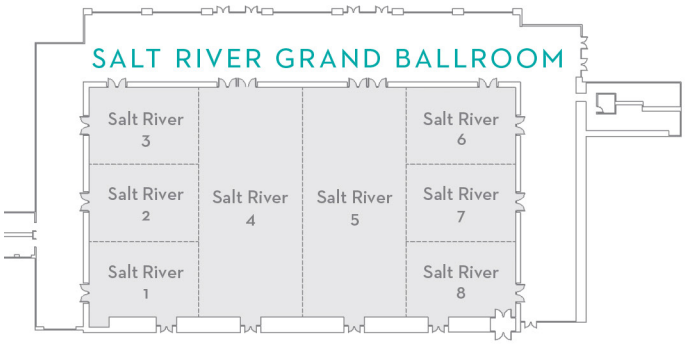
The International Water Conference®

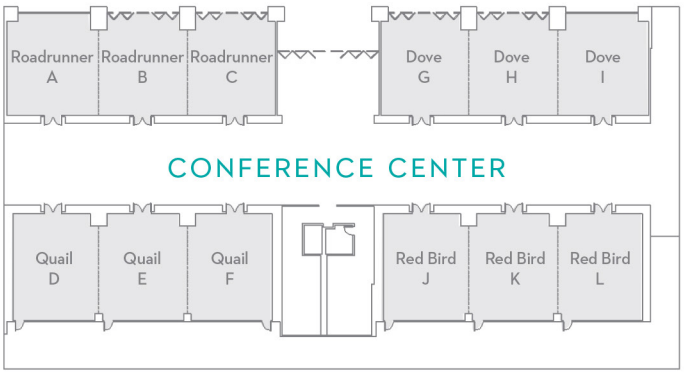
November 7-11, 2021

Talking Stick Resort
Scottsdale, AZ, USA

Conference Program Guide

TALKING STICK RESORT | IWC FLOOR PLAN





SCHEDULE AT A GLANCE

	SALT RIVER 2	SALT RIVER 3	SALT RIVER 6	SALT RIVER 7
SUNDAY, NOVEMBER 7				
1:00–5:00 PM	Continuing Education Workshops (separate registration required)			
5:00–7:00 PM	Attendee Reception in the Salt River Foyer (near to Exhibit Hall)			
6:00 PM	First Timers Reception in the Salt River Foyer (near to Exhibit Hall)			
MONDAY, NOVEMBER 8				
8:00–10:00 AM	Cooling Water	Process: Innovations and Optimization	Business of Water	Removal of Trace Contaminents
10:30 AM–12:00 PM	Keynote Session	Keynote Session		
12:00 PM–1:00 PM	Attendee Luncheon in the Exhibit Hall			
1:15–5:00 PM	RO & Membranes 1	ASME Session Boiler Guidelines	Mining Wastewater	Trace Contaminent Treatment
5:00–7:00 PM	Attendee Reception in the Exhibit Hall			

SCHEDULE AT A GLANCE

	SALT RIVER 2	SALT RIVER 3	SALT RIVER 6	SALT RIVER 7
TUESDAY, NOVEMBER 9				
8:00 AM–12:00 Noon	PFAS Treatability	Modelling & Measurement	Industrial Wastewater	MLD, ZLD & Brine Mgmnt.
12:00 Noon–1:00 PM	Attendee Luncheon in the Exhibit Hall			
1:15–5:00 PM	RO & Membranes 2	Proven Strategies for Reuse	CCR Water Management	Sustainability & Optimization
5:00–7:00 PM	Attendee Reception in the Exhibit Hall			
WEDNESDAY, NOVEMBER 10				
8:00 AM–12: 00 Noon	PFAS 2	Power & FGD	Water & Wastewater	Water's New Flex
1:00–5:00 PM	Continuing Education Eorkshops (separate registration required)			
THURSDAY, NOVEMBER 11				
8:00 AM–12:00 Noon	Continuing Education Workshops (separate registration required)			
1:00–5:00 PM	Continuing Education Workshops (separate registration required)			

WELCOME TO THE IWC!

INTERNATIONAL WATER CONFERENCE

WELCOME TO THE INTERNATIONAL WATER CONFERENCE!

The Engineers' Society of Western Pennsylvania (ESWP), the IWC Executive Committee, and Advisory Council are proud to welcome you to the 82nd Annual International Water Conference®. We are so pleased to meet again in person, following our first-ever "virtual' IWC in 2020. The IWC is a leading provider of technical information and training for the water and wastewater business. For the past 82 years, we have expanded to cover a wide array of industry sectors while continuing to provide technical information to the forefront of our industry. Here is what we have planned for you...

Technical Program – our technical program continues to expand to new topics. There are two sessions on PFAS this year along with the basic sessions on boiler water, cooling water, wastewater, membrane technology, power, mining, and more! As the IWC technical program evolved over the past years, it includes sustainability, water delivery projects, recycle / reuse and concentrate management. The IWC Advisory Council has an Emerging Topic Committee to keep pace with industry needs. It is our hope that you will enjoy the technical content of our sessions and offer ideas for future sessions.

Peer Review – the heart and soul of the IWC conference is the peer review format with prepared discussions followed by a question and answer session. This provides a well-rounded view of new technical information. This year's Technical Program Chairperson, Mike Soller, has done an excellent job of assembling the technical program. Mike coordinated with Session Chairs, Discussion Leaders, Authors, and Discussers to provide a well-rounded technical program. Thanks to everyone who participated in developing this year's technical program and shared their time and expertise to assemble this program.

Conference APP – a must have! Again this year we are using an APP for mobile use during the conference. Full information on papers, workshops, authors, exhibitors, attendees and more can be found within the app.

Workshops –our conference also offers the opportunity for you to gain more in-depth expertise by attending four-hour training sessions presented by experts in the field, covering a wide-range of topics for beginner and experienced level water and wastewater treatment professionals. We would like to thank Jane Kucera and the instructors for putting together a great set of courses this year. The workshops are held Sunday afternoon, Wednesday afternoon, and all day on Thursday. It is not too late to sign up for one or more of the workshops at the registration desk throughout the conference.

Exhibit Hall – be sure to visit the Exhibit Hall during lunch and dinner times There are representatives from over 60 different companies exhibiting the newest advancements in water and wastewater treatment. Refreshments will be provided throughout the Hall during exhibit hours, so be sure to grab a bite to eat while you are networking.

Keynote Speaker – our keynote speaker this year is Dr. Erik Hoek, professor in UCLA's Department of Civil & Environmental Engineering, Institute of the Environment & Sustainability and the California NanoSystems Institute. He is also faculty director of the UCLA Sustainable LA Grand Challenge, a campus-wide initiative to transform Los Angeles into the first sustainable megacity by 2050. We look forward to his presentation!

Continuing Events – New this year is our "Ask Me!" booth, set in the Salt River Foyer and staffed by volunteers from our Executive Committee and Mentor Committee - this is a great place to learn more about the IWC. This year we continue with a golf outing on Sunday afternoon, and a Top Golf Social on Wednesday evening. Advance registration is required for these events. The H2O Theatre are informal presentations by experts in their respective fields that are held during session hours.

Supporters / Sponsors – we also need to recognize our dedicated IWC Executive Committee members for their commitment to the conference success. Every "EC" member is a volunteer and has spent countless hours coordinating sessions, exhibits, and workshops to make sure the conference runs smoothly. Also, thanks to thank the Advisory Council companies that offer their support, expertise, and guidance for maintaining a relevant and interesting program each year. The members of the "AC" are the key conference sponsors that contribute to a wonderful conference experience for all of us. If you have any interest in becoming a member of the Advisory Council, please see an ESWP staff member at the registration desk.

Last, But Not Least – a conference of this size does not happen without the hard work of a lot of people. I want to thank the ESWP staff - Dave Teorsky, Michael Gaetano, and Kristina Emmerson. The continued success and growth of the IWC is a direct result of their hard work.

We are so glad to welcome you back to the IWC! I hope you enjoy this year's conference and learn new information, engage in lively conversation with colleagues and enjoy the Scottsdale area and Talking Stick Resort activities. The IWC Executive Committee and Advisory Council welcomes you back! Please do not hesitate to share your conference ideas with us.

Enjoy the conference!

Jay

James (Jay) Harwood
SUEZ Water Technologies & Solutions, Oakville, ON, Canada
General Chair, 82nd Annual International Water Conference

ABOUT THE IWC!

ABOUT THE IWC

The IWC is the world's premier Conference for understanding and dealing with the technical and business challenges of industrial water treatment. IWC presents the latest in scientific advances and practical applications in this field, cutting across a wide range of industries and functional areas.

As the preeminent international technical forum in the field, the IWC will bring together 1,000 (approx.) end users, researchers, practicing engineers, managers, educators, suppliers and contractors. It is dedicated to advancing new developments in the treatment, use and reuse of water for industrial and engineering purposes.

The IWC has always been a strong educational conference. Attendees come to learn about the latest applications available in the industrial water treatment industry, educate themselves in current technology and applications through attendance in IWC workshops, and network with their peers' active in water treatment.

CONFERENCE PROCEEDINGS

All registered attendees (except Exhibit Only) receive the Official Conference Proceedings of the International Water Conference®. The Proceedings are downloadable approximately two months following the conference.

CALL FOR PAPERS

To participate in the 2022 International Water Conference® as a presenter, please watch for the opening of the IWC Call for Papers. The Call for Papers is done exclusively on-line through the IWC home page at www.eswp.com/water.

AMERICANS WITH DISABILITIES ACT

The International Water Conference® and the Engineers' Society of Western Pennsylvania support the Americans with Disabilities Act (ADA), which prohibits discrimination against, and promotes public accessibility for, those with disabilities. We ask those requiring specific equipment or services as an attendee to contact the ESWP Conference Department and advise us of any such requirements in advance.

PROFESSIONAL DEVELOPMENT HOURS

Attendees are eligible to earn up to 20 Professional Development Hours (PDH) to satisfy Continuing Education requirements. Official confirmation of your attendance will be provided after the IWC, upon request. The Engineers' Society of Western Pennsylvania, sponsor of the IWC, is recognized as an Approved Provider by the Florida Board of Professional Engineers Bureau of Licensing and the New York State Board of Professional Licenses*. ESWP may grant Professional Development Hours to other states as well. *Special sign-in procedures are required for NY State PDH's

ATTENDEE RECEPTIONS

To help you enjoy your stay in Scottsdale during the IWC, we have many special events and activities planned for you. Join your fellow conference attendees at the annual Welcome Back! Reception, held on Sunday in the Salt River Foyer to welcome you to the Conference, along with a special "First-Timers Reception" at 6:00pm, also in the Salt River Foyer. Also, all registered attendees are welcome to attend the Evening Receptions on Monday and Tuesday afternoons in the Exhibit Hall. Luncheon buffets are also provided Monday and Tuesday afternoons in the Exhibit Hall. Schedule time to visit the exhibits and enjoy lunch on us! Seating for lunch is available in Salon 1 and Salon 8

LITERATURE TABLE

Our media partners are instrumental in helping promote the IWC. There is a table filled with literature from these partners as well as information about the area. Please take a moment to stop by and check it out!

SPOUSES' WELCOME BREAKFAST

For spouses who are traveling with conference registrants, the IWC will host a Welcome Breakfast on Monday, November 8. You will be able to meet and network with other spouses to plan your own agenda of activities. Please complete registration form at the IWC Registration Desk. Advance registration is required.

IWC FUN RUN

Come join us for the 36th Annual IWC Fun Run! This event, sponsored by ResinTech, is open to all runners and walkers attending the conference and T-shirts will be awarded to all participants (limited quantity). Start time & place: Tuesday Morning, November 9 at 7:00 AM Sharp; meet in the hotel lobby at 6:45 AM. Distance: 3 miles – flat and easy course.

MERCHANDISE

Pre-prints for (most) technical presentations are available at the Registration Desk. Pre-prints can be purchased for $40 per 2GB flash drive with all the available papers. Also, you can find copies of previous years' IWC Proceedings for $55 per volume.

NAME BADGE IDENTIFICATION

All registered conference attendees are asked to please wear your official IWC name badge at all times. Your official IWC name badge is your passport to the Technical Session, the Exhibit Hall, and International Water Conference® social functions.

Please note that exhibit hall only registrations are only entitled to attend functions in the exhibit hall. They are not permitted to attend technical session or plenary sessions. This will be strictly enforced on site. If you wish to upgrade your registration to a full-conference or one-day registration, please do so at the registration desk.

REGISTRATION LISTS

There will be a registration list of all those attending the conference available to view at the Registration Desk. A PDF version will also be available on the computer in the WebSpot to view and jump onto a USB.

An electronic version of the Registration List will be available at the Registration Desk the morning of Wednesday, November 10.

SOCIAL MEDIA

Keep up on the latest details of the conference by using #IntlWaterConf and follow @IntlWaterConf on Twitter, like us on Facebook: International Water Conference, or follow us on our LinkedIn Spotlight Page: International Water Conference. Don't forget to look for our new APP for all things IWC!

ABOUT THIS GUIDE

We make every attempt to "go green" by providing this guide in electronic format. In addition to helping the environment, we want to encourage use of the conference APP. Where abstracts, session descriptions, or exhibitor descriptions are truncated, you can find the full version on the conference app. Thank you for your understanding! Despite our most conscientious efforts, some errors and omissions are bound to occur. We thank you for your patience and we promise to do better.

FUTURE CONFERENCE DATES

See you next year on November 6 – 10, 2022; at the Hilton in the Walt Disney World Resort, in Orlando, FL, USA. Join us!

