia reproduction.

On-site continuous testing was conducted next after achieving positive results from laboratory batch testing. On-site testing has revealed that ozonation could effectively reduce the toxicity of effluent, indicating the necessity for advanced treatments to guarantee water quality. Ozone at 19.5 mg/L significantly reduced the toxicity by 75% on Pimephales promelas survival, 100% on Pimephales promelas growth, 100% on Ceriodaphnia dubia survival and 100% on Ceriodaphnia dubia reproduction.

The test results met the state requirements for effluent discharge. As a result, the chemical manufacturer decided to install an ozone water treatment system for toxicity reduction of their wastewater effluent.

Discusser: Cynthia Wagener, P.E., ExxonMobil Corporation, Spring, TX

IWC 24-48: Water Intensity Reduction Paths to Sustainability

Time: 4:10 PM

Timothy Eggert, Veolia WTS, Portland, OR ; Dan Harbs, Veolia WTS, Fountain Valley, CA; Robert Hendel, Veolia WTS, Trevose, PA; Matt McEachran, Veolia WTS, Las Vegas, NV

These days, virtually everywhere you look and most anything you read seem to talk about sustainability of an industry, plant, or unit operation. Sustainability covers a broad range of topics from Green House Gas (GHG) emissions, energy footprint, and water consumption. The use of the term “intensity” for measuring and tracking sustainability improvements for many industries is now a key metric that needs to be calculated, and soon will likely need to be reported to C-suite executives and government agencies. Sustainability goals are being set by corporate executives, and now it’s up to engineers, operators, and solution providers to figure out how to meet these goals in a consistent, economical, and measurable way.
This paper discusses water sustainability with a review of current government policies, standard calculations for measuring water intensity, and overview of the four phases of water intensity reduction: discovery, baseline, reduction, and reuse. Of the four phases, this paper will focus on water reduction strategies within the current unit operations found within the battery limits of industrial facilities. Case studies for common unit operations, namely, cooling systems, boiler steam production, and wastewater operations (segregation and direct reuse), will be presented. Sample calculations for water intensity will be provided to show the applicability of this approach to a large portion of the industry. Since water intensity is often tied to other sustainability indicators, the impact on non-water sustainability elements such as GHG reduction from energy usage will be discussed, among others.

Discusser: Kirk Ellison, EPRI-Electric Power Research Institute, Charlotte, NC

Tuesday, 11/5/2024; 1:30 PM

T6: Refineries: Wastewater Treatment Issues and Managing Biofilms

IWC Rep: Jeff Easton, ClearStream Environmental, Cottonwood Heights, UT

Session Chair: Bryan Hansen, P.E., Burns & McDonnell, Kansas City, MO

Discussion Leader: Jim Summerfield, Ecolab, Freeland, MI

This session covers treatment of various wastewaters present in refineries for reduction of chemical oxygen demand (COD) and for production of a water quality suitable for use in hydrogen hydrolysis. We will also dive into a better understanding of how biofilms adhere to surfaces, how surfactants remove and prevent biofilms, and discover a novel sensor for monitoring of deposition and biofilm risk in heat exchanger surfaces.

IWC 24-49: Renewable Wastewater Treatment Challenges and Solution

Time: 1:25 PM

Brent Lugo, Baker Hughes, Sugar Land, TX ; Sankaran Murugesan, Baker Hughes, Sugar Land, TX; Jim Kiolbassa, Baker Hughes

Renewable fuels are considered as the low carbon fuels towards energy transition and decarbonization efforts. These fuels are produced from various feedstocks, including vegetable oils, used cooking oil, and biomasses, using catalytic conversion processes. During the catalytic renewable fuels production, the wastewater becomes contaminated with high levels of organics, such as free fatty acids, phospholipids, and glycerol. These dissolved organics increase the chemical oxygen demand (COD) of wastewater, which can significantly impact the secondary treatment processes in a wastewater treatment plant (WWTP) at biorefineries. The presence of high levels of dissolved organic matter can overwhelm the biological treatment systems, leading to decreased treatment efficiency and increased operational costs. Therefore, effective COD reduction is essential to ensure the proper functioning of secondary treatment processes in a WWTP.
This paper presents methods to reduce dissolved organics, especially COD, in wastewater collected from biorefineries using various feedstocks, such as corn oil, tallow, used cooking oil, and poultry. The study includes detailed characterization and analysis of individual feedstocks and their effects on wastewater and COD levels. Further, different chemical additive approach as well as process modification to reduce COD are discussed in detail. Overall, this study underscores the importance of efficient wastewater treatment in renewable fuels production and offers insight into sustainable solutions for managing biofuel wastewater from the production of biofuels.

Discusser: Bridget Moyles, GHD, Allison Park, PA

IWC 24-50: Gulf Coast Refinery Cooling System uses Patented Deposit Sensor Technology for Optimization and Risk Management

Time: 2:15 PM

Laura Vanvliet, Nalco Water, An Ecolab Company, Houston, TX

Over the past several decades, there have been many attempts to quantify scaling and biofilm fouling risk on heat exchanger surfaces in industrial cooling water systems. Historically, these techniques have had limited success in refinery applications due to the inherent stresses in refinery cooling water systems. Furthermore, these techniques often lack actionable insights to mitigate the deposition risk or are unable to monitor across a range of heat exchanger conditions.
Understanding the limitations of prior art forms, a novel deposit sensor was developed that is designed to monitor deposition risk at four separate temperature targets and includes on-line data collection which permits proactive mitigation. This paper presents a case history of the patented technology in a highly stressed Gulf Coast refinery and explains how information from the sensor identified deposition risk and allowed for adjustments in operation to prevent loss of production due to poor heat transfer in critical heat exchangers.

Discusser: Patrick Regan, Solenis, Wayne, PA

IWC 24-51: Water Reuse For Sustainable Refinery Upgrade

Time: 3:20 PM

Thomas E. Higgins, Ph.D., P.E., Worley Group, St. Augustine, FL ; Masood Irani, Worley Group, Long Beach, CA; Faysal Khan, Worley Group, Houston, TX

Renewable energy production technologies are undergoing rapid development to facilitate a large scale transition from the current fossil fuel basis to one that is more sustainable. These new technologies require significant quantities of ultrapure water.

A petroleum company is pursuing a project to convert waste oil and grease into a hydrocarbon biofuel. Oils and greases are carboxylic compounds of carbon, hydrogen and oxygen.

Petroleum fuels are hydrocarbons. Conversion from carboxylic form to fuel require replacing oxygen with hydrogen, as well as conversion of double bonds to single bonded carbon. Both require green hydrogen, for a sustainable process. Green hydrogen requires about 1 gallon of ultrapure water and 2.4 KW-hr of electricity to produce a pound of hydrogen.

The evaluated project will hydrolyze about 800 gpm of ultrapure water to produce about 600 tons of green hydrogen per day.

Petroleum company currently uses public utility water in their refinery. The companies sustainability goals preclude using additional public utility water for the project. Two options are being pursued to provide water for the project, while not increasing utility water usage:

1.Treating clean stormwater for makeup to an existing coolng tower, and
2.Treating the current treated wastewater to a quality for the green hydrogen hydrolyzers.

Three options were evaluated for reuse of stormwater for cooling tower makeup:

1.Sand filtration
2.Membrane filtration
3.Membrane filtration and nanofiltration softening

Two options were considered for treating wastewater effluent for hydrogen hydrolyzers:

1.GAC Absorption, membrane filtration and Ion Exchange demineralization
2.GAC Absorption, membrane filtration, RO and electrodialysis.

For each of these options, process flow diagrams and mass balances were developed. Mass balances included water flow rates, as well as individual ions. A chemistry tool (OLI Stream Analyzer) was used to determine precipitation reactions, which could result in scaling of equipment and heat exchangers in the plant. RO tool was used to determine salt rejection and product yields. A baseline of existing water balance for the processes was used to calibrate our mass balances. Equipment was sized based on typical sizing criteria. CAPE and OPEX estimates were prepare for each option using parametric models, factored capacity tables, and factored or escalated quoted costs.

Discusser: Craig Mills, WesTech Engineering, Salt Lake City, UT

IWC 24-52: Control of Biofilms by Using Adhesion Energy Concept

Time: 4:10 PM

Duy Nguyen, ChampionX LLC, Sugar Land, TX

Bacterial adhesion and biofilm formation cause health issues such as implant failure, food contamination and lead to economic losses due to microbiologically influenced corrosion (MIC) on the surface of oil/gas pipelines. However, understanding the mechanism of how the biofilm adhered to the solid surface was not fully understood. The interaction between bacteria and surfaces plays a vital role in dairy, environmental, industrial, and medical applications. Surfactants are commonly used to remove and prevent bacteria adhesion on surfaces. The objective of this work was to investigate the adhesion of Pseudomonas spp., Staphylococcus aureus, and Staphylococcus xylosus on polycarbonate, marble, granite, polystyrene, stainless steel, the work required to prevent and remove the biofilm by four different surfactant types (cationic, anionic, and amphoteric, nonionic), and the affinity of the surfactants and biofilms at the surfaces by using contact angle measurements. These fundamental parameters were used as a tool for assessing the performance of a biocide and then were correlated to CDC reactor and confocal microscopy studies which only provide phenomenological results. The work required to remove the biofilm from polystyrene is negative for cationic surfactants while positive for nonionic, amphoteric and anionic surfactants, suggesting that cationic surfactants are more effective at removal of biofilm. These results are in good agreement with CDC and confocal microscopy studies. Cationic surfactants also prevent biofilm formation by having a stronger affinity for the solid surface than the biofilm as reflected by a lower interfacial tension of surfactant/ substrate than the interfacial tension of the biofilm/substrate. Understanding the mechanism of how the biofilm adhered to the solid surface would expedite the development of surfactants for removal and prevention of biofilms.

Discusser: George Ganzer, Gee Consulting US, Buckingham, PA

Tuesday, 11/5/2024; 1:30 PM

T7: Zero Liquid Discharge (ZLD)

IWC Rep: Elke Peirtsegaele, ZwitterCo, Inc., Carpenteria, CA

Session Chair: Ashwin Thakkar, Aquatech International, Toronto, ON, Canada

Discussion Leader: Kenneth Chen, P.E., Brown & Caldwell, Las Vegas, NV

Zero Liquid Discharge (ZLD) for the various Industrial Wastewater Treatment applications using different technologies, i.e. using Reverse Osmosis (RO), Counter Flow Reverse Osmosis (CFRO), CCRO, as well as Brine Concentration & Evaporation for the treatment of highly concentrated waste. The application goals can be for high recovery, Recyle & Resue, Metals Recovery (i.e. Lithium), wastewater volume reduction for MLD, or environmental compliance. Interesting facts highlighting Lessons Learned from various industries. Session also highlights the CapEX and OpEX optimization using various technologies.

IWC 24-54: Leveraging MLD/ZLD Success Across Industries

Time: 2:15 PM

Toni Bechtel, DuPont Water Solutions, Edna, MN ; Simon Pitts, DuPont Water Solutions, Johannesburg, Gauteng, South Africa

Zero-liquid-discharge (ZLD) is a well-established wastewater treatment approach utilized across a range of industrial applications. Irrespective of total treatment volume or global location, the most expensive portion of the ZLD scheme is the conventional thermal treatment which requires an appreciable physical footprint as well as carbon footprint to operate. The implementation of minimum-liquid-discharge (MLD) to reduce the final thermal treatment volume via multi-staged reverse osmosis membranes has proven to be an effective hybrid solution that reduces the cost and energy demand of thermal ZLD. However, water is not always the only valuable resource within a wastewater stream.

Many heavy industries in the Asia-Pacific region are required by local regulations to practice ZLD and have implemented the hybrid MLD/ZLD scheme to remain cost competitive. They have demonstrated, with great success, their ability to reuse water, but also reuse and/or valorize components of their wastewater. In India, textile facilities have an established pretreatment protocol involving mechanical filtration, ultrafiltration, and WAC softening, followed by multi-stage reverse osmosis to produce clean water for reuse within the facility and a highly concentrated waste stream. That high concentrated waste stream is then passed through a divalent ion-selective nanofiltration membrane, which preferentially rejects divalent ions to the concentrate stream and passes monovalent ions to the permeate stream. The divalent-rich concentrate stream is then recycled directly back to the textile dye bathes while the monovalent-rich permeate steam can also be recrystallized and recycled within the process or resold as an industrial-grade salt. The chemical industry in China employs a remarkably similar wastewater treatment scheme, where streams rich in divalent ions, such as calcium and magnesium, can be recovered from wastewater, recrystallized, and sold as industrial-grade salts. The monovalent-rich streams, generally comprised of sodium chloride, can then be utilized in soda ash or caustic production, or the chlor-alkali process.

The hybrid MLD/ZLD model has been successfully employed to increase wastewater reuse and resource recovery across heavy industries in much of China, India, and Southeast Asia. This approach can and should be leveraged to other, seemingly unrelated industrial applications across the globe. Many industries, which previously had few water-related regulations and an abundant water supply, such as the agricultural sector or microelectronics and semiconductor manufacturers, are facing increasingly stringent local regulations, water scarcity, and increasing resource and material costs. Creative solutions to treat and reuse challenging wastewater streams already exist – we just need to open ourselves to the possibilities.

Discusser: Omkar Lokare, Turing AI, Woburn, MA

IWC 24-55: Enabling ZLD of Cooling Tower Blowdown Utilizing CCRO

Time: 3:20 PM

Ashesh Vora, DuPont, Marlborough, MA

A leading U.S based aerospace company operates a facility where CCRO plays a key role in their water conservation efforts. The majority of water used is in the utilities sector for boiler feed and cooling tower requirements. The source of the make-up water for both processes is municipal (potable) water. In addition to utilizing city water as feed, the utilities sector also generates the majority of wastewater that is discharged into the municipal sewage system from cooling tower and boiler blowdowns.

In October 2020, an updated sewage discharge permit was issued by the local authorities incorporating more stringent discharge requirements, focusing on sulfate, selenium, and cyanide limits. This permit would take effect in April 2023. To comply with the new permit, the manufacturer contracted an engineering firm to assist in developing a solution. This included a review of the existing wastewater treatment processes, water flow and usage, as well as potential reuse options such as recycled wastewater for use as utility water.

Following a comprehensive review of several treatment options, it was recommended that a pilot program be undertaken to test the feasibility of utilizing membrane-based recycling technology to produce feed water to the utilities from the wastewater treatment plant. Ultrafiltration and Closed-Circuit Reverse Osmosis (CCRO) technologies were selected for this trial. Historically treating and reusing blowdown waters comprised of high salinity, suspended solids, and proprietary water treatment chemicals has proven to be difficult with traditional reverse osmosis systems. However, the operational benefits of the closed-circuit technology are designed to overcome and mitigate these challenges and deliver a high-water recovery solution.

Th pilot program verified the ability of the membrane systems to produce high-quality water capable of not only meeting the new discharge regulations, but also provide reuse water suitable for use within the facility. The UF system reduced wastewater influent turbidity from an average 9.7 NTU to an average turbidity of 0.025 NTU in the final filtrate. The CCRO unit verified the ability to operate up to a maximum recovery of 92%. Although influent conductivity was variable and ranged between 2,000 uS/cm (micro-Siemens per centimeter) and 10,000 uS/cm, the CCRO system still produced a quality permeate stream consistently averaging 125 uS/cm. The CCRO brine had an average conductivity of 25,000 uS/cm making it suitable for further processing in a brine crystallizer to further solids reduction. The entire treatment process could then be considered a Zero Liquid Discharge (ZLD) plant.

Discusser: Vinod Raje, Aquatech International, Heartland, WI

IWC 24-56: Selection of ZLD Technologies for Industrial Applications

Time: 4:10 PM

Joseph Tinto, Gradiant Corporation, Seattle, WA ; Wing Cho, Gradiant Corporation, Seattle, WA

Water scarcity and corporate sustainability goals are resulting in a wave of high-recovery water treatment and wastewater reclaim facilities. As facility recoveries increase, brine management is often required, and Zero Liquid Discharge (ZLD) is increasingly necessary. This paper analyzes CAPEX, OPEX, lead times, etc. for two novel brine concentration technologies, counter flow reverse osmosis (CFRO) and carrier gas extraction (CGE), as well as conventional mechanical vapor recompression (MVR) evaporation. These evaluations were performed on three common feed chemistries: (1) wastewater originating from the manufacture of semiconductors, (2) oilfield produced water, and (3) lithium brines from direct lithium extraction (DLE) methods. The analysis indicates that each treatment option has its own advantages and disadvantages. No one brine concentration method is superior for all applications; they all have their place, depending on owner key performance indicators (KPIs) as well as availability and cost of electricity, steam, chemicals, and footprint. The paper will also share some short case studies on the application of these technologies in ZLD systems.

Discusser: Yasaman Saedi, Stantec, Las Vegas, NV

Tuesday, 11/5/2024; 1:30 PM

T8: Solutions in Brine Management – Applications for Mining

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

Session Chair: Diane Martini, Burns & McDonell, Chicago, IL

Discussion Leader: Don Downey, Ecolab, Paris, ON, Canada

Mining wastewater is notorious for being acidic, dissolving high concentrations of salts such as calcium, magnesium, sulfate nitrate and chloride, and containing trace metals like antimony, arsenic, and selenium. These brines share many characteristics with coal pile runoff, produced water, and some industrial wastes and have traditionally been managed in pits or ponds. New applications are being developed and others are being transferred from other industries to tackle these challenges.

This session will review treatment systems that run the gamut from bulk biological treatment for selenium to advanced membrane and other technologies for salts removal. Beginning with pond treatment using saturated rock fill, followed by pond management techniques to remove arsenic, antimony and sulfates, and moving on to pilot testing for thiosalts management technologies, we will close with the exploration of a newer membrane technology for salt removal.