IWC EXECUTIVE COMMITTEE

The Engineers' Society of Western Pennsylvania (ESWP) is the proud sponsor of the International Water Conference (IWC) ESWP is a member-based, non-profit organization based in Pittsburgh, PA. Since its founding in 1880, ESWP has provided a venue for continuing education, business development, and social interaction among members of the global engineering and technical community. ESWP would like to thank the members of the IWC Executive Committee for their continued efforts in planning the Conference!

Wayne Bernahl
W. Bernahl Enterprises Ltd.

Max Brefeld
TOYOTA MOTOR NORTH AMERICA

Brandon Delis
Electric Power Research Institute

Michele Funk, P.E.
Bechtel Corporation

Michael Gottlieb
ResinTech

James (Jay) Harwood, Conference Chair
SUEZ Water Technologies & Solutions

Derek Henderson, P.E.
Duke Energy Corporation

William Kennedy, P.E.
Stantec

Jane Kucera
Nalco Water, an Ecolab Company

Tom Lawry
McKim & Creed

Dennis McBride
Burns & McDonnell

Ivan Morales
Carbonet Nanotechnologies Inc.

Paul Pigeon, P.E.
Golder Associates, Inc.

Scott Quinlan, P.E.
Tetra Tech

Colleen Scholl, P.E.
HDR

Patricia M. Scroggin-Wicker, P.E.
Burns & McDonnell

Jonathan Shimko
McKim & Creed

Michael J. Soller, P.E., CPC
Bowen Engineering

Jim Summerfield
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IWC ADVISORY COUNCIL

Since 1940 the Engineers' Society of Western Pennsylvania has sponsored the IWC. The event is also supported by over 50 member companies who participate as members of the IWC Advisory Council. The companies represent the leading water treatment service companies, OEMs engineering firms, consultants and chemical suppliers in the industry. Noted below are the Representatives of our "AC" Companies

Air Liquide America
Brad Crocker

AMBI-Design, Inc.
Shan Sundaram, P.E.

Aquatech International Corporation
Patrick Randall

Athlon, A Halliburton Service
Lawrence (Larry) Broussard

Avista Technologies
Tom Imbornone

Baker Hughes, a GE company
Mary Jane Felipe

Bechtel Infrastructure and Power Corporation
HG Sanjay, Ph.D., P.E.

Bowen Engineering Corporation
Michael Soller, P.E., CPC, DBIA

Burns & McDonnell
Dave Guinta

ChemTreat, Inc.
Brad Buecker

ClearStream Environmental, Inc.
Jinmy Woods

Culligan
Anne Arza

Duke Energy
Derek Henderson, P.E.

DuPont Water
Elke Peirtsegaele

EPRI (Electric Power Research Institute)
Jason Monnell

Evoqua Water Technologies
Walter Kozlowski

Fluor Enterprises
Tamim Popalzai

GAI Consultants, Inc.
Emma Wolff, P.E.

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Holly Johnson Churman, P.E.

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Kalluri Group, Inc.
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Stantec
Joshua Pendergrass, P.E.

SUEZ Water Technologies & Solutions
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U.S. Department of Energy, NETL
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Brittany Hohman, P.E.

WesTech Engineering, Inc.
Dr. Jefferey Easton, P.E., Ph.D.

Wigen Water Technologies
Eric Geibel

Worley
Tom Higgins, P.E., Ph.D.

ZwitterCo, Inc.
Chris Roy

Business of Water

Room: SALT RIVER 6

IWC Rep: Scott Quinlan P.E., Tetra Tech, Pittsburgh, PA

Session Chair: John Yen, Graver Water Systems, Warren, NJ

Discussion Leader: Juvencio Casanova, Evoqua Water Technologies, Houston, TX

TIME: 8:00 – 10:00 AM

At the heart of every decision is the business case to justify a purchase or rental of a water treatment system combined with construction, engineering and installation. Ultimately all of these factors are linked to the impact on capital and operating expenses combined with socio-economic and regulatory drivers. This session explores several business cases and lessons learned in the microelectronics, potable water and wastewater markets.

TIME: 8:10 AM

IWC 21-02: Improving Disinfection Performance in an Urban Drinking Water System

Darrin Lowe and Michael Soller, P.E., CPC, DBIA, Bowen Engineering Corporation, Indianapolis, IN; Grady Stout, P.E., Tennessee American Water, Chattanooga, TN

Using Flocculation and Sedimentation has been time tested to assure treatment and decrease turbidity prior to filtration. This session paper discusses the use of alternative contracting methods to upgrade to lamella clarifiers to increase plant capacity in the same footprint as traditional sedimentation basins. Additionally, design, construction, and implementation challenges and solutions are discussed to show how a collaborative effort can maximize efficiencies within all parties.

Discusser: Juan Meneses, Nalco Water, Lake Charles, LA

TIME: 9:00 AM

IWC 21-03: First Stage Design & Start-up of a Zero-Liquid Discharge (ZLD) Facility to Produce Ultra-Pure Water

Ryan Sullivan, Americus Mitchell, and Sahil Azeez, Sundt Construction, Tempe, AZ

Access to water is a critical factor in light industrial manufacturing settings, with manufacturing often located in stable climates to take advantage of consistent weather, atmospheric and seismic conditions necessary for manufacturing systems. However, these locations can be arid and water scarce, making clean water relatively expensive and often requiring users to consider options for recycle and reuse. This paper highlights the design, construction and startup of the first portion of a facility's efforts to reuse their used plant wastewater, as well as the operations management of the plant over a 1-year period.

Discusser: Alexander McDonald, Ph.D., Evoqua, Houston, TX

Removal of Trace Contaminant – Potable / Ground Water

Room: SALT RIVER 7

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

Session Chair: Ajit Dighe, Thermax, Houston, TX

Discussion Leader: Sam Fackrell, Bowen Engineering Corp., Glen Burnie, MD

TIME: 8:00 – 10:00 AM

The regulated contaminants such as Radium, Barium, Arsenic, Manganese & Oxidation, is driving research and product development for ways to remove trace contaminants to ever lower limits. This session features paper explores research on using Ion Exchange resin & Oxidation process cases studies for removal of various trace contaminants from potable / ground water.

TIME: 8:10 AM

IWC 21-04: Radium Removal from otherwise Potable Water. Lessons learned with a Radium Selective Hybrid Ion Exchanger

Peter Meyers and Kaitlyn Clark, ResinTech Inc., Camden, NJ

The radium selective hybrid ion exchanger has been around for quite a while now. It is a cation resin with barium sulfate precipitated inside the polymer. In use, radium exchanges into the resin, then replaces barium in the precipitant. Aside from issues about spent media disposal, use of the radium selective hybrid has been hindered by the media's disturbing tendency to sometimes leach barium well above the federal MCL of 2 mg/L. Although adding supplemental sulfate to the feedwater is a way to mitigate barium leaching, feeding supplemental sulfate has not always been successful. In this paper we take up the question of why barium leaches from the hybrid, at what concentrations, and how the various bulk ions in the feedwater affect this leaching.

Discusser: Katherine Van Sice, Sewickley, PA

TIME 9:00 AM

IWC 21-05: Removal of Microplastics from Water with a Magnetic Ferrofluid

Ahmad Pourmovahed, Zachary McKay, Alexander Speer, Kyle Alburtus, Kettering University, Flint, MI

From large fishing nets to microscopic pieces originating from synthetic clothing fibers, plastics have been polluting the environment and our drinking water for decades. This article serves to provide further awareness of the dangers of plastic pollution and presents the results of a student design project which investigated and replicated an experimental method for removing microplastics from water by using an energy efficient apparatus. Once scaled, this design may serve as an addition to water treatment plants and remove microplastics from drinking water. The method, previously documented by a young inventor, mixes water containing microplastics, oil, and a ferrofluid invented by NASA. Since plastics and oil are non-polar, they are attracted to each other and coagulate with the ferrofluid after which a strong magnet is used to extract the coagulated mixture, leaving behind purified water. The designed system has three stages and depends on gravity for water flow until the process is complete. A small DC motor powers a mixing device inside the top section mixing prescribed amounts of water, microplastics, olive oil, and ferrofluid during which the coagulant forms, trapping the microplastics. The coagulant and impurities will then settle to the bottom of the top container where they will rest until a valve is opened to release the fluid into the second stage. Stage two includes a 3-D-printed magnetic filter. The magnetic filter housing is made up of an outer housing and a magnetic roller driven by another motor. The outer housing acts as a funnel for the fluid flowing from the top container. The fluid is directed towards the middle of the housing where a spinning magnetic roller uses magnetic attraction to collect the coagulant. The remaining fluid runs over the roller and out of the bottom of the magnetic filter into the middle container. A hole in the bottom of the middle container allows the purified water to flow into the final stage. The purified water is then tested using a spectrometer for light absorbance rates. The light absorbance recorded from water samples is compared to the known concentrations also tested to establish a baseline. The results are used to determine the exact amount of microplastics that remained in the water after flowing through the system. The design is efficient and environmentally friendly as no pumps are used. This system can remove around 65% of the microplastics at an estimated cost of 25 US¢/L of water.

Discusser: James Beninati, P.E., HDR, Pittsburgh, PA

Cooling Water

Room: SALT RIVER 2

IWC Rep: Brandon Delis, P.E., Electric Power Research Institute, Charlotte, NC

Session Chair: Joshua Pendergrass, P.E., Stantec, Nashville, TN

Discussion Leader: Rebecca Osteen, Southern Company Services, Birmingham, AL

TIME: 8:00 – 10:00 AM

Poor cooling water quality can result in equipment fouling, reduced heat exchange rates, and damage to critical process equipment that can lead to unplanned downtime. This session will explore several operational and process control approaches to prevent cooling water degradation and treat systems effected by fouling.

TIME: 8:10 AM

IWC 21-07: The Art and Science of Treating Once-Through Cooling Water

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

Once-through cooling requires a large quantity of the water, however, the consumption is very low as only a very limited amount of water is lost either to evaporation or seeping through ground. Most of the once-through cooling is used in the power generation where either rivers or impounded lakes are the source of water. An impaired water, produced water or sea water can also be used without pre or post treatment. Optimization of chemical treatment is very important because of the large quantity of the water and also to prevent overfeeding, which may take away the lake's ability to self-soften.The paper discusses various technologies and models for inhibitor optimization, such as taking advantage of self-softening of lakes, treating the water only for the duration in the heat exchanger, automation and control, and predicting the on-set of precipitation event for better management. The on-set of precipitation deploys simple on-site laboratory test "Cooling Lake Inhibitor Optimization" (CLIO) to determinate real time potential for precipitation of the supersaturated mineral. This test is also helpful to tae advantage of any natural inhibitor or residual treatment inhibitor present in the lake.

Discusser: Kevin Levesque, P.E., Dewberry Engineers, Inc., Raleigh, NC

TIME: 9:00 AM

IWC 21-08: Non-Phosphorous Passivating Chemistries for Heat Exchangers

Mary Jane Felipe, William Watson, and Swamy Margan, Baker Hughes, Sugar Land, TX

The maintenance of the reliability and heat transfer efficiency of heat exchangers are key factors in optimizing refinery operations. To maximize the service life of the heat exchange equipment, pretreatment is typically done. During turnarounds, operators clean heat exchangers by removing the accumulated scale and thick metal oxide layer. After the cleaning, these heat exchangers are passivated by introducing a prefilmer that forms a protective film rapidly on the heat exchanger surface. Passivation of cooling water systems after a turnaround is a recognized best practice that extends the life and performance of mild steel heat exchangers. Without proper passivation, corrosion products quickly develop on mild steel tube surface creating deposits and increasing the potential for under deposit corrosion.

A common prefilming or passivating agent for mild steel heat exchanger metallurgies during turnaround is phosphate-based chemistries. To achieve rapid film formation, the phosphate chemistries are dosed in very high level. After the passivation procedure, it is often required that the phosphate passivating solutions be blown down before heat load is applied to the tower. This is to minimize the chance of phosphate fouling. In addition to possible phosphate fouling when using phosphate-based chemistries, releasing the phosphate on discharge streams is also a concern.

This paper presents an effective and reliable non-phosphorous passivation chemistry for heat exchangers. Field data shows very low corrosion rate was achieved during passivation and no further corrosion nor fouling was observed during heat load. Formation of the non-phosphorous containing film on the mild steel metallurgies was confirmed using X-ray photoelectron microscopy and electrochemical studies.

Process: Innovations and Optimizations in Water Use and Recovery

Room: SALT RIVER 3

IWC Rep: Jim Summerfield, Dupont Water Solutions, Saginaw, MI

Session Chair: Matthew Roth, Dupont Water Solutions, Midland, MI

Discussion Leader: Daniel Cicero, Nalco Water, an Ecolab Company, Naperville, IL

TIME: 8:00 – 10:00 AM

This session's papers will discuss ways to reduce and or recover water starting with a case study audit on water usage from source through discharge, a paper on optimization of a solids dewatering system and a paper on an innovative low energy thermal evaporations system to recover water from high TDS streams such as MLD/ZLD for reuse.

TIME: 8:10 AM

IWC 21-11: Beyond the Filter Press Leachate Dewatering Design Alternatives

Ron Ruocco P.E., Stantec, Charlotte, NC

Physical/chemical treatment is typically designed to co-precipitate heavy metals to meet regulatory limits, or as pre-treatment to mitigate inhibition of subsequent biological processes.

Physical/chemical treatment systems often utilize flocculation/clarification for coagulation and agglomeration of precipitated solids followed by solids thickeners and filter presses for additional dewatering. Additional dewatering is necessary to qualify dewatered material for beneficial use, or landfill disposal. This paper presents the design and operational details intricate to alternative dewatering equipment including rotary thickeners, and screw presses in lieu of large cylindrical tank thickeners and filter presses.

Discusser: Lindsay Buhl, Aquatech, Hartland, WI, USA

TIME: 9:00 AM

IWC 21-12: Low Energy Ejector Desalination System (LEEDS)

Jorge Aguinaldo and Joseph Kanzleiter, Bechtel Energy, Inc., Houston, TX

LEEDS is a newly developed innovative thermal desalination process that uses water driven highly efficient multi-phase ejector (MPE) instead of mechanical vapor compressor or blower in a mechanical vapor compression evaporator system to recover water or distillate high saline water. The advantages of LEEDS is its lower energy consumption compared to conventional mechanical vapor compression (MVC) evaporators and other thermal desalination processes. Like the mechanical vapor compressor the multi-phase ejector (MPE) compresses the steam and resulting heat is used to heat the high salinity stream. The advantage of the LEEDS is lower CAPEX and OPEX. The use of MPE ejectors and off-the-shelf motive pumps significantly reduces the CAPEX and reduces delivery period. Applications of LEEDS are Minimal Liquid Discharge (MLD), Zero Liquid Discharge (ZLD) facilities, power plants, chemical process industries and manufacturing plants where MVCs are currently used. This presentation describes the pilot test results when treating actual produced water from Permian Basin.

Discusser: Chris Milligan, P.E., ChartWater, BlueInGreen, Fayetteville, AR

Keynote Session

Room: SALT RIVER 2 & 3

IWC Rep: James (Jay) Harwood

TIME: 10:30 AM –12:00 NOON

The IWC Keynote Session is the official start to the 2021 IWC! Welcome Back! In addition to the presentation of the annual awards, we are pleased to have Dr. Eric Hoek as our Keynote Speaker.

The Annual Awards are presented to celebrate the following achievements in the water treatment industry. Awards are presented in the following categories:

FIRST TIME PRESENTER AND OVERALL BEST PAPER AWARD

These awards are to be presented annually to an IWC presenting author (or authors) who best exemplifies the goal of clearly communicating new information, or a new understanding about a significant aspect of water use or water chemistry, or best enhances the knowledge that enables effective utilization of water in industry or another use that benefits humanity. To that end, we are pleased to announce the winners from the 2020 IWC.

The First Time Presenter Award Winner is Adam Sutherland, P.E., from Stantec for presentation of IWC Paper 20-66, Controlling Oxidation Air in an FGD Absorber as a Means to Simplify Wastewater Treatment. The Best Overall Paper Award Winner is Colleen Scholl, P.E., from HDR for presentation of IWC 20-58, The Value (and the Challenges) of Corrosion Transport Monitoring

PAUL COHEN AWARD

As a memorial, to Paul Cohen and his contributions to the power generation industry, the IWC is proud to recognize the authors of the most precise and innovative presentation in the field of power systems water technology that was presented at the 2020 IWC. This year, we honor Colleen Scholl, P.E., from HDR for presentation of IWC 20-58, The Value (and the Challenges) of Corrosion Transport Monitoring.

IWC AWARD OF MERIT

Each year, the International Water Conference presents the IWC Award of Merit to honor an outstanding individual in the field of industrial water technology. This year's Merit Award Recipient is Jane Kucera.

KEYNOTE ADDRESS

Dr. Eric Hoek is a professor in UCLA's Department of Civil & Environmental Engineering, Institute of the Environment & Sustainability and the California NanoSystems Institute. He is also faculty director of the UCLA Sustainable LA Grand Challenge, a campus-wide initiative to transform Los Angeles into the first sustainable megacity by 2050.

Dr. Hoek's academic work explores the union of membrane technologies, nanomaterials and electrochemistry for a more sustainable future. He has also applied this knowledge as an entrepreneur having co-invented/founded several technology companies (e.g., NanoH2O, Water Planet, PolyCera, IntelliFlux) and as a consultant having advised various international, federal and California state agencies, municipalities, technology companies, investment funds, law firms and research funding agencies.

Dr. Hoek has worked on applications including drinking water treatment, wastewater treatment, ocean and brackish water desalination, municipal and industrial water reuse, oil & gas produced water treatment, oil spill remediation, salinity gradient power, biogas production, kidney dialysis and protein purification. He has over 130 peer-reviewed scientific publications, over 70 patents filed globally, is the co-Editor-in-Chief of The Encyclopedia of Membrane Science and is the Editor-in-Chief of the Nature journal npj Clean Water. Dr. Hoek has a Ph.D. from Yale University, M.S. from UCLA, B.S. from Penn State and completed UCLA Anderson's Executive Management and Director Education & Certification Programs.

Full Spectrum Mine Wastewater

Room: SALT RIVER 6

IWC Rep: Paul Pigeon, Golder Associates Inc., Lakewood, CO

Session Chair: Evan Claytor, SUEZ Water Technologies & Solutions, Richmond, VA

Discussion Leader: Don Downey, Purolite Corporation, Paris, ON, Canada

TIME: 1:15 – 5:00 PM

Process water plays a critical role in mining operations, but it can also lead to costly waste treatment solutions for owners. The mining industry faces many challenges from the rising and falling of commodity prices, to environmental regulations and even governmental policies. The four papers presented in this session look to not only solve environmental issues but also demonstrate that water companies can bring solutions which help stabilize operations and increase profitability.

TIME: 1:25 PM

IWC 21-13: Pilot Study of HDS Process Treating Concentrated Mine Water

John Schubert, HDR, Sarasota, FL; Sriram Ananthanarayan, BHP; Mark Owens, HDR, Midlothian, VA

The closure of inactive mine sites requires the disposition of water that has over time accumulated onsite. This involves the treatment of a potentially large volume of water to meet discharge criteria. In one specific case, a large volume of water had accumulated from mining operations. The water is characterized as being highly acidic, with a high sulfate and TDS concentration, and large concentrations of a variety of metals and metalloids. It is expected that treatment of the accumulated water and groundwater flowing into the pit will continue long term. Several processes are currently under consideration for removal of the bulk of the major wastewater constituents, including sulfate, fluoride, aluminum, copper, iron and host of metals and metalloids at lower concentrations including arsenic, selenium and molybdenum. As an initial evaluation, the High Density Sludge (HDS) process was selected for lab scale pilot study. The study was conducted in HDR's process research lab in February and March, 2021. The pilot system operated at a flowrate of nominally 100 ml/min, under a variety of operating conditions. A critical concern was the high strength of the wastewater and the resulting high solids formed in neutralization. This paper will describe the wastewater characteristics, pilot system configuration, effluent concentrations of critical parameters, and the general interpretation of results.

Discusser: Joe Tamburini, AWC Water Solutions, Langley, BC, Canada

TIME: 2:15 PM

IWC 21-14: Arsenic Removal Pilot for Waste Liquor from Metal Refining Roaster

John Van Gehuchten, P.E., McKim & Creed Inc., Glenshaw, PA and Katherine Van Sice, Sewickley, PA

A metal refining roaster in Pennsylvania generates a weak acid waste stream from the system's scrubbing system. A pilot was conducted to evaluate the optimum conditions for removing the arsenic concentration from varying from 1000 to 500 parts per billion to less than 100 parts per billion. This paper will present data with respect to the water quality trends, treatment conditions applied, optimizations made during the process, and other relevant field obtained data.

Discusser: Darrell Hartwick, Buckman, North Lancaster, ON, Canada

TIME: 3:20 PM

IWC 21-15: Troubleshooting Hollow Fiber UF System at Operating Acid Mine Drainage Water

Louise Murphy, Eloy Montoya and Victor Wirick, Golder, Lakewood, CO

This paper examines troubleshooting methodology for a hollow fiber ultrafiltration (UF) system used as a polishing step in treating acid mine drainage at an operational water treatment plant. The UF system became an

unsustainable labor sink at the plant. Gathering information, troubleshooting, and systematically implementing solutions has allowed the system to run without major issues.

Discusser: Chris Friesen, Purolite, Calgary, AB, Canada

TIME: 4:10 PM

IWC 21-16: Pilot Study of Solvent Extraction/Electrowinning for Copper Recovery

John Schubert, HDR, Sarasota, FL; Sriram Ananthanarayan, BHP; Chloe Grabowski, HDR, Missoula, MT

A mine owner is undertaking closure studies of its inactive mine sites in the southwestern United States. As part of the closure studies, large inventories of pit water at its closed sites will require treatment prior to discharge. The water is characterized as being highly acidic, with significant concentrations of sulfate and Total Dissolved Solids. Several metals including aluminum, copper, iron, manganese and magnesium are present in high concentrations ranging from high hundreds to thousands of mg/L. A variety of other metals and a number of rare earth elements are present at lower concentrations ranging from 5 to 50 mg/L. An initial evaluation, which considered potential economics and process viability, indicated a sufficient concentration of copper is present in the pit water to consider recovery of copper as a byproduct prior to further treatment of the water for discharge. The study further indicated that the highest return on investment is expected to be from the solvent extraction /electrowinning process (SX/EW). A lab scale flow through pilot study was conducted to evaluate the performance of the process. This paper describes the lab study, the results of the study, and conclusions related to the product quality and economic viability of the process.

Discusser: Kristina Minchow, Golder, Lakewood, CO

Trace Contaminant Treatment

Room: SALT RIVER 7

IWC Rep: Jay Harwood, SUEZ Water Technologies & Solutions, Oakville, ON, Canada

Session Chair: Peter Meyers, Resintech, Camden, NJ

Discussion Leader: Robb Simm, Stantec, Chandler, AZ

TIME: 1:15 – 4:10 PM

Mass limits for wastewater discharges containing contaminants such as selenium and arsenic often result in concentration limits well below the MCL's established for potable water. These (sometimes seemingly impossible) limits drive research and product development for passive ways to remove these contaminants that don't require constant vigilance. This session features papers that explore common attributes of trace contaminants as well as recent innovations in passive treatment technologies being used for their removal.

TIME: 1:25 PM

IWC 21-17: Fundamentals of Trace Contaminant Removal and Long Life Medias

Justin Schram and Frank DeSilva, ResinTech Inc., Camden, NJ

The removal of trace contaminants in water depends as much or more on the concentrations of the bulk ions in the water as the concentration of the trace contaminant. Often, trace contaminants are presents at the parts per billion (ppb) or parts per trillion (ppt) level in a see of harmless bulks ions on the order of 100-1000 parts per million (ppm).

Since the trace contaminants are present at such low concentrations, meaningful throughputs may be achieved with ion exchange resin even if the trace contaminant is not a preferred ion. When the trace is preferred, very long throughputs may be achieved. In cases where the resin has a high affinity for a trace contaminant it may be operated on a single use basis with no regeneration.

This paper focuses on the fundamentals of trace contaminant removal. The principle of concentration difference in trace contaminant removal, the importance of the water analysis in designing treatment plans, cases where regenerable or single use are preferred, and common pitfalls of single use systems will be discussed.

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

TIME: 2:15 PM

IWC 21-18: Biological Removal of Soluble Arsenic

Thomas Higgins, P.E., Ph.D., Worley, St Augustine, FL; Michael Finneran, P.E., American Electric Power, Columbus, OH; Heyward Suber, Worley, Atlanta, GA

Chemical and physical treatment is effective at removal of particulate arsenic from FGD wastewater, but we demonstrate that it is not effective at removal of soluble (filtered) arsenic. We present data from an active FGD biological treatment system where there is significant removal of soluble arsenic, sufficient to achieve the ELG limit.

Discusser: Mark Owens, P.E., HDR, Midlothian, VA

TIME: 3:20 PM

IWC 21-19: The Long Game – Passive Selenium Removal for Long-term Water Management

Andrew Holmes, Ph.D., P.Eng. (ON, BC); Kevin Dufresne, P.Eng. (ON, BC); Silvia Mancini, Ph.D., P.Geo. (ON, BC); and Janet Goodfellow, P.Eng. (ON, MB); Geosyntec Consultants, Guelph/Toronto, ON, Canada

Regulation of selenium continues to drive critical decisions around water treatment in mining and power industries during mine operation, mine closure, ash pond closure and other long-term facility management plans. Over the past five years, there has been a significant shift towards the development of passive and semi-passive water treatment options, including Gravel Bed Reactors (GBRs), to replace or supplement active water treatment plants in effort to sustainably manage selenium issues in the long-term.

Discusser: Americus Mitchell, SUNDT, Tempe, AZ

RO & Membranes #1

Room: SALT RIVER 2

IWC Rep: Lyndsey Wiles, ZwitterCo, Cambridge, MA

Session Chair: Elke Peirtsegaele, DuPontr, Bend, OR

Discussion Leader: Matthew Flannigan, Nalco Water, an Ecolab Company, Naperville, IL

TIME: 1:15 – 5:00 PM

Wastewater treatment using membrane technology is becoming more and more prevalent across the globe as fresh water sources continue to dwindle. In attempt to treat and reuse water and wastewater as a means of protecting fresh water sources, industrial and municipal facilities are requiring creative approaches using membranes for sustainable and cost-effective solutions. In this session, we will examine how innovations in material science have led to a new generation of RO elements that use thin-membrane technology to offer more surface area, realizing lower capital and operating costs. We will also learn how various wastewater treatment systems around the world were updated from conventional treatment schemes to more sustainable treatment solutions, allowing these systems to treat difficult wastewater streams while meeting tightening discharge and reuse limits without the need for excessive chemical use, thermal equipment, or extensive brine management.