IWC 24-57: An Effective Selenium Passive Removal Process that Meets Mine Closure Challenges - removal of Nitrate and Selenium from Mine-influenced Water using Saturated Rock Fill (SRF) Process

Time: 1:25 PM

Maria Borja, WSP, Denver, CO ; Tom Rutkowski, WSP, Denver, CO

Testing was completed on the applicability of saturated rock fill (SRF) technology to treat mine-influenced water for nitrate and selenium removal. SRF technology is in situ technology that utilizes backfilled mine pits as anaerobic bioreactors. Influent is pumped into the rock media along with nutrients, to support biological selenium reduction, flows horizontally through pit media, and is then extracted via pumping wells. In 2023-2024, WSP conducted a bench-scale trial of the removal of nitrate and selenium from mine water using the SRF process. The bacterial inoculum was developed from sediments at the mine site. Carbon (acetic acid) and nutrient (phosphorous) were added to the source water upstream of the SRF reactor to promote denitrification and bioreduction of selenium to less soluble forms in the SRF reactor. The effluent of the SRF reactor was pumped into an aeration stage and finally through a solid-liquid separation stage. Over 7 months of testing, an average of 99% of nitrate, 95%, and 94% of dissolved and total selenium were removed. Two different types of waste rock were tested in parallel test reactors, and both performed similarly. Testing allowed optimization of the hydraulic retention time from 10 to approximately 5 days, which will allow for a reduction in the total capital cost and material required for the implementation of the SRF system in the mining unit at a big scale.

Discusser: Thomas E. Higgins, Ph.D., P.E., Worley Consulting, St. Augustine, FL

IWC 24-58: Breaking The Salt Cycle: How a Novel Antimony Retrofit Increased Water Treatment Plant Recovery by 50% and saved $3M in Brine Management Controls

Time: 2:15 PM

Denney Eames, WaterTectonics, Everett, WA ; Raymond Davis, Hecla Mining Co., NV; Kurt Hansen, Watertectonics, Everett, WA

A Nevada gold mine needed to improve their water treatment plant. The mine had two brine storage ponds that were full, and they were planning on building two more storage ponds. The new plant needed to treat 200-gpm and produce the least amount of brine concentrate. The existing water treatment plant operated at less than 65% recovery. The discharge water needed to meet Nevada Profile I targets to be discharged to a public water. The key water contaminates of concern were:

- Arsenic
- Antimony
- Sulfate

During the design process, the project team developed a novel, non-membrane approach to remove antimony from the water. The design improved the projected recovery to >87%. Process controls were critical to the success of the water treatment system.

Commissioning of the plant was challenging. Influent water quality was highly variable. Water quality parameters will be presented covering the first eight (8) days of operations through the process train. A discussion of the results and process changes will be presented.

Lessons learned from three years of operations will be presented. The operational and process changes made during this period improved recovery to over 99%. The mine was able to cancel the construction of the additional brine ponds, saving more than $3 million dollars. In addition, a discussion of the issues experienced during a 3-month drilling program at the site and the solutions discovered will be presented.

Discusser: Ken Martins, Stantec, Reno, NV

IWC 24-59: Pilot Demonstration of New Tools for Thiosalts Management to Reduce Treatment Costs and Carbon Footprint at a Canadian Mine

Time: 3:20 PM

H.C. Liang, Ph.D., Pchem, BQE Water, Vancouver, BC Canada; David Kratochvil, BQE Water, Vancouver, BC, Canada; Kresimir Ljubetic, BQE Water, Vancouver, BC, Canada; Nasrin Mehrjoo, BQE Water, Vancouver, BC, Canada; Mohammadali Shahsavari, BQE Water, Vancouver, BC, Canada

Thiosalts species including thiosulphate, trithionate and tetrathionate are formed by incomplete oxidation of sulphur bearing minerals and can sometimes be present in mine waters and metallurgical process waters. Although thiosalts are not regulated directly, their concentrations in effluents discharged into environment are regulated indirectly through toxicity tests. In Canada, Daphnia magna 48-hour lethal toxicity tests are mandated under the federal MDMER regulations and thiosalts are known to negatively affect the results. Although biological oxidation systems can be used to oxidize thiosalts to sulphate, many mines in Canada discharge water into environment only seasonally and require a rapid ramp-up in capacity during spring freshet which is beyond the capabilities of biological systems. Consequently, the most common methods of removing thiosalts in Canada involve the use of strong chemical oxidants such as hypochlorite and/or Fenton's reagent. Depending on the mass load of thiosalts reporting to treatment, the system operating cost can be high, and the carbon footprint associated with the supply of these chemicals to remote mines significant. As part of a holistic assessment of thiosalts management options at a remote mine site in Canada, new and unique tools involving the use of selective ion exchange and electro-oxidation were pilot tested. The pilot results show that depending on site specific factors, the new tools can offer better outcomes compared to traditional approaches and be integrated into overall site water management plans in multiple different ways allowing project-by-project customization.

Discusser: Erin Diven, P.E., Stantec, West Chester, PA

IWC 24-60: RSL Membranes-Technology update with Mining Application

Time: 4:10 PM

David Bromley, David Bromley Engineering Ltd., Vancouver, BC Canada; Robert Stephenson, Waterstider, Vancouver, BC, Canada

Replaceable skin layer membrane continues to provide unique and amazing results. At IWC 2023, replaceable skin layer membranes were presented for their ability to treat produced water from the oil and gas industry. An update on the technology's commercialization into produced water and mining operations will be provided. The latter on mining applications will be the focus. In the mining application, the replaceable skin layer membrane technology separates colloidal metals produced by a new crystallization technology allowing for surface discharge of mine tailings pond waters. A review is provided on the methods used to crystallize metals in the tailings pond water and the use of membranes to remove the crystallized metals. The latter is a key bottleneck in the treatment solution. The RSL Membrane™ success is reviewed and compared with conventional membranes. An in-depth look at the data will provide insight into the stress testing of the replaceable skin layer membrane technology.

Discusser: David Donkin, UCC Environmental, Waukegan, IL

Wednesday, 11/6/2024; 8:00 AM

W1: PFAS Remediation: Regulation, Adsorption, and Destruction

IWC Rep: Brad Wolf, Berkeley Reasearch Group, Pittsburgh, PA

Session Chair: Tom Gurley, ChemTreat, Glen Allen, VA

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

With the finalization of national drinking water standards for per- and polyfluoroalkyl substances (PFAS) in early 2024, the need for reliable, known PFAS remediation technologies is as great as ever. The diversity of PFAS compounds and the liquids and solids they are present in necessitates a comprehensive review of best available technologies and developing technologies. Please join us in this session as experts from diverse fields converge to address one of the most pressing environmental challenges of our time. The session begins with a road map for navigating PFAS treatments, and then further dives into specific treatment technologies such as reverse osmosis, ion exchange, activated carbon, and several destruction methods.

IWC 24-61: PFAS What To Do BEFORE You Do It

Time: 8:10 AM

Philip Farina, Clear Creek Systems, Toledo, OH

With the publication by the USEPA of new regulations governing limits on PFAS for drinking water; municipalities and engineering companies may be facing a daunting task on how best to proceed in understanding the various commercial technologies available for managing PFAS in their source waters. There is no single technology or media that is best for all situations. Each site represents unique issues and thus demands a unique solution. Understanding the current technologies for managing PFAS in source waters will allow a municipality or other impacted groups the ability to make an informed decision as to what treatment method will best meet their individual needs. This presentation will provide a road map of steps to take before deciding on a specific course of action and technology to be employed for PFAS management. We will explore the various commercialized technologies, and their pros and cons. We will then delve deeper into the various media that may be employed for PFAS management, the relative media costs under different conditions, and disposal options. This will allow a stakeholder to build a PFAS treatment system effectively, economically, and most of all safely, while remaining compliant with these new regulations.

Discusser: Paul Nedwick, ResinTech, Camden, NJ

IWC 24-62: PFAS Removal from Lightly to Highly Contaminated Source Waters by Ion Exchange Resins: Case Studies

Time: 9:00 AM

Zhendong Liu, LANXESS Corporation, Birmingham, NJ ; John McPeak, LANXESS Corporation, Birmingham, NJ; Dirk Steinhilber, LANXESS Deutschland GmbH, Cologne, Germany; Kirtipal Barse, LANXESS Corporation, Birmingham, NJ; Firuza Mir, LANXESS Corporation, Birmingham, New Jersey

The concentrations of Per- and Polyfluorinated Alkyl Substances (PFAS) range from single digit ppt to high ppb or low ppm levels in different contaminated streams. For example, in ground water and some surface waters, the PFAS is normally in low ppt ranges. In storm water or wastewater near contaminated sites, PFAS species are often in much higher concentrations. This paper shares experiences of using ion exchange resins to remove various PFAS species at different concentration levels.

The first case study involved using a highly selective ion exchange resin in a lead/lag configuration to treat a contaminated ground water containing 16 ppt PFOA, 13.8 ppt PFHpA and 114.5 ppt PFNA. The operation lasted almost 3 years and at the time of rebed, the target regulated species still has not reached end points at the mid-vessel sampling port. Based on data extrapolation, the operation can last probably another 1 year. Pressure drop across the resin bed was maintained low during operation by regularly changing the pretreatment cartridge filters.