TIME: 1:25 PM

IWC 21-21: Benefits of Operating the First Membrane Systems Utilizing New Thin-Membrane Technology

Richard Franks, Myles Davis, and Craig Bartels, Hydranautics, Oceanside, CA; Lance Thibodeaux and Sam Pallares, LA Sanitation and Environment, San Pedro, CA

In the past year, several membrane systems were started using new, Thin-Membrane Technology which allows the highest active membrane area to be

manufactured into the standard spiral wound element. These new membrane systems, which include RO for municipal wastewater reclamation and NF operating on offshore oil platforms, are the first of their kind in utilizing the new technology and demonstrate how wide range of applications can benefit from this innovation.

The spiral wound element was developed in the 1970s to package RO and NF membrane material into a compact, efficient and usable unit. Since that time, incremental improvements in element design and materials of construction have led to enhanced efficiencies and productivity. However, the overall element design has remained largely unchanged. Most notably, in recent years, efforts to fit more material into the present spiral element configuration reached an optimal plateau. Advances in automated manufacturing resulted in either increasing element surface area or increasing thickness of the feed/brine spacer. Either enhancement could be selected depending on the quality of the feedwater or the efficiency of the pre-treatment. However, it was not possible for the system designer to capitalize on the benefits associated with both enhancements. For this reason, when treating high quality source water, system designers prefer to use spiral elements that contain higher surface area to realize lower capital cost or lower operating cost. When treating high fouling source water such as municipal wastewater, RO designers have utilized the thicker feed/brine spacer to reduce differential pressure losses, minimize fouling and improve cleaning effectiveness. Designers selecting elements with thicker spacer forfiet the benefits associated with higher area elements. In recent years, thanks to innovations in material science, a new generation of RO elements are now being operated in full scale plants. These elements offer both a larger surface area and thicker feed/brine spacer.

This paper will detail the innovation in the construction of the new membrane material and compare its effects on element performance with previous generation membranes. The paper will analyze the operation of these new elements in at least two different applications including municipal wastewater reclamation and treatment of seawater on an offshore oil platform. Based on the operation of these new elements, a capital and operation cost comparison will be made with similar plants operating with the older generation of membranes.

Discusser: Nicole Bartoletta, McKim & Creed, Inc., Sewickley, PA

TIME: 2:15 PM

IWC 21-22: Extracting Lessons Learned from a Coal Mine Impoundment Desalination Water Treatment System

Tom Imbornone and Ken Robinson, Avista Technologies, San Marcos, CA

Wastewater treatment is becoming more prevalent across the globe. The complexity of the water treatment systems are also increasing as a result. When the wastewater to be treated is sent to an impoundment first, there is higher variability to the organics and solids level. It is especially challenging when this impoundment is also composed of seawater, as in the case discussed in this paper. Typically, the goal of a water treatment system is to achieve the desired product water quality at the minimum total cost. Sometimes this mistakenly results in a lower capital system cost at the expense of increased operating costs for the final water treatment system.

This paper will discuss a water treatment system in the Midwest where the capital system's robustness was sacrificed to the point where operational costs became much higher than desired. The main components of the system were originally a settling basin, multimedia filters (MMF), and two stage seawater RO's. Membrane life was short resulting in an upgrade of the MMF's to an Ultra-Filtration (UF) system. The system also struggled with scaling of the RO's. We will dive into the critical aspects of where this system was/is deficient and cover alternatives to the choices made.

Specific topics the paper will discuss are as follows:

- Particle count requirements ahead of an RO
- MMF performance issues
- Break tank considerations
- The importance of purified water during UF clean in place
- Impact of water temperature on scaling and antiscalant dosage

The goal of this paper is to help guide a future owner or operator of a water treatment system so that they have a better understanding of some of the problems and risks in treating impoundment water.

Discusser: Simone Callioni, Aquatech International, The Hague, Netherlands

TIME: 3:20 PM

IWC 21-23: Advanced Wastewater Treatment in Textile – An Overview of Bangladesh Region

Harkirat Kaur, Alka Deshpande, and Monica Sharma, SUEZ Water Technologies & Solutions, Bengaluru, India; Joshua Dewanaga, SUEZ Water Technologies & Solutions, Bellevue, WA

The Textile Industry is among the most water consuming industries. Different process units make use of various chemicals to produce finished fabrics. Consequently, significant quantities of wastewater containing a variety of harmful chemicals is generated. Bangladesh, which is one of the world's largest apparel exporter, generated approximately 280 million cubic-meters of wastewater in year 2019. The majority of the existing water treating plants in Bangladesh have used conventional treatment schemes which involved physical-chemical conditioning (occasionally) followed by biological processes. But increasing space constraints coupled with soaring demands for textile units expansion called for a compact and robust water treatment solution. Moreover, following the zero discharge of hazardous chemicals (ZDHC) guidelines, textile units pivoted to operate more sustainably by reducing their chemical consumption for pre-treatment while meeting the stringent discharge limits.

Membrane Bioreactor (MBR) processes, which combines biological treatment with submerged Ultrafiltration membranes, provides significant advantages over the conventional treatment process. It avoids the use of hazardous chemicals and is an ideal technology for generating water quality suitable for further treatment using reverse osmosis (RO) to enable wastewater recycling and reuse, which is the next key focus of Bangladesh region. This paper will discuss how MBR achieves improved water quality (in terms of COD, BOD, TSS and Colour) for the treated water being discharged from different textile processing applications such as:

- Knit Dyeing
- Yarn Dyeing
- Denim/Woven Dyeing and
- Denim Washing

The development process for designing MBR solutions starting from lab studies to site operations will be presented along with operational data to validate performance over conventional water treatment schemes. In addition, key learnings will be discussed which resulted in equipment design improvements (i.e. size reduction) and to improve processes for removal of threads/fibres, and to reduce dye colouring the final effluent stream for discharge.

Discusser: Ken Robinson, Avista Technologies, San Marcos, CA

TIME: 4:10 PM

IWC 21-24: 99% Recovery of Scaling Cooling Tower Blowdown with a Reverse Osmosis Membrane Demonstration Plant

Derek Mandel, P.Chem, Saltworks Technologies, Richmond, BC, Canada; Ryan Upshall, P.E., Nutrien, Carseland, Alberta, Canada; Makoto Kobuke, Hydranautics, Kusatsu, Shiga, Japan

A reverse osmosis demonstration plant achieved 99% recovery of highly scaling cooling tower blowdown at an Alberta agrichemical facility. In this paper, the authors share details of the ultra high recovery membrane system's design and performance, including system process flow, mass-energy balance, and feed, permeate, and concentrated brine chemistries. The novel integrated ultra high recovery reverse osmosis system reduced the need for thermal evaporator capacity or wastewater trucking to a discharge facility.

Discusser: Steve Russell, Kiewit, Lenexa, KS

ASME Boiler Guideline Revisions and Related Topics

Room: SALT RIVER 3

IWC Rep: Wayne Bernahl, W. Bernahl Enterprises Ltd., Elmhurst, IL

Session Chair: Ken Kuruc, Hach, Perrysville, OH

Discussion Leader: Jerry Jones, Ecolab, Sugar Land, TX

TIME: 1:15 – 5:00 PM

ASME feedwater and boiler water guideline revisions will be presented and discussed by a panel of ASME committee members along with several other boiler operating topics. Discussions will focus on improving the efficiency of and minimizing combined water and energy consumption in the steam/water cycle, silica deposition and fouling with corresponding methodologies to assure steam purity, and a secondary additive to enhance the performance of traditional film-forming amines.

TIME: 1:25 PM

IWC 21-25: Amine-based Filmer Chemistry for Boilers with Improved Water Solubility and Performance

Mahesh Budhathoki, Ph.D., Donald Meskers, Jr., Claudia Pierce, Ph.D., and Gregoire Poirier Richer, SUEZ Water Technologies & Solutions, Trevose, PA

Film forming chemistries for steam generating systems have gained in popularity in recent years. Users often must select between a non-amine filmer with limited corrosion protection and an amine-based material with stronger protection but potentially undesirable properties such as water insolubility, steam condensate deposition, cation conductivity contribution, etc. In this work, a secondary additive is used to mitigate the challenges of an amine-based filmer. Results show that the added component not only affects the filmers' steam partitioning but also minimizes fouling propensity and cation conductivity contribution while enhancing overall corrosion performance. Initial field data are discussed and correlated with the laboratory results.

Discusser: James Bellows, James Bellows and Associates, Maitland, FL

TIME: 2:15 PM

IWC 21-26: Doing More with Less: Optimizing the Industrial Boiler Steam/Water Cycle

Colleen Scholl, P.E., HDR, Whitewater, WI

Steam remains essential to operation in most industrial facilities today accounting for nearly 30% of the process energy consumption utilized in the US manufacturing sectors. Some industries are larger steam users than others; for instance, based on the latest Manufacturing Energy Consumption Survey (MECS) released at the end of 2017, the amount of steam, as a percentage of the total energy consumed, utilized by the pulp and paper industry is 83%, by the chemical manufacturing industry is 57%, and by the petroleum refining industry is 42%. In many instances, this steam is injected directly into plant processes, loss via leakage, vented to atmosphere, or discarded via blowdown. Given this data, opportunity exists to optimize operations and address sustainability initiatives by combining goals for energy and water efficiency.

This paer will describe the water and energy balance that exists in typical industrial steam/water cycles. It will discuss and assess various opportunities for improving efficiency and minimizing combined water and energy consumption through the implementation of chemical control options, water quality improvements, water recovery and reuse, system upgrades or retrofits, and modification of operational practices. Tradeoffs and payback period for several sample cases will be detailed and presented.

Discusser: Robert Bryant, Nalco Water, Missouri City, TX

TIME: 3:20 PM

IWC 21-27: Overview and Panel Discussion on Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry in Industrial and Institutional Boilers

Robert Bartholomew, P.E., sheppard t. powell associates llc, Baltimore, MD

A Virtual panel discussion is proposed by members of the ASME Research & Technology Committee on Water and Steam in Thermal Systems to discuss the Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry in Industrial and Institutional Boilers. Significant revisions of this consensus document are nearing completion in the committee. These presentations and the associated panel discussion is designed to explain the new consensus, what has changed and why those changes were implemented.

Presentation 1: Introducing the Revised Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry, Robert Bartholomew, P.E.

This presentation will provide a general overview of the consensus document by the Committee Chair and will include the following:

- Introduce the Consensus Guidelines and the Process for Their Development
- Outline the Current Consensus
- Discuss what it contains and what is new
- Discuss what it does not contain.

Presentation 2: Understanding Carryover Estimates and Boiler Water Conductivities, Anton Banweg, Nalco (retired)

This presentation will focus on correcting misleading or incorrect information in prior published guidelines from the perspective of a former boiler manufacturer previously involved with setting boiler guarantees, ABMA limits and ASME consensus limits. This will explain how boiler water limits were calculated based on previously agreed boiler manufacturer guarantees and selected steam total dissolved solids (TDS) targets.

Presentation 3: Understanding Steam Purity Limits, James Robinson, SUEZ, Horsham, PA

This presentation will discuss the rationale for the range of steam purity values included in the document from the perspective the Chair for A Practical Guide to Avoiding Steam Purity Problems in the Industrial Plant published in 1995 (and one of the two remaining members of the Committee that worked on the very first ASME Consensus document published in 1979).

TIME: 4:10 PM

IWC 21-28: Understanding Silica and Alkalinity ASME Consensus for Industrial Steam Generation Systems

Edward Beardwood, Beardwood Consulting & Technologies Inc. (BC&T Inc), London, ON Canada

Silica present as an impurity in waters used for the production of steam have resulted in both water side deposition in steam generators and steam/condensate fouling within turbines. A brief review of the history of silica deposition/fouling and its control will be provided. The suggested boiler water silica limits in the new ASME booklet; "Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry in Modern Industrial Boilers" , and their derivation will be discussed. The elements comprising total steam purity as well as a procedure for estimating the silica contribution will be disclosed. The effects of silica volatility and prediction methods will be provided. This then allows one to determine the steam generation system operational control range set points required to meet the silica steam purity specification associated with a particular turbine and its duty. Emphasis on the methodology used to avoid silica deposits within steam generators and fouling of steam turbines will be outlined. To illustrate the process; an example calculation is provided in the paper.

Industrial Wastewater Treatment

Room: SALT RIVER 6

IWC Rep: Tom Lawry, McKim & Creed, Inc., Sewickley, PA

Session Chair: Ed Greenwood, Wood, Chantilly, VA

Discussion Leader: Cristina Piekarz, P.E., HDR, Walnut Creek, CA

TIME: 8:00 – 11:10 AM

For industrial wastewater, treatment challenges continue to be wide ranging and multifaceted. For many industries with complex waste streams treatment can be especially challenging. As well, the ELG discharge requirements are evolving; becoming more site specific and more practical which will drive the need for specialized treatment solutions. In this session, we will explore these growing trends and discuss several new innovative treatment strategies rising to the challenge. Papers will examine the obstacles facing industry and some new approaches when treating complex high strength wastewaters.

TIME: 8:10 AM

IWC 21-29: Developing Reasonable Best Available Technology Discharge Limits for Bottom Ash Transport Water Purge Allowances for Operational Coal-Fired Electric Generating Units

Lindy Johnson, Stantec, Chattanooga, TN; Adam Sutherland, Stantec, Nashville, TN; Bill Kennedy, Stantec, Charlotte, NC

EPA declined to promulgate Best Available Technology (BAT) limitations for bottom ash transport water (BATW) discharges from high-recycle systems in the 2020 Steam Electric Effluent Limitations Guidelines (ELGs). Instead, EPA determined that ELGs for BATW discharges would be established on a site-specific basis using Best Professional Judgement (BPJ). BAT established by BPJ should follow the same statutory factors EPA uses in national ELG rulemaking, only applied at each site. This paper uses a case study to describes steps to establish technically defensible BAT discharge limits by BPJ that result in reasonable treatment approaches and costs.

Discusser: Diane Martini, Burns & McDonnell, Chicago, IL

TIME: 9:00 AM

IWC 21-30: FGD Scrubber Ferrous Injection and Sulfite Control to Achieve ELG Limits

Thomas Higgins P.E., Ph.D., Worley, St. Augustine, FL; Michael Rogero and Troy Patton, P.E., Seminole Electric Cooperative, Inc., Palatka, FL; Mary McCloud, Worley, Ft. Lauderdale, FL

Seminole Electric operates a novel treatment system that uses ferrous chloride to chemically reduce and remove selenium from FGD wastewater. The plant employs sulfite control in the scrubber modules which has reduced soluble selenium in the wastewater but is limited in turndown of aeration. Plant demonstrated that ELG limits could be achieved efficiently by feeding ferrous iron to the scrubber module, reducing and precipitating selenium before it could be oxidized into a more difficult to treat form.

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

TIME: 10:20 AM

IWC 21-31: Sulfolane Treatment: Adaptive Approach using a Moving Bed Bioreactor

Srinivasa Varadhan and Janet Goodfellow, Geosyntec Consultants International, Guelph, ON, Canada; Scott Forbess and Richard Hodges, Geosyntec Consultants, Inc., Rancho Cordova, CA

This paper presents a case study on the adaptation of moving bed bioreactor (MBBR) technology for treating sulfolane, an emerging groundwater contaminant and a comparison of proven sulfolane treatment technologies.

Laboratory and field pilot testing data suggested that the sulfolane degrading inoculum preferred to be attached to inert MBBR media than be suspended. The pilot system demonstrated low sensitivity to nutrient requirements, but greater sensitivity to temperature and dissolved oxygen concentration. Hydraulic retention time and inert media quantity were optimized to meet the treatment performance objectives. The pilot system was successfully scaled up to a 600 gallon per minute (gpm) system.

Discusser: Chandler Johnson, World Water Works, Inc., Oklahoma City, OK

TIME: 11:10 AM (MOVED FROM MONDAY MORNING)

IWC 21-10: Case History: Efforts to Minimize Raw Water Usage and Wastewater Discharge at a Large Industrial Facility

Daniel Sampson and Cristina Piekarz, P.E., HDR, Walnut Creek, CA; Josh Prusakiewicz, HDR, Ann Arbor, MI; Ben Stanley and Dave Engelman, DGC Operations, LLC, Middletown, NY

CPV Valley Energy Center is a 2×1 combined-cycle electrical generating facility with an Air-Cooled Condenser (ACC). The ACC significantly reduces water use, but Valley was struggling with high usage and discharge rates. Critical water management issues included higher greywater intake and discharge costs, higher chemical usage, heat losses in the HRSG's (which led to lower thermal efficiency) and higher operator demand to maintain plant chemistry and tank levels. This paper will describe the plant's efforts to minimize water usage and wastewater discharge, what did and did not work well, and the results.

Discusser: Monica Sharma, SUEZ Water Technologies & Solutions, Bangalore, Karnataka, India

MLD, ZLD and Brine Management

Room: SALT RIVER 7

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

Session Chair: Wayne Bates, Hydranautics, Rockton, IL

Discussion Leader: Jordan Pearce, P.E., OLI Systems, Houston, TX

TIME: 8:00 AM – 12:00 NOON

Minimum Liquid Discharge (MLD) and Zero Liquid Discharge (ZLD) systems are becoming more popular as industry drivers incentivize maximizing water recovery and minimizing disposal volumes of liquid concentrate (brine). This session reviews current concentration and disposal methods, with an emphasis on the use of RO membrane technologies upstream of evaporators, crystallizers, centrifuges, ponds, and other evaporation methods. We consider these upstream membrane processes to be MLD processes, since recovery can be limited to 90-97% of the feed, and not ZLD processes, which require 100% recovery.

TIME: 8:10 AM

IWC 21-33: Xcel Cherokee near ZLD Wastewater Treatment System Design Considerations

Paul Brandt, Burns & McDonnell, Kansas City, MO; Bryan Hansen, Burns & McDonnell, Denver, CO; Adam Kortan and Jason Miller, Xcel Energy, Denver, CO

The Xcel Cherokee Generating Station in Denver, Colorado was recently given new NPDES permit limits for chlorides, sulfates, total inorganic nitrogen (TIN) and other constituents for the plant's common outfall. Meeting the new chloride and sulfate concentrations became the limiting factor for technology selection and compliance. Wastewater produced at the plant includes cooling tower blowdown, reverse osmosis (RO) system reject, stormwater, and other miscellaneous plant wastewaters. Due to the new NPDES limits, Xcel Energy, with the assistance of Burns & McDonnell, determined that a near-ZLD wastewater treatment system was the best option for the plant to replace an existing conventional clarification system. Treated water from the new system is returned to the plant for reuse and concentrated brine is routed to new evaporation ponds. Various options were evaluated in the study phase to help select the most economical treatment configuration including: Makeup water softening, High efficiency reverse osmosis, Nanofiltration, Closed-circuit reverse osmosis, Forward osmosis, Ultra-high pressure reverse osmosis, Membrane electrodialysis, Osmotically enhanced reverse osmosis, Mechanical vapor

recompression evaporator, Forced circulation crystallizer, Alternative thermal evaporator designs, Evaporation ponds, Waste heat cooling tower, Bypass evaporator spray dryer, Operational changes, Discharge to a nearby POTW facility

The wastewater system ultimately selected and designed includes:

Equalization ponds, High rate softening clarification, Multimedia filtration, Closed circuit reverse osmosis with 98% recovery of wastewater for reuse, Evaporation ponds for concentrated brine wastewater, Filter press for sludge dewatering, Required startup in Fall of 2021

The WWT project is currently under construction and is planned to complete startup at the end of 2021. This paper will cover the following aspects of the study and detailed design phases of the wastewater treatment system:

- Study phase options considered and drivers for the near ZLD system selected.
- Process description and design considerations/limitations of equipment selected.
- Operational changes to reduce wastewater flow requiring treatment.
- Challenges of elevated TOC in wastewater, effects on selected wastewater equipment, and TOC removal methods evaluated.
- Challenges and recommendations of locating new equipment in existing water treatment building
- Methodical approach to evaporation pond selection/sizing.

Discusser: Prasad Kaniampal, Aquatech International, Canonsburg, PA

TIME: 9:00 AM

IWC 21-34: Power Plant Water Balance Tool Optimizes Load Leveling and Achieves ZLD

Daniel E. Carey, Ph.D., P.E., Worley, Charlotte, NC; Thomas E. Higgins, Ph.D., P.E., Worley, St. Augustine, FL; Eric Costello, Tom Gaboian, and Nate Parker, Orlando Utilities Commission, Orlando, FL

Orlando Utilities Commission (OUC) operates two coal fired boilers in the Stanton Energy Center and has recently announced they will repower both units with natural gas. OUC had a need for a water balance model to guide dispatch, maintain ZLD, and understand the site wide salt balance. A calibrated model was created to predict evaporation rates, pond storage volumes, chloride and TDS. The model has been useful for optimizing current operation and predicting future conditions.

Discusser: Daniel Sampson, HDR, Walnut Creek, CA

TIME: 10:20 AM

IWC 21-35: Increasing Productivity of an Existing RO Plant BY Reducing the Rejected Brine Stream by 80%

Boris Liberman, Gal Greenberg, Lior Eshed, and Matan Alper, IDE Water Technologies, Kadima, Israel

PFRO leverages mechanical and chemical ingenuity to solve conventional reverse osmosis (RO) challenges.

Using the Abilene PFRO demo case study, we will demonstrate how, by constantly changing osmotic and hydraulic conditions, PFRO prevents bacteria reproduction, reduces scaling, extends membrane lifespan, and leads to higher water production and higher recovery, compared to traditional RO.

PFRO technology is most suitable for water reuse applications, in which biofouling and scaling are the natural limiting factors for higher recovery.

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

TIME: 11:10 AM

IWC 21-36: System Start Up and Operation of a ZLD RO Brine Treatment System

Sean Forsberg and Americus Mitchell, Sundt, Tempe, AZ

A zero liquid discharge brine treatment system was constructed to treat RO reject at an industrial wastewater plant in the southwest USA. The system produces a mixed salt and distilled water effluent. The system is composed of a falling film evaporator, forced recirculation crystallizer and centrifuge for salt dewatering. This paper will discuss operational performance of the plant, issues faced during commissioning and start up and recommended design changes for future ZLD plants.

Discusser: Richard Stover, Gradiant, Woburn, MA

State of the Science: PFAS Treatability Review

Room: SALT RIVER 2

IWC Rep: Mike Gottlieb, ResinTech, West Berlin, NJ

Session Chair: Kristen Jenkins, OLI Systems, Inc., Parsippany, NJ

Discussion Leader: Eric Klinker, DuPont, Edina, MN

TIME: 8:00 – 11:10 AM

This session focuses on recent advances in PFAS treatment in water for a range of applications from drinking water to leachate. Conventional technologies (GAC and IX) are covered as well as research on the capability of over 10,000 organisms to biodegrade PFAS.

TIME: 8:10 AM

IWC 21-37: Per- and Polyfluoroalkyl Substances (PFAS) in Landfill Leachate: Assessment, Forensics, Treatment and Management

Janice Stonebridge, P.E., and Krista Barfoot, Ph.D., C.Chem, QPRA, Stantec, Waterloo, Ontario, Canada; Angus McGrath, Ph.D., Stantec Consulting Services, Nevada City, CA; Peter Daniels, P.E., Stantec Consulting Services, Golden Valley, MN; Henry Croll, E.I.T., Stantec Consulting Services, Des Moines, IA

PFAS, a group of more than 3,000 human-made chemicals, are ubiquitous at very low levels in the environment, and have been measured in water supplies across the US. PFAS investigative efforts have historically been focused on the release of aqueous film forming foam; however, growing concerns regarding the potential for PFAS releases from other sites are prompting the expansion of that focus. On March 20, 2019, California's State Water Resources Control Board released an order requiring PFAS investigations at landfills, identifying 196 sites for assessment. While, internationally, standards for allowable concentrations of various PFAS in different environmental media continue to evolve, guidance and regulation specific to the assessment of PFAS at landfill sites continues to lag.

Landfill leachate poses a significant challenge for PFAS removal because the other constituents in the matrix have a greater affinity for adsorptive surfaces of granular activated carbon (GAC) or ion exchange (IX) and inorganic species will also tend foul treatment systems. Emerging technologies have been shown to be effective at removing PFAS from landfill leachate that are compatible with GAC and IX, allowing post treatment polishing to achieve effluent standards by both. The resultant concentrated PFAS waste reduces the overall mass of solids requiring incineration.

This talk will explore the current status of developing standard industry practices for sampling PFAS at landfills, interpreting the results to identify potential sources, assessing potential risks, evaluating leachate treatment technologies, and identifying management options.

Discusser: Patrick McKeown, P.E., ECT2, Portland, ME

TIME: 9:00 AM

IWC 21-38: City of Issaquah, WA's Experiences with PFAS Removal for the Past Six Years

Pierre Kwan, P.E., HDR, Seattle, WA; Robert York, P.E., City of Issaquah, Washington, Issaquah, Washington; Beth Mende, P.E., HDR, Bellevue, WA

This presentation shares details of how a water system implemented a treatment response after detecting per- and polyfluoroalkyl substances (PFAS). The City of Issaquah, Washington provides drinking water to its customers from groundwater wells. As part of federal mandated monitoring in 2015, the City detected PFAS in its 250 GPM Well No. 4. PFOS was detected at concentrations as high as 600 ng/L, 8.5-times higher than the USEPA Lifetime Advisory Level of 70 ng/L for PFOS+PFOA and 40-times higher than the pending State action level of 15 ng/L. The City immediately reviewed the situation and selected wellhead treatment to handle the situation. The entire system was designed, permitted, constructed, and started up in 77 days. The facility started operations in June 2016. At the time of this presentation, the system has been in continuous use for nearly six years and is one of the longest continuously operating PFAS removal systems in the world. This presentation discusses the operational surprises, challenges, and unintended consequences that the operators has dealt with over this time.

Two vertical granular activated carbon (GAC) vessels were installed in lead/lag configuration, with more vessels planned in future expansions. Given the project implementation speed, the project took the unusual step of installing one type of GAC media in the lead vessel and a second type of GAC in the lag vessel. The intent was to exhaust the lead vessel to determine the amount of PFOS removal, then switch to the lag vessel to quantify the second vessel's performance. This operation allowed determination of which media provided the best dollars per gallon treated that the owner would use for future GAC replacement.

Operational insights that the City has gained include large differences between predicted and actual performance and operating costs, the media becoming radioactive despite the water having non-detectable radiation, frequent bouts of biological fouling, and ongoing regulatory issues with media disposal. In addition, while the full-scale GAC system was operating, we pilot tested ion exchange (IX) resins to determine if switching to IX would provide lower operational costs. The IX testing showed great promise in terms of quality but failed due to biological fouling. Potential solutions to allow IX to operate successfully were deemed financially infeasible and operationally complex versus continuing with GAC. The intent of this presentation is to share the City's lessons learned so that other users can be more successful in addressing PFAS treatment challenges.