The second case is a pilot study of a storm water contaminated by approximately 1 ppb PFAS. A PFAS selective resin was used for the test at a relatively low EBCT (<2min). As expected, the PFBA, PFPeA and PFHxA species broke through much earlier than the longer chain species such as PFOA and PFOS. If these shorter chain species are regulated in the future, the short breakthrough times will not be feasible for a practical operation. Instead, a configuration of using a regenerable pretreatment resin followed by a single-use polisher resin can be a more economical option.

The third case study is on an impounded water contaminated by AFFF with about a total of 100-200 ppb PFAS species. The treatment system used GAC, a regenerable pretreatment ion exchange resin and a polisher resin. The data shows great removal efficiency of various PFAS species with the combination. The regenerable pretreatment resin was able to remove a large load of PFAS, especially the longer chain compounds, while the polisher resin ensures the final PFAS in effluent meeting the targets. The operation has successfully lasted 12 months and treated nearly 14 million gallons of water without resin replacement.

The studies indicate it may be beneficial to customize resin configurations based on influent PFAS concentrations.

Discusser: Stephen Wheeler, ResinTech Inc., Camden, NJ

IWC 24-63: Initial Results from PFAS Destruction Testing: Low-Temperature Drying and Ultra High Temperature Plasma Synthesis Reactor for Biosolids Management

Time: 10:10 AM

Brandon Davis, Heartland Water Technology, Murfreesboro, TN ; Jim Henderson, Heartland Water Technology, Carrollton, VA

In response to the pressing challenges posed by PFAS regulations and the limitations in traditional biosolids disposal methods, a technical solution has emerged, leveraging low temperature conductive drying in tandem with ultra-high-temperature ionic gasification. This innovative approach promises an up to 95% mass reduction with 90% carbon conversion of biosolids depending on waste characterization while concurrently generating two valuable resources: reusable char and clean renewable syngas for energy recovery.

The presentation will cover results from testing done in the pilot HelioStorm™ gasifier (M1) in Idaho Falls and on the fully operational commercial-scale system (M3) at Heartland's Technology Center in Tennessee.

Heartland contracted Montrose Air Quality Services (MAQS) to conduct evaluation of destruction and removal efficiency (DRE) of PFAS using the M1 at the Idaho Falls Facility. Biosolid feedstock was spiked with AFFF known to contain PFAS with samples of biosolids, syngas, char, and AFFF collected and analyzed, and mass balances were performed. Based on the testing, the contracted lab presented destruction results for four prominent PFAS compounds (PFOA, PFOS, 6:2 Fluorotelomer sulfonates and 8:2 Fluorotelomer sulfonates). DRE results of the pilot testing indicate a greater than 99% destruction rate in PFOS, 6:2 FTS, and 8:2 FTS, and a 95% destruction rate for PFOA.

In September 2023, Heartland worked with Pace Analytical Services to analyze char samples using the M3. Lab analyses indicate non detect results for the dozens of PFAS compounds tested. Additionally, Heartland worked with Mostardi Platt to conduct PFAS testing on the M3 gasifier at the Technology Center in late September. Testing was with biosolids and samples of the biosolids, syngas, and char were taken. Results are expected by Q1 2024. During the Mostardi Platt PFAS testing, an FTIR was used to look for fluorine compounds in the syngas and other minor species of interest. The FTIR testing did not detect any fluorine compounds including HF, CF4, C2H6, and SF6. The lack of detection of the short chain perfluorinated compounds is a strong indication the demineralization of the PFAS compounds is complete and that they aren't just being cracked into shorter chains. The lack of HF in the gas, as well as the lack of HCl and H2S, strongly indicates that the F, Cl, and S atoms are being captured in situ by the char in the gasifier, likely as salts with the Ca and Mg in the ash fraction of the char.

Discusser: Caroline Wilson, P.E., Kiewit, Shawnee, KS

IWC 24-64: Economically and Environmentally Sustainable Method of PFAS Destruction

Time: 11:00 AM

Devesh Mittal, Aquatech International, Canonsburg, PA

Per- and polyfluoroalkyl substances (PFAS) tagged as "forever chemicals" are leading environmental contaminants, increasingly affecting communities and industries worldwide. Existing liquid treatment technologies currently concentrate PFAS to a media through absorption or anion exchange as a form of removal. However, this leaves a concentrated PFAS contaminated material requiring expensive and energy intensive disposal, treatment, or regeneration. While removal treatment options have developed as a first step to address the immediate problem, they do little to eliminate residual liability for the industry or the municipalities entrusting PFAS these approaches.

Aquatech will present a unique PFAS treatment system developed along with our technology partners, which is an economically and environmentally sustainable treatment method that destroys PFAS from contaminated liquids. Unlike existing PFAS removal technologies, the treatment method to be presented offers a complete onsite PFAS destruction solution non-selectively and sequentially break the carbon-fluorine bonds using a durable and low-cost proprietary reactor.

The presentation will describe the destruction technology and include data from successful bench trials, field pilots, as well as large-scale demonstration and commercial programs in Europe, the U.S. and Australia. It has already been commercially deployed on-sites to treat a variety of PFAS-impacted liquids.

Learning Objective 1:

Current PFAS Treatment Options concentrate PFAS through absorption or anion exchange leaving a concentrated PFAS contaminated material. Aquatech approach allows for a complete onsite PFAS destruction solution that breaks the carbon-fluorine bonds.

Learning Objective 2:

Aquatech approach has low energy consumption and has been demonstrated to run off a portable solar system.

Learning Objective 3:

Large scale demonstration and commercial programs will demonstrate how destruction of PFAS has been used to neutralize Aqueous Film Forming Foam and other PFAS bearing streams.

Discusser: Shannon Brown, Woodard & Curran, St. Charles, MO

Wednesday, 11/6/2024; 8:00 AM

W2: Salty Tales: Approaches taken in Brine Space

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

Session Chair: Andrew Erickson, Sargent & Lundy, Sargent & Lundy

Discussion Leader: Arash Karimi, Ph.D., P.Eng., Worley, Calgary, AB Canada

Join us for a riveting session on Brine Processes and Optimization, where we will have a choppy ride through the high seas of brine. No worries though, we will navigate through it with amazing papers covering experiences and approaches to brine; all while keeping your sense of humor buoyant amidst the briny waves. Come aboard and let's set sail towards a saltier, yet sustainable future!

IWC 24-65: Advanced and Minimum Liquid Discharge (MLD) Reverse Osmosis Technologies

Time: 8:10 AM

Michael Boyd, Veolia WTS, Louisville, CO

Over the past decade, there have been more advancements to how spiral, thin film compositive (TFC) reverse osmosis (RO) membranes are operated than at any other point in time relative to the inception of the technology. Static, multi-stage arrays are being replaced by dynamic-multi-stage arrays or dynamic-single-stage arrays (open loop, closed loop and dead end) and thermal evaporators are being replaced by ultra-high-pressure RO and/or low salt rejection RO or osmotically assisted RO. As these new technologies are commercialized, it’s important to understand the strengths and weaknesses of each process and when and where each are applicable. This presentation will review multiple feed water sources and their associated water chemistries, their associated scaling and fouling potentials, system designs and corresponding membrane projections. The overall objective will be to understand where these technologies fit and the associated performance within an overall process flow diagram for water, wastewater reuse and zero liquid discharge applications.

Discusser: Omkar Lokare, Turing AI, Woburn, MA

IWC 24-66: The Power of UV Technology to Combat Biofouling and Boost Membrane Performance

Time: 9:00 AM

Ytzhak Rozenberg, Atlantium Technologies, Beit, Shemesh Israel; Amichai Felder, Atlantium Technologies, Beit Shemesh, Israel

The accumulation of microorganisms, extracellular polymeric substances (EPS), and assimilated organic carbon (AOC) on membrane surfaces, known as biofouling, can lead to reduced performance and shortened membrane lifespan. Specifically, with biofouling, membranes experience a rapid increase in DP (differential pressure), frequent clean-in-place (CIP) requirements and higher energy consumption. Additionally, biofouling can cause permanent damage to the membrane, requiring expensive replacements and causing facility downtime and lost production. Studies indicate that biofouling, whether direct or through other related and contributory factors, is responsible for approximately 80% of reverse osmosis (RO) membrane failures. Current methods to prevent biofouling, such as chemical biocides, don’t always reduce the biofouling potential. These methods are costly and potentially harmful to humans and the environment.

An alternative treatment approach based on a novel medium-pressure (MP) ultraviolet (UV) technology and its unique operational approach minimizes the membrane biofouling potential, limits anaerobic and aerobic bacterial growth, and protects RO membranes and other sensitive equipment without chemicals. Based on ten years of operational data across over 50 installations, the MP-UV technology enhances membrane performance by dramatically reducing CIP intervals and eliminating unscheduled CIP, increasing permeate recovery while enabling production stability and prolonging membrane life.