Discusser: Peter Meyers, ResinTech Inc., Camden, NJ

TIME: 10:20 AM

IWC 21-39: Estimating Ion Exchange Capacities for PFAS/PFOS Compounds Using Isotherm and Mass Transfer Data

Dirk Steinhilber, Lanxess, Koeln, Germany

Ion exchange has been shown to be a highly effective method for the removal of PFAS/PFOS compounds down to concentrations that meet even the most stringent current regulatory levels. In addition, excellent kinetics and capacity for these compounds, using specially developed ion exchange resins, results in a process design that uses a very low empty bed contact time (EBCT) for the effective removal of these compounds. This kinetic efficiency combined with high-capacity results in both capital and process economies over alternative removal methods such as granular activated carbon.

One challenge in assessing ion exchange resin types for these family of compounds is the very low concentration of the contaminants which, along with the high capacity of selective resins, results in extremely high throughputs making laboratory or field column testing very time consuming.

This paper describes laboratory studies using industry accepted methodologies that experimentally derive isotherm rate kinetics and mass transfer coefficient for a particular contaminant and resin which may then be used to predict breakthrough curves and operating throughput.

Using these with well documented adsorption models, such as Langmuir & Freundlich, we are now able to provide a good estimate of operating capacities of ion exchange resins for various PFAS / PFOS compounds

The paper also compares, using the aforementioned methodology, a number of industry available selective resins promoted for the removal of PFAS/PFOS compounds.

Discusser: Francisco Barajas-Rodriguez, AECOM, Austin, TX

Modeling & Measurement

Room: SALT RIVER 3

IWC Rep: Colleen Scholl, HDR, Whitewater, WI

Session Chair: Brad Buecker, ChemTreat, Lawrence, KS

Discussion Leader: Chip Westaby, Turner Designs Hydrocarbons, Fresno, CA

Time: 8:00 AM – 12:00 Noon

Critical to proper chemistry control of industrial water and steam systems is accurate measurement and data analysis of process conditions. This session, from four industry experts, offers a broad overview of measurement and modeling techniques for cooling water, high-purity makeup water, and wastewater effluent to optimize internal plant processes and to ensure that plant wastewater discharge streams meet environmental guidelines.

TIME: 8:10 AM

IWC 21-41: Hardness and Alkalinity Revisited: A Novel Solution for Control Utilizing the Langelier Saturation Index

Ken Kuruc, Hach, Perrysville, OH

The presence of calcium and magnesium, along with other ions such as iron, strontium, aluminum, zinc and manganese, have caused issues in industrial water loops for decades. Not only are these cations responsible for scaling and restrictions in piping, they can diminish heat transfer capacities so critical to many of these loops. In the past, while sites have relied on laboratory testing and/or on-line monitors/analyzers for hardness and alkalinity, control could still be somewhat elusive.

The Langelier Saturation Index (LSI) is another tool available to water treaters to help in managing hardness and alkalinity, yet it is often not fully utilized or understood. In this review, the LSI will be discussed in terms of hardness, alkalinity, pH and total dissolved solids (TDS). A general overview of the more common methods of softening in the industrial setting will be given in order to demonstrate the necessary techniques for controlling this parameter. The brief coverage will be limited to the more common methods of precipitation, ion exchange and reverse osmosis (RO), and will assume some prior knowledge of this area of water treatment.

Finally, a solution will be offered which will permit automation and control of hardness and alkalinity based on the LSI. Two different technologies will be discussed: colorimetric and titration. Advantages, concentration ranges and limitations for each will likewise be considered.

Discusser: Nicole Bartoletta, McKim & Creed, Inc., Sewickley, PA

TIME: 9:00 AM

IWC 21-42: Predicting the Future: Forecasting Industrial Wastewater Characteristics and Optimum Treatment

Edward G. Helmig, Susan E. Ambler, Mary Beth Miller, and Patrick J. Cyr, Woodard & Curran, Wayne, PA

This paper describes the process developed for a predictive model and simulation of complex biopharmaceutical manufacturing processes used to produce monoclonal antibody (mAb) type therapeutic proteins. However, the methodology described can be applied to most any manufacturing process and treatment situation. The focus of this work is forecasting both the untreated wastewater characteristics, compliance risks, resulting treatment requirements,

and the final treated wastewater characteristics for the effluent that is generated by the manufacturing process. Compliance risks are then assessed, and treatment, whether using existing or recommended technologies, is then evaluated using a standard Activated Sludge Model (ASM) with kinetic and stoichiometric parameters adjusted for biopharmaceutical wastewater characteristics. Model accuracy is 97% for organics and 94% for inorganics.

Discusser: Louise Murphy, Golder Associates Inc., Lakewood, CO

TIME: 10:20 AM

IWC 21-43: RO Membrane Protection Facilitated by Direct, Accurate, and Automatic Measurement of ULR Chlorine Residual

Vadim Malkov, Ph.D., Hach, Loveland, CO; Collin VanderZanden, Maxim Integrated, Beaverton, OR

Quality of the steam cycle water requires special attention and chlorination/dechlorination phase is very important, especially for reclaimed water sources. Ability to accurately measure and control chlorine concentrations allows to minimize membrane maintenance and extend life of the RO filters. Improved management of dechlorination, permitted by efficient ULR chlorine monitoring, resulted in over 30% reduction in SBS usage and halved the frequency of CIP at a power utility. This process optimization is also projected to reduce losses in power production, providing further cost savings.

Discusser: Joris de Grooth, NX Filtration, Netherlands

TIME: 11:10 AM

IWC 21-44: Predictive Modeling of FGD Wastewater Characterization to Plan for Future Fuel Flexibility

Adam Sutherland, and Josh Pendergrass, Stantec Consulting Services Inc., Nashville, TN; Mayra Giraldo, Stantec Consulting Services Inc., Atlanta, GA

When designing a wet FGD wastewater treatment facility at a coal-fired power plant, it is critical to consider the effect of coal variability on the composition of the wastewater produced by the scrubber. Plants typically require fuel flexibility to remain competitive. That potential variability in coal can have a tremendous impact on treatment equipment size, feed rates, materials of construction, and ability to meet regulatory limits. By modelling the combustion process, including emission control devices, it is possible to develop bracketed data for future FGD wastewater volume and characteristics. This consideration can help minimize future capital and O&M expenditures to meet the challenges of ever-changing coal sources and regulatory requirements.

This paper will examine the key coal characteristics which affect wastewater in a coal plant. It will focus on determining the fate of chlorides and trace metals regulated by the EPA's 2020 Effluent Limitation Guidelines, which can affect treatment chemical selection and dosing system sizing. The discussion will also include performance and operational impacts of the various air emission control devices, including scrubber additives, the selective catalytic reduction (SCR) equipment, and electrostatic precipitators on FGD wastewater.

A chlorides and trace element model has been developed using partition coefficients published in the literature. Several case studies using the model are presented. This paper will compare model estimates with measured concentrations (chlorides, selenium, arsenic, and mercury) in key wastewater streams to demonstrate the utility of the model for developing bench and pilot scale testing regimens that address the anticipated future range of fuel blends at a power plant.

Discusser: Jonathan Shimko, McKim & Creed, Sewickley, PA

CCR Water Management – New Approaches and Recent Experiences

Room: SALT RIVER 6

IWC Rep: Jonathan Shimko, McKim & Creed, Sewickley, PA

Session Chair: Riley Flowers, Ph.D., Southern Company, Birmingham, AL

Discussion Leader: Kirk Ellison, EPRI, Charlotte, NC

TIME 1:15 – 5:00 PM

As environmental regulations have evolved, the coal power generation industry and those who serve to maintain the nation's energy balance have been inspired with a new focus on power plant wastewater and coal combustion product management. Utilities are rethinking their wastewater management strategies. This session will present new approaches to coal combustion product landfill leachate and valuable case studies in handling bottom ash transport water and equipment wash water in the new regulatory environment.

TIME: 1:25 PM

IWC 21-45: Considerations for Landfill Leachate Treatment in Existing FGD Wastewater Treatment Facilities

Matt Newhart, Stantec, Alpharetta, GA; Adam Sutherland, Stantec, Nashville, TN; Bill Kennedy, Stantec, Charlotte, NC; Lindy Johnson, Stantec, Chattanooga, TN

With a tightening regulatory environment regarding discharge of coal combustion residual (CCR) landfill leachate, it may be advantageous for owners to evaluate the use of onsite existing wastewater treatment infrastructure for landfill leachate treatment prior to discharge. Existing phys/chem wastewater treatment systems may have increased available capacity with coal-fired generation facing reduced demand.

This paper will examine the feasibility of the option of using existing FGD or other wastewater treatment facilities for treatment of landfill leachate and other additional wastewaters. Evaluations will be made in the context of CCR landfill post-closure requirements. Regulatory challenges and considerations will be explored including application of EPA's combined wastestream formula. The paper will also review keys to developing a robust leachate wastewater design basis including predicting flow and leachate water quality. Appropriate collection, storage, and conveyance recommendations will be developed. Calculating combined influent quality while maintaining fuel flexibility is also explored. Finally, a comprehensive approach for evaluating capacity at existing wastewater treatment facilities will be provided, with emphasis on evaluating potential obstacles while maintaining wastewater treatment system redundancy.

Discusser: Derek Henderson, Duke Energy, Raleigh, NC

TIME: 2:15 PM

IWC 21-46: A Comparison of Measured Landfill Leachate Generation to Predictive Modeling

Cedric Ruhl, P.E., and See Hoon Lee, P.E., Wood, Chantilly, VA; Kirk Ellison, EPRI, Palo Alto, CA; Ken Daly, P.E., Wood, Charlotte, NC

An accurate prediction of leachate volume can be useful for facilitating water management and selecting a treatment system for a CCR landfill. The authors developed a method for estimating leachate generation volume throughout a CCR landfill life cycle based on design leachate generation rates, landfill geometry, and landfill filling rate. The method predicted leachate volume to within 10 to 30 percent of measured leachate volume for four CCR landfills, indicating that the predictive method may be a useful tool for the industry.

Discusser: Dean Bell, P.E., American Electric Power, Columbus, OH

TIME: 3:20 PM

IWC 21-47: Lessons Learned in Implementing Treatment of Bottom Ash Sluice from Conceptual Design through Start-up and Commissioning

Chloe Grabowski, HDR, Missoula, MT; Julie Horan and Dan Sampson, HDR, Walnut Creek, CA

In response to the Coal Combustion Residual (CCR) Rules, coal fired power plants have closed or are in the process of closing their CCR surface impoundments. The impoundment closure date for many facilities is rapidly approaching prompting the need for creative solutions and effective team work to achieve tight compliance timelines. This paper will present a case study to implement a bottom ash treatment system at a large coal fired power plant in North America. It will cover the approach taken to pursue a very tight timeline and discuss numerous hurdles encountered and lesson learned from conceptual design through start-up and commissioning.

Discusser: Emma Wolff, P.E., GAI Consultants, Homestead, PA

TIME: 4:10 PM

IWC 21-48: Lessons Learned Treating Outage Wash Wastewater for Coal Fired Utilities

David Donkin, United Conveyor Corporation, Waukegan, IL

The coal-fired electrical utility sector is faced with the regulatory requirement to retire their coal ash sluicing ponds under the finalized Coal Combustion Residuals (CCR) regulation. Wet-to-dry ash handling solutions are being implemented throughout the fleet to allow ponds to come out of service. One area of wastewater treatment need that still remains, once the ponds are retired, is the management and treatment of boiler, air pre-heater, economizer and precipitator wash wastewater. Historically these washwaters were simply directed to the CCR pond along with other ash materials and basically diluted with other materials prior to discharge. This option soon will no longer be available. The primary constituents of concern are total suspended solids, iron, copper and other heavy metals, and pH control. In addition, outage wash wastewater presents unique challenges with respect to wide flow variations and contaminant loading changes throughout a wash. A variety of new solutions are being implemented throughout the fleet, including mobile systems, sedimentation basins, and retro-fit of existing ash handling wet-to-dry infrastructure. Lessons learned from approximately 2 years of managing wastewater from outage washes will be reviewed.

Discusser: Mahyar Ghorbanian, LG&E and KU Energy LLC

Sustainability & Optimization

Room: SALT RIVER 7

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

Session Chair: Pat Randall, Aquatech International, Tampa , FL

Discussion Leader: Robert McCandless, P.E., Brown and Caldwell, Phoenix, AZ

TIME 1:15 – 4:10 PM

Sustainability is the science of wisely utilizing resources today to improve their availability for future generations. Now more than ever, industry has both societal and corporate responsibility to improve their water footprint and optimize its use. This session will demonstrate smart ideas using innovative technology to improve the sustainable use of water while protecting this critical resource.

TIME: 1:25 PM

IWC 21-49: Data Center Cooling and Water Management – A Holistic Approach

George Hollerbach, P.E., BCEE, Geosyntec Consultants, Lyndhurst, NJ; Philip Benson, Jr., P.E., PMP, Geosyntec Consultants, Washington, DC

The digital footprint in the US is expected to double every two years. Simultaneous to DC growth, planners must anticipate that climate change, water scarcity and the growing population demand for water. DC's can improve water supply resiliency through diversification of supplies, water conservation, and water reuse.

This paper will focus on the optimization of the data center water footprint – a measurement of the quantity of freshwater consumed and polluted.

Discusser: Carla De Las Casas, Brown and Caldwell, Walnut Creek, CA

TIME: 2:15 PM

IWC 21-50: Central Valley California Utility Removes Cr(VI) with Insitu Stannous Generator Technology

Vladimir Dozortsev, Ph.D., and Rick Bacon, Ph.D., Aqua Metrology Systems, Sunnyvale, CA

An novel intelligent Cr(VI) remediation system demonstration unit was installed at a community in the Central Valley of California to evaluate the performance of the technology to treat Cr(VI) to non-detect levels (under 1 ppb) in unchlorinated well water. The technology is based on a proprietary approach that generates on demand a stannous ion reagent in-situ via an electrolytic process. The pilot provided confirmation of the technology's efficacy and third-party validation for this cost-effective alternative to traditional Cr(VI) treatment systems. Results are detailed.

Discusser: Ashutosh Sharma, Aquatech, Washington, PA

TIME: 3:20 PM

IWC 21-52: Sustainable Cooling Water Systems – Opportunities and Novel Solutions

Walt Kozlowski, Evoqua Water Technologies, Schaumburg, IL; Jon McClean, Ph.D., Evoqua Water Technologies, Pittsburgh, PA; Ben Sparrow, P.E., Saltworks Technologies, Richmond, BC, Canada

Open-evaporative cooling water systems present multiple opportunities to improve a site's sustainability position by reducing water, energy, waste, and chemical use. Sustainability of a cooling system can be impacted by proper selection and application of equipment and chemistry; however, this paper will focus on equipment with the following objectives:

- Identify areas where water treatment equipment can have the most impact on sustainability
- Discuss innovative solutions to common challenges
- Present a case study supporting an example of a novel solution

Traditional methods of cooling tower water treatment usually involve feed of scale and corrosion inhibitors and limiting cycles of concentration based on LSI calculations. Biological growth is often controlled with biocides such as bleach or bromine. However, cycles of concentration are limited when using chemical programs alone, bleach feed can cause increased system corrosion, and cooling efficiency can be reduced by fouling from suspended solids. These conditions can have a negative impact on sustainability.

Water treatment equipment can positively impact sustainability in cooling systems in multiple areas. The most common areas are:

- Makeup or sidestream filtration to remove suspended solids and reduce fouling
- Non-chemical methods to control biological growth
- Removal of scaling ions to increase cycles

Data centers usually have extremely high heat loading, maintaining a clean system is critical for operations and to minimize energy use. Maintaining effective and continuous cooling is critical. Recently, a large organization which operates multiple data centers across North America had a goal of maximizing heat exchanger efficiency by limiting fouling combined with reducing chemical feed and waste. The solution was to utilize a high-efficiency sand filter for particulate removal in combination with UV for biological control. This combination has proven to minimize particulate loading while significantly reducing the need for biocide feed by over 75%.

In many cooling systems, calcium and/or silica are scaling species that

limit cycles of concentration. Scale-control chemistries have limitations and operators are sensitive to increasing cycles by increased chemical feed as this can be challenging to control and is often cost prohibitive. Electrodialysis reversal (EDR) provides the ability to increase cooling tower cycles and reduce water use by selective removal of these ions. EDR is a proven technology that acts as a kidney loop when installed in cooling systems. This paper will review the pros and cons of EDR and where it is the best fit to support water reduction goals.

Discusser: Colleen Scholl, HDR, Whitewater, WI

RO & Membranes #2

Room: SALT RIVER 2

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

Session Chair: Tom Imbornone, Avista Technologies, Inc., San Marcos, CA

Discussion Leader: Tony Fuhrman, LG Chem, Torrence, CA

TIME 1:15 – 5:00 PM

Membrane systems are becoming increasingly prevalent across the globe due to their reliability, performance, and efficiency. All membrane systems have waste streams that must be addressed. Many RO systems are also prone to bio-fouling. This session discusses alternative approaches to cope with bio-fouling of RO membranes, a revisit of cellulose acetate membranes, and an approach to purifying complex waste streams from membrane plants.

TIME: 1:25 PM

IWC 21-53: Be Free of Biofouling in your RO System

Eric Klinker, DuPont Water Solutions, Edina, MN; Guillem Gilabert Oriol, DuPont Water Solutions, Tarragona South, Tarragona, Spain; Gerard Massons, DuPont Water Solutions; Marc Slagt, DuPont Water Solutions, Zealan, Netherlands

Biofouling is identified as one of the most common and severe operational issues plant operators face in today's RO operation. The detrimental effects of biofouling in RO systems can decrease water supply reliability significantly while at the same time increase the total cost of water by additional energy, chemical consumption and reduced membrane lifetime. This presentation will discuss a novel vessel-based multimedia technology that effectively and efficiently mitigates the negative effects of biofouling in downstream RO systems by its ability to instantly create and sustain reliably a biostatic environment. Data will be presented that demonstrates over 1.5 years of zero biofouling and trouble-free RO operation in an industrial scale pilot trial conducted in a desalination plant in Spain suffering from the negative effects of biofouling. This novel treatment system has the potential to significantly improve the stability of plant operations and reduction of plant downtime thanks to the reductions in CIP frequency up to 75% and in membrane replacement rates.

Discusser: Wayne Bates, Hydranautics, Rockton, IL

TIME: 2:15 PM

IWC 21-54: Cellulose Acetate Membrane is Not Dead

John Williams, MANN+HUMMEL Water & Fluid Solutions, Goleta, CA; Elke Peirtsegaele, DuPont Water Solutions, Bend, OR

For many years now, spiral-wound reverse osmosis (RO) and nanofiltration (NF) elements have proven very successful in alleviating freshwater shortages by treating various waters and wastewaters. In fact, spiral-wound RO and NF membrane elements are the most used desalination technology available on the market. Although RO and NF membranes are a relatively new technology, there have been many developments and changes in the membrane materials that have paved the way to the increasingly robust technology in use today. Today, RO and NF membranes are commercially available in either cellulose acetate (CA) or polyamide membrane chemistries. While newer thin-film polyamide chemistry largely dominates the current reverse osmosis membrane market, there are still applications where CA membrane is favored due to its specific properties and performance.

This paper dives into the history behind how CA membranes were developed, improvements made to the membrane chemistry over time, and how its chemistry differs from polyamide-based membranes. It also discusses the benefits that CA membranes offer, including the fact that these membranes can handle residual chlorine and why they are less susceptible to fouling. Lastly, this paper looks at the different applications and case studies that CA membranes are used in and why they are preferred over polyamide-based membranes, proving that CA membranes are here to stay.

Discusser: Drew Desembrana, P.Eng., SUEZ Water Technologies & Solutions, Oakville, ON, Canada

TIME: 3:20 PM

IWC 21-55: Enzymatic Cleaning Restores the Performance of Biofouled Membranes at Mild Conditions

Xingpeng Zhang, Suez Water Technologies & Solutions Singapore Pte Ltd, Singapore; Jeffrey Melzer and Nicholas Popolizio, SUEZ Water Technologies & Solutions, Trevose, PA; Agata Zarebska, Novozymes, Denmark; Henrik Bangsø Nielsen, Novozymes, Denmark

Membrane biofouling is a critical factor impacting reverse osmosis membranes. Efficient cleaning of biofouled RO membranes often requires harsh chemicals, including biocides and strong alkaline cleaners, that can damage the membrane. In contrast, enzymes can be powerful targeted catalysts to break down organic macromolecules into smaller molecules during normal clean in place (CIP) operations. While enzymes have been used in the Food & Beverage industry for daily maintenance (cleaning process membranes to remove proteins, grease, fat, and sugars), they have not been used extensively during water systems CIP operations due to the nature of the biofouling and operating conditions in these applications.

SUEZ – Water Technologies & Solutions and Novozymes investigated the nature of biofoulings on membranes and enzymes/chemical combinations that could address their cleaning. We discovered that a proprietary combination of enzymes and cleaner formulations can effectively clean biofouled membranes. Consequently, CIP's can be conducted with milder pH and reduced chemical usage.

This paper covers the discovery from laboratory, to piloting, to field application, demonstrating the efficiency of enzyme-enhanced cleaners compared with harsh alkaline cleanings in restoring the performance of biofouled membranes.

Discusser: Mark Donovan, P.E., GHD, Irvine, CA

TIME: 4:10 PM

IWC 21-56: Converting Highly Complex Municipal UF/RO Reject Waste Water to OTSG Boiler Feed Water in the Middle East

Prasad Kaniampal and M.N. Rao, Aquatech, Canonsburg, PA

In recent years, a prestigious Oil Company in the Middle East has intensified its efforts to extract heavy oil for which water is a critical component for steam generation. Deviating from the conventional way of treating ground water or sea water to produce Once-Through Steam Generator (OTSG) Boiler feed water, the Oil Company decided to investigate using the Ultrafiltration (UF) / Reverse Osmosis (RO) Reject Waste Water from nearby Municipal Waste Water Treatment Plant. They were looking for an environmentally sound and economically viable solution to achieve their 'best out of waste' sustainability goal.

The major challenge was the waste water itself, due to its being a highly complex waste water with high levels of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Hardness and Total Dissolved Solids (TDS). The original Front End Engineering Design (FEED) process scheme intended for treating this waste water was found unreliable in meeting required OTSG Boiler feed water production and quality.

Aquatech developed a solution-oriented alternate scheme, which not only guaranteed required OTSG Boiler feed water production and quality but also resulted in significant capital and operating cost savings. This paper compares

the benefits of the implemented scheme over the original FEED scheme thereby providing insight into developing a solution-oriented approach for Oil & Gas customers. It also discusses how the application of proven membrane technologies can treat complex membrane plant waste waters to achieve customer goals.

Discusser: Roy Daly, LG Chem, Torrance, CA

Proven Strategies for Water Reuse

Room: SALT RIVER 3

IWC Rep: Ivan Morales, Integrated Sustainability, Inc., Houston, TX

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

Discussion Leader: Alan Daza, Safbon, Tampa, FL

TIME 1:15 – 4:10 PM

Water recycle and reuse continue to be the foundational principles for good water management and sustainability practices. The goal is to reduce industrial impact to local water resources and improve the quality of life in local communities. These admirable goals are often met with the hard reality and challenges that are exposed in actual practice. Our four papers discuss successes and challenges that were encountered in different reuse and recycle scenarios across varied industries from high purity water to produced water recovery.

TIME: 1:25 PM

IWC 21-58: Can Zero-liquid Discharge be Affordable?

Tina Arrowood, DuPont Water Solutions, Elko New Market, MN

Zero-liquid discharge (ZLD) maximizes the potential of wastewater to be a circular resource of both water and salt and in doing so, it serves to protect fresh water bodies from the detriment of excessive withdrawal and increasing salinity levels. Yet, ZLD has been considered a last resort wastewater treatment option due the significant energy required to evaporate the water and concentrate the dissolved salts to saturation. The question is, how can we reap the benefits of zero-liquid discharge without the high operational costs? The answer is Minimal Liquid Discharge (MLD). In 2008, Bond et. al. (Journal AWWA 2008, 100(9), 76-79) proposed that implementing membrane based minimal liquid discharge operations in combination with thermal zero-liquid discharge will reduce the cost of ZLD by 60%. Yet more than 10 years later ZLD remains a doubtful treatment solution. Perhaps reducing the energy costs by 60% isn't enough. If not, then how can the low margin Textile industry in Southern India manage to practice MLD-ZLD wastewater treatment for the past 10 years? To learn more from their experience, face to face interview sessions with 14 wastewater treatment manager-operators in Southern India's textile region were conducted. A detailed analysis and conclusions from these interviews is summarized in this presentation which include validation of the energy savings benefits of an MLD-ZLD system as published by Bond in 2008. In addition, an unexpected result shows that the value of the recovered water and salt from the textile wastewaters nearly off-set the operational cost of the MLD-ZLD system. Thus, it is the combination of MLD-ZLD treatment and the value of the water and salt produced from the wastewater that make ZLD a viable solution. The Southern India Textile wastewater treatment operations provides a remarkable example to other industries that circular economy coupled with the implementation of MLD-ZLD wastewater treatment systems can provide a sustainable wastewater management solution. Additionally, technology advances in MLD treatment processes are making MLD-ZLD systems even more sustainable.

Discusser: Ken Martins, Stantec, Reno, NV

TIME: 2:15 PM

IWC 21-59: Non-phosphorous Corrosion Inhibition in High Total Dissolved Solids Reuse Water

Mary Jane Felipe, Ph.D., and William Mansfield, Baker Hughes, Sugar Land, TX; Greg Davis, Bartholomew Ramplin, and Jeffrey Miller, Baker Hughes, Huntington Beach, CA

Water reclamation and reuse offer an effective means of conserving freshwater supplies. Along with the continued global warming and increase in pricing, the use of fresh water as a makeup water for cooling towers is becoming more cost prohibitive. To alleviate, refinery operators are implementing the use of reuse water.

It is known that reuse water contains a high amount of total dissolved solids. As the water's dissolved solids level increases, corrosion and deposition tendencies also increase. When the water conductivity increases, treating mild steel corrosion becomes more difficult and the traditional chemical solutions becomes limited. This paper details the effective corrosion inhibition of up to 8000 micromhos allowing water cycling of reuse makeup water from 2-3 to 5-6 cycles of concentration. Very low corrosion rates (<0.5 mpy) were achieved with no discernible etching, pitting, or other corrosion mechanism observed. The non-phosphorous corrosion inhibition solution also mitigated the formation of calcium phosphate scale.