Two seawater desalination case studies will be detailed. First, a 100,000 m3/day facility for drinking water experienced significant operational improvements, including a 50% decrease in CIP frequency and a 65% decrease in micron filter replacement events, leading to 4.8% and 7.7% cost savings, respectively. Membrane performance also improved; there was a 21% decrease in post-CIP differential pressure (DP) and an 8.2% increase in membrane permeate with the MP-UV technology. Second, a 1,000 m3/day water facility at a mining site was able to eliminate the use of chlorination and dechlorination chemicals by using the MP-UV technology. Additionally, there was a decrease in CIP frequency from every two to every five weeks, a reduction in post-CIP DP from 2.5 to 1.25 Bar, a greater than 80% savings on cartridge filters, and a greater than 60% decrease in membrane cleaning expenses.

Discusser: Chris Baron, ChemTreat, Newark, DE

IWC 24-67: Novel Approach to High Recovery and High Efficiency Desalination using Membrane Flux Balancing, Intermittent Concentration Polarization Disruption and Direct Real-Time Membrane Monitoring

Time: 10:10 AM

Dileep Agnihotri, Ph.D., WaterSurplus, Loves Park, IL ; Jody Burgess, WaterSurplus, Loves Park, IL; John Barelli, WaterSurplus, Loves Park, IL

Current brackish water desalination systems face challenges in achieving >80% recovery due to design limitations from flux disparity (over-flux on lead elements and under-flux on tail elements), hydraulic limitations (management of flow-velocities for mixing of concentration polarization (CP) layer) and longer residence time where concentrate re-circulation loop is employed. Higher recoveries can be achieved with a concentrate recovery RO requiring additional capital and operating costs. Another option is a blend-concentrate-bleed loop process (CCRO) where re-circulation and pressure cycling method with a single stage design is deployed, leading to ~30% poor product water compared to traditional RO, while having a significant membrane impingement risk which can shorten membrane life and design could result in rapid scaling when flow-meter calibrations are off due to feed-back-loop circuit. Another option is with flow-reversal design (FRRO) where stage of an RO is reversed to allow membranes to face different concentrations with time, however, this approach requires a lot of valving and leads to reliability challenges while still unable to address the flux disparity issue.

We present an innovative method (IMPACT-RO) for achieving high recovery rates by integrating membrane flux balancing and intermittent CP disruption process loops into a single RO system, while maintaining the core design of the traditional RO. This approach involves blending portions of the feed supply with subsequent stage concentrates in either a continuous or periodic manner, resulting in flatter flux profile and disrupted CP layer while eliminating the need for a concentrate recycle loop, thus minimizing residence time within the RO. Additionally, the system incorporates direct membrane monitoring technology to detect fouling and takes proactive measures to mitigate, halt, and reverse fouling. The outcome is an RO system with enhanced recovery rates, reduced maintenance requirements, lower energy consumption, and prolonged membrane lifespan.

This paper presents data from multiple industrial RO systems, used for beverage ingredient water production and water reuse in food production. In addition, paper presents first-principal field validation data with performance on Silica, Calcium Sulphate, and Calcium Carbonates scaling behavior at or above saturation with technical insight on induction cycle and scaling behavior from a controlled testing using 100-gpm RO system at Bureau of Reclamation Research Facility in Alamogordo, NM. Many industrial customers, including top beverage facilities, water reuse plants, and power plants, have embraced this technology allowing them to achieve higher recoveries, up to 10%, while saving up to 20% in energy, and requiring less maintenance in CIP.

Discusser: David Shin, Hydranautics, Oceanside, CA

IWC 24-68: Alternative Solution for the High pH RO Process in the Semiconductor Industry – a Techno-Economic Comparison of an Innovative Brine Minimization Technology

Time: 11:00 AM

Roi Zaken Porat, IDE Water Technologies, Kadima, Israel; Liron Ophek, IDE Water Technologies, Kadima, Israel; Yonatan Graber, IDE Water Technologies, Kadima, Israel

The semiconductor industry requires substantial amounts of water and suffers from water scarcity. This industry is growing and expanding rapidly, together with the enormous amounts of water it consumes for the wafer production processes. The industry goal to recycle more and discharge less becomes ever more crucial.
The semiconductor wastewater treatment plant is usually divided into two main areas:

(1) Segregated waste streams that are treated for reclaim (from the wafer production area) (2) Biological treatment for the overall rejects/untreated streams from area (1) followed by a standard high recovery process (HERO) and the thermal units (evaporator and/or crystallizer) for full ZLD.
This paper will introduce an alternative solution for treating the biological treatment effluent (usually MBR), to the standard brine minimization section that mostly takes place by the HERO process. The paper will present a comparison between the common, standard process with a novel desalination technology, the MaxH2O Desalter, focusing on their effectiveness in achieving maximum brine minimization and the economic consequences of choice.
The standard process involves extensive pre-treatment steps, including softening, ion exchange (IX), and CO2 degassing, followed by a multi-stage reverse osmosis (RO) system operating at pH > 10.5 to maintain silica in a dissolved form. While effective, this process relies on high chemical usage, particularly in softening and IX.
In contrast, the new Desalting technology operates at a lower pH (~9) and achieves significant silica removal, reducing chemical operational expenses (OPEX) by up to 50%. The technology forms pellets instead of sludge, which can serve as feedstock for cement production, promoting a circular economy and reducing CO2 emissions.
A detailed case study and techno-economic comparison demonstrating the advantages of the innovative technology over the standard process in achieving ZLD for an industrial client will be presented. The innovative technology increases recovery rates prior to reaching the thermal units, which is crucial for project economic viability. The findings highlight the cost-effectiveness and environmental sustainability of the innovative desalination technology, making it a promising solution for the semiconductor industry facing water scarcity and stringent environmental regulations.

Discusser: Adhiraj Joshi, P.E., Whittier Filtration, Inc., Brea, CA

Wednesday, 11/6/2024; 8:00 AM

W3: Wastewater 2: Bubbles, Biofilm, and BOD: Wastewater Solutions for Industry

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

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

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

Wastewater treatment is effective using different types of processes, but defining what works best includes a full understanding of the facility constraints and challenges. The papers in this session will address boiler water treatment and condensate polishing, nutrient reduction and removal, and sustainability by using different chemistry techniques and biological processes. These papers use research case studies in operating facilities such as an apple processing plant, a food and beverage construction project and a pharmaceutical plant in Mexico to evaluate the treatment of brine from an existing primary RO system.

IWC 24-69: Successful Field Demonstration Treating Highly Concentrated Silica Brine Using a Dynamic, Single-

Stage Reverse Osmosis Technology

Time: 8:10 AM

John Korpiel, P.E., Veolia WT, Wexford, PA ; Francisco Javier Díaz Díaz Mirón, Veolia WT, Tlalnepantla, Estado de Mexico, Mexico; Jose Angel Solis Herrera, Veolia WT, Tlalnepantla, Estado de Mexico, Mexico

A field demonstration was conducted at a pharmaceutical plant in Mexico to evaluate the treatment of brine from an existing primary reverse osmosis (RO) system using a proprietary dynamic single-stage RO (DSSRO) technology. The brine being treated was supersaturated in silica, which would have presented significant fouling challenges for a conventional steady-state RO system and/or would have significantly limited its water recovery. The objective of the field demonstration was to evaluate the effectiveness of the piloted RO technology in recovering water suitable for plant reuse and in minimizing brine volume for either disposal or for future thermal concentration using an evaporator (which was also tested).

DSSRO is a generic term used to classify RO systems which operate in semi-batch (non-steady-state) mode, while utilizing a single-stage RO membrane array. The piloted technology operates via regularly recurring semi-batch production cycles, consisting of a service step (operating at 100% recovery) followed by a short purge step. The technology leverages precipitation induction time, frequent disruption of the concentration boundary layer, and improved control of hydraulics to enable operation at higher water recovery rates than conventional steady-state RO, while minimizing the potential for membrane scaling and fouling.

The feed brine treated by the piloted RO technology was already supersaturated in silica (150 - 250 mg/L as SiO_2), and the technology operated to provide brine water recovery in the range of 60 - 75% throughout the field demonstration. Thus, the piloted RO technology further concentrated silica to the range of 575 - 720 mg/L as SiO_2 in its concentrate while maintaining relatively stable operation. This far exceeds the silica concentration achievable in the concentrate of a conventional RO system, which is typically in the range of 150 - 240 mg/L using a silica-specific antiscalant. The overall system water recovery achieved during the field demonstration, taking into account pre-concentration by the existing primary RO system, ranged from 84 to 91%. The pilot operation was deemed a success in meeting the objectives for water recovery rate, concentrate stream silica concentration, and reuse water quality, in conjunction with downstream polishing treatment technology. The paper will discuss the pilot process configuration, piloting operation conditions, pilot results, and conclusions for future full-scale implementation.

Discusser: Kurt Blohm, American Water Chemicals, San Diego, CA

IWC 24-70: Drivers for Residual COD Removal at Industrial Water Resource Recovery Facilities (WRRFs)

Time: 9:00 AM

William Celenza, Burns & McDonnell, Chicago, IL ; Sean O'Mara, Burns & McDonnell, Chicago, IL; Victoria Otrubina, Burns & McDonnell, Chicago, IL

Treated effluent COD levels have become directly linked to overall treatment efficiency and water quality. Influent wastewater BOD:COD ratio is often measured for predicting biotreatability; however, the resulting treated effluent BOD:COD ratio has not typically been used as a treatment benchmark. For industrial wastewater treatment plants that directly discharge, only BOD values are typically required to be reported; however, as water stress becomes more of a major risk for industry the need to reclaim treated effluent for reuse is driving a need to also further lower COD levels. In treated industrial effluent, residual COD results from recalcitrant organic compounds as well as contaminants of emerging concern (CECs) that include pass through pharmaceutical compounds such as estrogenics, and synthetic chemicals including dioxanes, esters, benzene derivatives, etc. As more organic compounds can be chemically oxidized than biologically oxidized, the BOD:COD ratio for a well-stabilized secondary effluent can be as low as 1:10. For BOD discharge limits of 30 mg/l, the resulting effluent COD level can be over 300 mg/l; an order of magnitude higher than the target for feed to tertiary treatment techniques used to reclaim effluent for reuse. More sustainable water use in industry requires further closure of the water circuit by reducing dependence on external fresh water sources, and more wastewater treatment steps integrated into process schemes to allow for final effluent reuse options. Industrial wastewater discharge limits in states such as Louisiana and countries such as China have already required COD values as low as 3 times BOD values, requiring treatment schemes directed at residual COD removal. This discussion will review typical treatment scenarios at industrial wastewater treatment plants and then present schemes to increase COD removal efficiencies to meet the merging of both wastewater reuse requirements and stringent discharge criteria. Case histories on residual COD removal schemes linked to performance and/or regulatory drivers will also be presented.

Discusser: Dallas Torgersen, WesTech Engineering, Salt Lake City, UT

IWC 24-71: MBBR + DAF Solutions for Food & Beverage Industry

Time: 10:10 AM

Chandler Johnson, World Water Works, Oklahoma City, OK ; Justin Olson, World Water Works, Oklahoma City, OK; Scott Jay, World Water Works, Oklahoma City, OK

Moving Bed Biofilm Reactor (MBBR) + Dissolved Air Flotation (DAF) technology has been a mainstay solution for food & beverage clients to aid in meeting both pre-treatment regulations to direct discharge requirements. As regulations change from only BOD removal to ammonia to total nitrogen limits, industrial clients need to review and understand what their existing treatment system can achieve and look to upgrade them and re-use as much infrastructure as possible. The MBBR is a compact fixed film biological treatment system using single to multiple stage reactors to meet the desired effluent quality while being a flow through system with no recycles from the solids separation system. The paper will present three (3) case studies of new construction projects using the MBBR + DAF to meet BOD pre-treatment effluent limits for two of the case studies in the beverage industry and Total Nitrogen removal via denitrification of nitrates and treatment of BOD to meet direct discharge effluent limits for the third study.

Discusser: Anthony Amendola, P.Eng., Newterra, Brockville, ON, Canada

IWC 24-72: Advanced Fouling Control for Once-Through Systems including Innovative Solutions for Monitoring, Treatment, and Optimization

Time: 11:00 AM

Nora Eibergen, Nalco Water, an Ecolab Company, Naperville, IL ; Alex Pearson, Nalco Water, an Ecolab Company, Naperville, IL; Joanna Brown, Nalco Water, an Ecolab Company, Naperville, IL; Joseph Bopp, Nalco Water, an Ecolab Company, Naperville, IL

Surface condensers are at the heart of a thermal power plant and have a significant impact on steam turbine efficiency. Condenser health is strongly tied to plant performance and can be significantly compromised by the deposition of mineral scale, biological deposits, or silt. Chemistries are often applied to prevent operational issues such as scaling or microbiological fouling which can impact production, performance, and even result in unplanned shutdown.

Once through systems present unique challenges because they cannot use the same monitoring and control systems to apply chemistry that recirculating systems commonly utilize. Cooling ponds and lakes present further challenges due to dynamic conditions caused by overstabilization, self-softening, and algae blooms. These conditions lead to rapid changes in calcium, alkalinity, pH, TDS, and temperature that can contribute to fouling. New methods are required to better monitor, control, and optimize water treatment to ensure program efficacy at the lowest possible cost.

A case study will be presented that describes the successful application of a phosphorus-free scale inhibitor product to a once through cooling system at a fossil fuel power station. We will also discuss the implementation of a deposit monitoring program and online controller with an embedded dosage algorithm to validate and optimize the treatment program. This holistic solution has resulted in a lower risk of condenser fouling while also lowering cost and environmental impact of the treatment program at this power station.

Discusser: Utsav Shashvatt, Ph.D., Xylem, Houston, TX

Wednesday, 11/6/2024; 8:00 AM

W4: The Next Wave of Produced Water Management

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

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

Discussion Leader: Chip Westaby, Benchmark Measurement Solutions / TDHI, Kirkwood, MO

From water scarcity to energy transition, there are numerous challenges driving the evolution of produced water treatment and management. This session will dive into new approaches regarding modeling, piloting, and design of high-recovery treatment systems as well as explore new reuse opportunities as the industry adapts to the evolving regulatory landscape.

IWC 24-73: Over a Decade of Successful Operation Treating Produced Water at an Oilfield Using Elevated pH Reverse Osmosis Technology

Time: 9:00 AM

John Korpiel, P.E., Veolia WT, Wexford, PA ; Jacob Long, Veolia North America, San Luis Obispo, CA; Dwight Ferguson, Veolia North America, San Luis Obispo, CA

This paper discusses the successful application of proprietary integrated membrane technology to treat produced water at an oilfield water reclamation facility (WRF) in the western United States for beneficial reuse. The paper describes the water quality specifications, treatment challenges, innovative treatment process train selected, and system performance after eleven years of operation.

The WRF was constructed to desalinate approximately half of the oilfield’s produced water for surface water discharge as beneficial reuse in an area plagued by water scarcity. The WRF softens the other half of the produced water for reuse as make-up water for steam generation. The treatment process utilizes proprietary elevated pH RO technology, which consists of warm lime softening, ceramic membrane ultrafiltration, weak acid cation ion exchange softening, and elevated pH reverse osmosis. This core process is followed by customized, proprietary post-treatment to meet the specific needs of the application, including ammonia polishing ion exchange, advanced oxidation, pH control, remineralization, cooling/chilling, and aeration.

The treatment process has proven to be robust in treating a challenging produced water with high scaling potential due to silica, calcium salts, and metals, and a high fouling potential due to free oil and aromatic hydrocarbons. The treatment process has proven to be reliable in providing make-up water to the steam generator system that consistently achieves the client’s water quality specifications and desalinated water that consistently achieves compliance with the stringent National Pollution Discharge Elimination System permit for surface discharge. Over 11 years of operation, the WRF has sent 47 million barrels of treated, clean effluent to surface water discharge to help alleviate drought conditions in the area. The treatment system was designed to operate at high water recovery (≥ 90%) to minimize the daily volume of brine concentrate sent to deep well injection. The water recovery rate has been optimized over the years to minimize operating costs.

The WRF described in this paper is the first full-scale installation of this technology using a single ceramic membrane ultrafiltration step for softening and de-oiling of oil field produced water, eliminating the need for additional upstream de-oiling equipment. This robust system, utilizing an elevated pH reverse osmosis process, offers multiple advantages including the potential to increase oil production by minimizing injection volume, high water recovery rate for beneficial reuse, and guaranteed process performance.

Discusser: Jeff Easton, Ph.D., P.E., Clearstream, Sandy, UT

IWC 24-75: Evaluation of Polymeric Dispersant Chemistries to Reduce Scaling and Fouling in OTSG Systems

Time: 10:10 AM

Kaylie Young, Ph.D., ChampionX, Sugar Land, TX ; Marlon Norona, Southern Alberta Institute of Technology, Calgary, AB, Canada; Ron Maltman, ChampionX, Calgary, AB, Canada; Martin Godfrey, ChampionX, Sugar Land, TX; Matt LaPrairie, Southern Alberta Institute of Technology, Calgary, AB, Canada

Steam assisted gravity drainage (SAGD) and cyclic steam stimulation (CSS) are the two methods widely adopted to extract bitumen from underground oil sands deposits in Canada. These methods rely on the injection of large amounts of steam into the reservoir to reduce the viscosity of the entrapped hydrocarbons and allow them to be brought to the surface. Once through steam generators (OTSGs) are the main workhorses employed for steam production at SAGD and CSS facilities due to their versatile design that allows the use of poorer quality feedwater that contains elevated concentrations of organic and inorganic impurities. These impurities, along with residual oil and suspended particles present in the feedwater, lead to the eventual precipitation of organic and inorganic scales and increased corrosion in OTSGs. This may limit the reliability of steam generation and the overall capacity of a facility to produce steam and oil. To reduce the risk of tube fouling, OTSGs are commonly operated at relatively low steam quality (75-80%). Improving performance of OTSGs to achieve higher steam qualities is imperative for efficient production of oil sands and reduction of greenhouse gas emissions.

High levels of silica in the feedwater are especially problematic. Deposition of silica or silicates can lead to increases in local thermal resistance and eventually tube failure. Removal of silica deposits is difficult, expensive and potentially dangerous to health and safety.

This university/industry collaborative study summarizes the evaluation of various polymeric silica/silicate dispersant chemistries to mitigate scaling and fouling in OTSG systems. Fifteen polymeric dispersants were screened for performance in the lab before and after thermal aging conditions representative of the environment encountered in a typical OTSG. The top three chemistries were then tested for their ability to reduce scaling with SAIT's state-of-the-art pilot-scale OTSG units.

Discusser: René Bélanger, Kurita Canada Inc., Sturgeon County, AB, Canada

IWC 24-76: A Novel Approach to Obtaining High-Level Water and Steam Plant Mass Balances using Standard Process Simulators

Time: 11:00 AM

Basil Perdicakis, Suncor Energy, Calgary, AB Canada; Arash Karimi, Ph.D., P.E., Worley Consulting, Calgary, AB, Canada; Denis Westphalen, Process Ecology, Calgary, BC, Canada; Clayton Wong, Suncor Energy, Calgary, AB, Canada

Water and ionic chemistry material balances for steam assisted gravity drainage (SAGD) water and steam plants based in the oil sands regions of Alberta, Canada have historically been done in spreadsheet programs. Such approaches are prone to errors due to the complexity of the water flowsheet, particularly in more complex SAGD assets with multiple plants or reduced liquid discharge operations. A novel use of a standard process simulator is presented which provides a customizable high-level mass balance and corresponding chemical consumptions and water treatment waste volumes. This approach provides a high-level approximate answer (i.e. 80%) in a short amount of time, but is not based on any underlying thermodynamic or equilibrium calculations. HYSYS is used as the simulation platform in this work, but the methodology described could be implemented on other process simulators as well. Ionic species in water are entered as hypothetical solids and any desired reactions are manually hard coded into the simulation program. Once a few model details were resolved, the developed methodology was found to converge within a few minutes for complex plant configurations that could take nearly an hour to converge on other process simulations running rigorous electrolyte thermodynamics.

In addition to the elimination of errors that are prone to occur on a spreadsheet model, a key advantage of this tool is increased speed for developing high level water chemistry projections for growth projects and major plant process modifications. The model can also be easily tuned to match plant data for example in instances where full thermodynamic equilibrium is not reached (e.g. warm lime softener overflow streams) or the exact reaction mechanism is unknown. Furthermore, post-convergence processing of the output data is simple and straight forward and the model outputs can be used to specify stream conditions for subsequent engineering analyses (e.g. disposal formation compatibility). This high-level approach also yielded unexpected technical insights into the process (e.g. warm lime softening sludge composition). This approach has been found to be useful on its own to replace previously developed spreadsheet models. Developed models were found to match plant data to within 10%. Annual calibrations with site data are recommended as well as applying this methodology in conjunction with a rigorous simulation tool such as OLI Flowsheet: Electrolyte Simulation Package (ESP) that can be used to obtain a less frequent, but more in-depth understanding of the water and steam plant under investigation.

Discusser: Rena Bae, P.E., Stantec, Charlotte, NC

IWC Exhibitors

Alphabetical

Alfa Laval

Booth #: 522

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Alfa Laval is a leading global provider of innovative 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

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American Water Chemicals (AWC) is a membrane solutions expert that specializes in the production of specialty chemicals used for RO, NF, UF and MMF systems. Our products portfolio includes a range of antiscalants, cleaning chemicals, biocides and other treatment solutions.
As part of our total solutions approach, we perform membrane-related services like membrane autopsies, cleaning studies, pilot studies & water analysis, and provide our distributors and industry partners with technical training & support.

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.

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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.

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Applied Membranes, Inc. is a fabricator and global supplier of reverse osmosis and nano filtration membrane elements and water treatment components. We are also a leading fabricator of reverse osmosis, ultrafiltration and nano filtration treatment systems, from a few gallons per day to millions of gallons per day, for commercial, institutional, and industrial applications.

Aqua-Aerobic Systems, Inc.

Booth #: 218

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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

Booth #: 208

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Aquatech tackles the challenges of water scarcity and complexity by leveraging technology, expertise, and financing to deliver comprehensive solutions that reduce carbon and water footprint. As a leading global provider of water and process technology solutions, we help the world's most recognized companies achieve their sustainability and operational goals by implementing innovative approaches for water reuse, desalination, minimal and zero liquid discharge, and critical minerals recovery. Learn more at www.aquatech.com.

AST Bead Filters

Booth #: 325

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AST is the leading provider of bead filter solutions for wastewater remediation and reuse, industrial water filtration, and more. Our bead filter units are easy to operate, cost-effective, and offer superior clarification and biofiltration in a minimal footprint.

Atlantium Technologies

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With thousands of installations for global leading brands in various industries, we're committed to meeting our customers' water quality needs, ensuring pure results.

Avista Technologies

Booth #: /502

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Avista® Technologies Inc. was established in 1999 to develop and distribute membrane chemicals and provide global expert process support for reverse osmosis (RO), microfiltration/ultrafiltration (MF/UF) and multimedia filtration (MMF). As a global brand of Kurita, Avista helps customers worldwide to achieve their unique water treatment goals.

AWC Solutions

Booth #: 426/525

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Website: https://awcwater.com/

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.

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.

Benchmark Measurement Solutions - TDHI

Booth #:

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Website: https://oilinwatermonitors.com

We are the worldwide leader in the application of field portable, laboratory, and online continuous process monitors and analyzers. We offer solutions for measuring and monitoring hydrocarbons, algae and dispersed or suspended particles in water. Our monitors are based in fluorescence, ultrasonics and imaging technology.

Bowen

Booth #: 310

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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 #: 104

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Website: https://brownandcaldwell.com/

Brown and Caldwell's purpose is to unlock the potential of water and a healthy environment to create thriving communities. We hold safety, quality, diversity, technical excellence, and business performance in high regard. We approach our work with great care, responsibility, and technical innovation to achieve the best possible outcomes for our clients and communities. We are a leader in adapting state-of-the-art engineering, consulting, and construction management approaches to address complex industrial water challenges.

ChampionX

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Website: www.championx.com

ChampionX is a global leader in chemistry solutions, artificial lift systems, and highly engineered equipment and technologies that help companies drill for and produce oil and gas safely, efficiently, and sustainably around the world. ChampionX's expertise, innovative products, and digital technologies provide enhanced oil and gas production, transportation, and real-time emissions monitoring throughout the lifecycle of a well.

ChemTreat, Inc.

Booth #: 402

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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 #: 420

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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.

Cooling Technology Institute

Booth #: 317

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Website: 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.

Crest Water

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CREST Water is an advanced solution provider committed to innovative performance chemicals for sustainable application in water-related sectors. Our team is dedicated to delivering personalized customer experiences and establishing robust relationships with our global partners and clients.

David H. Paul, Inc.

Booth #: 211

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David H. Paul, Inc. (DHP) is a renowned water treatment training and consulting firm, specializing in membrane water treatment. Since its establishment in 1988, DHP has unwaveringly dedicated itself to delivering practical, cost-effective, and unbiased high-tech water treatment training and technical services. DHP hosts hands-on training sessions several times throughout the year at multiple locations and also offers the free Neptune World Water Treatment Resources App for RO professionals.

De Nora Water Technologies LLC

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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

Booth #: 212/311

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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 #: 112

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Website: www.ect2.com

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.

ENCON Evaporators

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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, Inc.

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Energy Recovery is a trusted global leader in energy efficiency technology. Building on our pressure exchanger technology platform, we design and manufacture reliable, high-performance solutions that generate cost savings and increase energy efficiency across several industries. With a strong foundation in the desalination industry, Energy Recovery has delivered transformative solutions that optimize operations and provide positive environmental impact to our customers worldwide for more than 30 years.

Environmental Energy Services

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EES, Inc. is a leading provider of innovative and comprehensive water treatment solutions to Power Generation, Mining and Industry. We manufacture metal precipitants and scrubber control chemistry to provide the most efficient treatment programs available. Additionally, EES provides toll blending services including custom coagulants, defoamers, flocculants, scale control, and slag mitigation. EES's R&D, technical service, manufacturing, and engineers work closely with customers to maximize the performance of their systems and chemical programs while minimizing costs.

FEDCO

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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, Inc.

Booth #: 509

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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.

Fluence

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We are a global team of engineers, scientists, and professionals passionate about changing the world of water through innovative, sustainable technologies. We specialize in providing plug-and-play, high quality, and cost-effective water and wastewater treatment solutions that can be quickly installed, automatically operated, and easily maintained, so you get reliable, clean water worry-free.

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.

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.

Hydranautics - A Nitto Group Company

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Hydranautics is a part of the Nitto Group and is one of the global leaders in the field of Integrated Membrane Solutions. Hydranautics offers complete membrane solutions like Reverse Osmosis, Nanofiltration, Ultrafiltration, and Microfiltration for water, wastewater and process treatment and applications.

Hydranautics' global membrane division is headquartered in Oceanside, CA, USA and have three state-of-the-art manufacturing sites located in Oceanside - USA, Shiga - Japan and Shanghai – China.

IDE Technologies

Booth #: 506

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IDE has developed some of the most advance membrane and thermal solutions and is firmly positioned as a world leader in desalination and water treatment solutions. IDE is at the forefront of the development, engineering, construction and operation of enhanced desalination, industrial water treatment and water reuse facilities. IDE has developed a proprietary technology line MaxH2O for high recovery, minimal discharge solutions that allow compliance with the ever-stricter regulations seen in industry.

Italmatch Chemicals

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Italmatch Chemicals is a leading global manufacturer, supplier and innovator of a broad range of specialty water management additives for Industrial Water Treatment & Process, Desalination, Geothermal, Mining, Personal Care and HI&I markets. With strong complementary brands and over 40 years' experience, our Advanced Water Solutions business unit provides customers with innovative solutions, supported by wide-ranging technical support and dedicated customer service.

Johnson March Systems, Inc.

Booth #: 202

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A worldwide leader in the design and fabrication of custom Chemical Dosing Systems for Boiler , Cooling Tower, Waste Water Treatment and Process Additive Systems, Steam and Water Sampling Panels (SWAS), Ammonia Feed Systems, ASME Code Pressure Vessels, Electrolytic Chlorination Systems, Gaseous Chlorination Systems, Equipment Shelters and Chemistry Laboratories. We are ISO 9001-2015 Certified by Underwriters Laboratories. All welders are ASME Code Certified and CWB (Canadian Weld Bureau) Certified. We have completed projects in over 66 countries worldwide. Johnson March was founded in 1935.

Justeq LLC

Booth #: 501

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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.

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With unique products and insights, we provide customized water treatment solutions. Our customers do more with less effort and cost. Our products range from filtration & membranes to innovative, proprietary products that can lower the total cost of operations. We also offer services to streamline existing applications, design new systems, & develop road maps for success. Mechanical, process, & chemical engineers custom-develop solutions for individual products or entire programs. Industries: Power, Wastewater,Drinking Water,Biotech,Manufacturing & More…

KURITA AMERICA

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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.

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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.

LG Chem, Ltd.

Booth #: 320/419

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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.

Longkou Keda Chemical Co. Ltd.

Booth #:

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Longkou Keda Chemical produces Bromine (BCDMH) and is located in Longkou City, China. Currently shipping to the US, Canada, Europe, South Africa, Australia, Japan and other countries. Longkou Keda has both US EPA registration and Canadian PMRA registration. In the US, the company's trademarked consumer brand "Hydria Clear" is registered in 49 states. The company has an US sales office and has an EPA registration for Cooling Tower applications. Company also supplies DCDMH and DBDMH.

Marmon Industrial Water

Booth #: 201

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Marmon Industrial Water designs and manufacturers water and wastewater treatment equipment solutions, more often known under the brand names Graver Water Systems and Ecodyne. Our engineers are subject matter experts in in raw water pretreatment, degasification, hot lime softening, boiler make-up, condensate polishing, wastewater treatment, cooling water treatment, and oil/water separation for petrochemical/chemical, power generation and heavy industrial plants on a global basis. As a result, MIW brings the right solution for your problem.

METTLER TOLEDO

Booth #: 102

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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.

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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 Industrial Water Services

Booth #: 207

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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.

Nalco Water

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A global leader in water and process management solutions, Nalco Water, an Ecolab company, works with customers across a wide range of industries to help meet their specific business and sustainability goals. We combine innovative products with digital innovation and expertise to maximize outcomes at an optimized cost. Vice President and General Manager Calvin Emanuel, from our Sustainable Growth Solutions team will deliver the 2024 IWC Keynote address: “Accelerating Water Stewardship for a Sustainable Future.”

Newterra

Booth #: 410

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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.

OLI Systems

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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.

Ovivo USA, LLC

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Parkson Corporation

Booth #: 203

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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.

Protec Arisawa

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Protec Arisawa is the industry leader in FRP membrane housings in the range of 300 to 1800 PSI. Our 8", 4" and other custom housings, are made completely in the USA and shipped throughout North America. Through proven product reliability, research and ASME certification, Protec vessels are the best housings on the market. We provide nationwide technical support and service as well as retrofitting options for aging or damaged vessels.

Pureflow Filtration & Ozone Divisions

Booth #: 308

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Established in 1972, Pureflow Filtration Div. manufactures water treatment systems for the removal of Arsenic, Iron, Manganese, Chromium, Fluoride, Nitrate, Radionuclides, Percolates, PFAS, organics, and other constituents from water supplies, and industrial process streams. Pureflow Ozone Div. is the exclusive strategic engineering partner for Primozone in the U.S & Canada. The partnership combines unrivaled ozone generator technology with a proven water & wastewater process/system engineering team.

Pyxis Lab, Inc.

Booth #: 118

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ResinTech, Inc.

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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.

RSL Membranes - DBE Hytec

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Saltworks Technologies

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Saltworks designs, builds, and delivers innovative process equipment for industrial desalination and lithium refining. From their vertically integrated facility in Vancouver, Canada, Saltworks delivers modular, digitized, end-to-end systems that recover water for reuse, achieve zero liquid discharge, produce critical mineral outputs, and protect aquatic ecosystems.

SAMCO Technologies

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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.

SNOWPURE Water Technologies

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Stantec

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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 #: 502

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Swan Analytical USA supplies reliable online continuous monitoring analytical instruments for Industrial Water and Water/Steam Cycle parameters including sodium, silica, cation conductivity, dissolved oxygen, pH, phosphate, turbidity, and hydrazine. Swan

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Thermax Inc.

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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

TLT Turbo Inc.

Booth #: 425

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As one of the world leaders in the design and manufacturing of high-performance industrial fans, TLT-Turbo strives to provide clients with the latest technology available in the marketplace. The TLT-Turbo MVR fan is suited to numerous applications in the chemical, pharmaceutical, wastewater treatment, and the organic production industries as well as other food and beverage process and manufacturing sectors.

Contact your nearest TLT-Turbo office for consult on your next MVR project.

Toray Membrane USA

Booth #: 326

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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.

Trojan Technologies

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We serve performance-driven municipal, industrial, and residential water treatment professionals by engineering solutions that enable our customers to meet their water quality objectives and improve the lives of more than one billion people globally.

UCC Environmental

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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

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Website: https://uetwater.com

Experienced Designer and Manufacturer of Reliable, Heavy-duty, Custom and Innovative Water & Wastewater treatment Equipment. Top Rated Membrane Water Filtration Systems Specialists With Custom Designs For Reverse Osmosis, Desalination, Ultrafiltration, Electrodionization, MLD, ZLD, Challenging Filtration Applications and Water Reclamation.

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Univar Solutions

Booth #: 516/518

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Website: www.univarsolutions.com

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 Water Technologies & Solutions

Booth #: 307/309

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Website: https://www.watertechnologies.com

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.

WaterSurplus

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Website: www.watersurplus.com

WaterSurplus delivers sustainable water treatment solutions across industries and around the world. Since its founding in 1989, innovation has been its hallmark. Today, that is represented by high-efficiency ImpactRO reverse osmosis systems, fouling-resistant NanoStack membrane elements, rapid-response PFAS treatment, pre-engineered filtration systems, a proprietary line of catalytic media, a ready-to-run rental fleet, and the availability advantage provided by WaterSurplus's original surplus water treatment equipment marketplace. For more information, please visit watersurplus.com.

WaterTectonics

Booth #:

Contact: TJ Mothersbaugh

Phone: 866-402-2298

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E-mail: contactme@watertectonics.com

Website: www.watertectonics.com

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 #: 315

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Website: www.wmfts.com/en-us/

Watson-Marlow Fluid Technology Solutions (WMFTS) is a leading provider of reliable and cost-effective pump technology for the water and wastewater industries. At IWC 2024 in Las Vegas, WMFTS will showcase its Qdos peristaltic chemical metering pumps, including the innovative Qdos H-FLO, along with Bredel heavy-duty hose pumps. These solutions are designed to optimize chemical metering efficiency, reduce maintenance costs, and enhance operator safety, making WMFTS a trusted partner for advanced fluid handling needs.

WesTech Engineering, LLC

Booth #: 407/409

Contact: Ian Fife

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Website: https://www.westechwater.com

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 #: 508/510

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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 #: 302

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WSP USA takes a lifecycle approach to managing water resources. Our professionals consider the impacts and implications of trends in climate, society, technology and resources across the entire water cycle, to provide a complete perspective and develop Future Ready strategies for a sustainable, water-secure future.

Xylem/Evoqua

Booth #:

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Xylem/YSI

Booth #: 519

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YSI, a Xylem brand, offers solutions for monitoring water quality and water quantity with best-in-class sensor technologies that provide the lowest cost of ownership per data point. Whether it's in the lab, field, or treatment facility, YSI's instruments provide reliable data to enable process control decisions, improve treatment efficiency, reduce operating costs, and ensure regulatory compliance.

ZwitterCo, Inc.

Booth #: 216

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ZwitterCo is on a mission to solve the world's most urgent water problems with its advanced zwitterionic membranes that combat organic fouling, the biggest challenge in filtration. ZwitterCo's award-winning technology enhances membrane life and performance in high-strength industrial wastewater, surface water, and food process streams, driving sustainable water reuse and reducing chemical use.