Discusser: Bryan Hansen, P.E., Burns & McDonnell, Centennial, CO

TIME: 3:20 PM

IWC 21-60: Industrial Wastewater Reclamation Case Histories and Lessons Learned

Daniel Sampson and Cristina Piekarz, P.E., HDR, Walnut Creek, CA

On-site reclamation of high and low TDS waste streams is a common feature of many modern industrial facilities. The design of these facilities generally assumes operation under steady-state conditions at various levels of production. Most designers do not, unfortunately, anticipate the impact of non-steady-state or off-design operation, the impact these operating periods might have on the plant's water systems, or the impact likely contaminants may have on reclamation systems. This paper examines on-site industrial wastewater reclamation systems at several industrial facilities including the original system design and intent, what was missed, what problems the plants experienced, and what the plants did to address these problems.

Discusser: Steve Russell, P.E., Kiewit, Lenexa, KS

Power & FGD (Water Chemistry to Power Success)

Room: SALT RIVER 3

IWC Rep: Derek Henderson, Duke Energy Corporation, Raleigh, NC

Session Chair: Jason Monnell, Electric Power Research Institute (EPRI), Charlotte, NC

Discussion Leader: Dave Guinta, Burns & McDonnell, Kansas City, MO

TIME: 8:00 AM – 12:00 NOON

In this session, we will splash into process design, chemical treatment, and their operational impact to the treatment and management of high-volume water streams in the electric power industry. We will explore biofouling control for cooling water systems, wet FGD Scrubbers additives, and innovative FGD wastewater treatment designs. It will be sure to provide engaging discussions, idea generation, and in-depth details regarding these solutions.

TIME: 8:10 AM

IWC 21-61: Halogen Stable Azole: Effectiveness and Mechanism of Action in Cooling Water Systems

Mary Jane Felipe, Chelsea Eaton, Swamy Margan, and Steven Lee, and William Watson, Baker Hughes, Sugar Land, TX

Copper alloys are used in cooling systems because of their excellent heat transfer properties. In the advent of copper alloy corrosion though, releasing the copper ions to the water not only raises an ecotoxicity concern in the effluent discharge but also induces galvanic corrosion to mild steel metallurgies leading to a bigger corrosion problem in the cooling systems. The use of triazole has been the go to chemistry since the 1970's. Triazoles such as tolyltriazole and benzotriazole are known to effectively form a film on copper metallurgies. The presence of nitrogen and the ring structure enhance film formation at the solid-liquid interface.

In a cooling water system, one of the basic problems to combat is the possible growth of microorganisms. These microorganisms can induce a type of corrosion that is often harder to treat than general corrosion. To mitigate, it is typical to feed halogen-containing biocides like chlorine and bromine. These oxidizing biocides are maintained at a fairly low parts per million level, however, it is very common to feed higher biocide level when the pump is not maintained properly. During biocide upsets, corrosion rates of the copper alloy metallurgies also increases because of the tolyltriazole's interaction with the halogen containing biocide.

This paper presents a halogen stable azole that forms a film on copper alloy metallurgies even in the advent of halogen-containing biocide upsets in cooling water systems. Corrosion inhibition is investigated using linear polarization resistance monitoring. Further mechanistic studies was done using Tafel polarization and impedance studies. Field data confirmed a 50-85% reaction of chlorine-containing biocide when a typical tolyltriazole inhibitor is used to prevent copper metallurgy corrosion. This data corroborates the data shown in the laboratory.

Discusser: Dan Cicero, Nalco Water, Naperville, IL

TIME: 9:00 AM

IWC 21-62: Design Innovations for the Largest FGD Plant in North America

Evan Claytor and Precious Ukonu, SUEZ Water Technologies & Solutions, Glen Allen, VA; Charles Chappell, TVA, Knoxville, TN; Mark Owens, HDR, Mosely, VA

Tennessee Valley Authority (TVA) and SUEZ were faced with the challenging engineering task of designing the largest FGD wastewater treatment plant to date in North America with a flow capacity of 4,400 gpm. In addition, the plant had a requirement for complete system redundancy. Several engineering design innovations occurred which allowed the project to maintain the budget, schedule, and the required operational flexibility. These design innovations are as follows:

The dual reactor tanks associated with each clarifier.

A very high rate synthetic media gravity filter

The elimination of acid feed prior to filtration

Duplex stainless steel was chosen as the material of construction for the tanks as a less expensive alternative to typical FGD coatings.

Discusser: Bryan Hansen, P.E., Burns & McDonnell, Centennial, CO

TIME: 10:20 AM

IWC 21-63: Effects of WFGD Additives such as DBA on Wastewater Treatment

Suzette Puski, Stantec, Providence, RI; Bill Kennedy, P.E., Stantec, Charlotte, NC

Many Wet Flue Gas Desulfurization (WFGD) systems use additives regularly to meet emission limits that were enacted after the scrubber system was designed. Organic acids such as DBA can provide additional benefits beyond the WFGD system by decreasing the load on the bioreactor in wastewater treatment and improving selenium removal.

This presentation will describe the different additives commonly used in WFGD, monitoring scrubber performance to reduce wastewater discharge, and the impact of additives on Wastewater Treatment system design and performance.

Discusser: Angela Zagala, Nalco Water, an Ecolab Company, Cary NC

TIME: 11:10 AM

IWC 21-64: Enrichments of Anaerobic Selenium Oxyanion Reducers from FGD Wastewater Effluent

Preom Sarkar, Meghan Brandi, Nicholas Means, Djuna Gulliver, and Joshua Miller, NETL-DOE, Pittsburgh, PA

While flue gas desulfurization systems are an important technology in mitigating air pollutants, such as sulfur oxide gases, from coal fired power plants, much of the wastewater produced when using this technology contains other pollutants that must be remediated before release back into the environment. Selenium is one of these pollutants of interest because it can cause detrimental ecological consequences even in small amounts. Currently it is known that biological treatment can be utilized to treat FGD wastewater in order to remove selenium, but the microorganisms involved in this process in this relatively extreme environment has not been studied. This project seeks to enrich, identify, and characterize the anaerobic microorganisms in FGD systems that have the capability to reduce selenium oxyanions (selenate and selenite) to elemental selenium and characterize the selenium nanospheres they produce. Presently, we have found a microbial community within the FGD effluent capable of reducing up to 99% dissolved selenate. The community was found to be composed primarily of bacteria from the genera anaerosolibacter and bacillus. This work begins to characterize a little understood microbial system, giving operators an opportunity to optimize FGD effluent treatment technologies.

Discusser: Lisa Kirk, Ph.D., P.Geo., and Seth D'Imperio, Ph.D., Enviromin, Bozeman, MT

Water's New Flex

Room: SALT RIVER 7

IWC Rep: Max Brefeld, TOYOTA MOTOR NORTH AMERICA, Georgetown, KY

Session Chair: John Van Gehuchten, McKim & Creed, Sewickley, PA

Discussion Leader: HG Sanjay, Bechtel, Reston, VA

Time: 8:00 AM – 12:00 Noon

The water world has been busy over the last year. Technology in the industry keeps improving and, in this session, we will take a look at a few of those innovations. In this catch all session there are new instruments, more uses found for brewery wastes, old water plants finding a new life, and investigating new nonfilter materials. Everyone can find something to like with this talented group of authors.

TIME: 8:10 AM

IWC 21-65: The Value and Challenges of Chlorination/ Dechlorination Process Optimization in Power Generation

Vadim Malkov, Ph.D., Hach, Loveland, CO; Mark Flynn, Heorot Power Management, Vernon, CA

Quality of the steam cycle water requires special attention and chlorination/ dechlorination phase is very important, especially for reclaimed water sources. Ability to accurately measure and control chlorine concentrations allows to minimize membrane maintenance and extend life of the RO filters. Improved management of dechlorination, permitted by efficient ULR chlorine monitoring, resulted in over 30% reduction in SBS usage and halved the frequency of CIP at a power utility. This process optimization is also projected to reduce losses in power production, providing further cost savings.

Discusser: Jason Lemire, P.E., Bowen Engineering, Columbus, OH

TIME: 9:00 AM

IWC 21-66: Using Brewery Waste to Optimize Nitrogen Removal in a Biological Nutrient Removal Facility

Coralynn Revis, P.E., and William Buxton, P.E., HDR, Missoula, MT; Tom Radcliffe and Josh French, City of Bozeman, Bozeman, MT; Theodore Grover, HDR, Bozeman, MT; Bryce Figdore, P.E., HDR, Bellevue, WA

Stringent nutrient regulations lead the City of Bozeman, Montana to consider alternative carbon sources for their biological nutrient removal wastewater reclamation facility to further reduce nitrogen in the effluent. Brewery waste from local microbreweries was gathered and tested through a pilot study to evaluate the effectiveness as an external carbon source. Data indicates a reduction of 25-40% of the total nitrogen in the effluent through the use of the brewery waste to further drive the biological reaction.

Discusser: T.J. Stroebl, Kurita America, Inc., Minneapolis, MN

TIME: 10:20 AM

IWC 21-67: Repurposing Existing Paper Mill Wastewater Treatment Plant For Future Flow

Mayra Giraldo, EIT, Stantec, Atlanta, GA; Nicole Stephens, P.E., Stantec, Raleigh, NC

Industrial wastewater treatment systems are designed to accommodate maximum flow and load conditions. It is rare, however, to encounter the question of how to adequately treat flows that are 25 times lower than the existing system's treatment capacity. This paper will document treatment considerations and recommendations for a pulp and paper mill system following decommissioning of paper machines resulting in a significant flow reduction and shift in wastewater strength.

Discusser: James Beninati, HDR, Pittsburgh, PA

TIME: 11:10 AM

IWC 21-68: Innovative Low Fouling, Chlorine Tolerant Hollow Fiber Nanofiltration Membranes for Micropollutant and Organic Removal

Joris de Grooth, Ph.D., Erik Roesnik, and Umang Yagnik, NX Filtration, Enschede, Netherlands

We see in our environment, specifically in our surface waters, more and more persistent chemicals like polyfluoroalkyl substances (PFAS), medical residues, insecticides, pesticides, nano-plastics, anti-biotic resistant bacteria, viruses; in general, micropollutants. This is caused by the fact that traditional wastewater treatment plants do not remove most micropollutants. Common technologies applied for removal of micropollutants include adsorption (activated carbon), advanced oxidation (O3, UV/H2O2) or multi-stage membrane processes, to re-use the effluent or to improve the effluent quality before disposal to surface water bodies. In this paper, an innovative solution for removing micropollutants using hollow fiber nanofiltration (NF) membranes, is presented.

These next-generation hollow fiber NF membranes are found to be suitable for direct treatment of surface water sources and (biologically treated) wastewater. These hollow fiber NF membranes remove color (via natural organic matter [NOM]), low molecular weight organics, micropollutants, and partial hardness, while allowing most monovalent salts to pass through the membrane. The membrane chemistry is based upon poly-ether-sulfone (PES), while the selective nanolayers are created from water-based electrolytes (layer-by-layer). The robust PES membrane in combination with layer-by-layer chemistry allows severe cleaning, e.g., with hypochlorite concentrations up to 200 ppm and a pH in the range of 1-14.

The main benefits of these innovative hollow fiber NF membranes include superior micropollutant and organics removal, fouling resistance, chlorine tolerance, minimal pretreatment, reduced chemical usage, and cleanability at a wide pH range. There is data to substantiate that these benefits translate to significantly low operating costs and lead to considerable CO2 footprint reduction.

The permeate from these hollow fiber NF membranes can be reused directly for a wide range of industrial process, agricultural applications. In combination with advanced oxidation as a post-treatment, the NF permeate can be used for more critical applications including drinking water.

Discusser: Joshua Dewanaga, P.E., SUEZ Water Technologies & Solutions, Bellevue, WA

PFAS #2

Room: SALT RIVER 2

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

Session Chair: Russ Huffmyer, McKim & Creed, Sewickley, PA

Discussion Leader: Nicole Bolea, P.E., ECT2, Minneapolis, MN

TIME: 8:00 – 11:10 AM

For this session on Perfluoridated Alkyl Substances (PFAS), the featured papers will cover the following topics; PFAS destruction by novel physical and chemical methods, solutions that have been implemented to address "low hanging fruit" and the sustainability of those solutions at a manufacturing site in North Carolina, a case study that will demonstrate the effective removal of high levels of PFAS compounds at a facility in Australia, and lastly, the development of a technology evaluation for PFAS treatment.

TIME: 8:10 AM

IWC 21-70: PFAS Mitigation in Chemours – A Different Kind of Challenge

Steven Grise, P.E. and Michael Davis, Ph.D., The Chemours Company, Wilmington, DE

Traditional treatment technologies have been challenged to handle the unique nature of PFAS compounds in the environment. Many existing technologies have limited effectiveness due to the physical and chemical properties of the compounds. That said, combinations of existing technologies with creative engineering solutions can be used to mitigate current emissions.

The Chemours Company is committed to being a leader in environmental stewardship and responsible manufacturing, abating air and water emissions of fluorinated organic compounds by at least 99% at its manufacturing sites globally. Our Fayetteville Works manufacturing site in North Carolina has been at the forefront of that effort. We have focused on finding ways to get PFAS air and water emissions from our operations as low as possible, to both meet our commitments and address community concerns. While additional work remains to be done, we believe we have some of the answers to achieving our goals.

This paper will discuss some of the solutions we have implemented. These solutions include the "low hanging fruit" of water minimization, the more challenging aspects of water internalization and thermal oxidation, and the path ahead. The discussion will cover the solutions and the sustainability of our decisions.

Discusser: Katherine Van Sice, McKim & Creed, Sewickley, PA

TIME: 9:00 AM

IWC 21-71: A Multi-Barrier Ion Exchange Process for the Removal of Short and Long Chain PFAS/PFOS Compounds

Rajeev Bhavaraju, LANXESS Pty Ltd., Granville NSW 2142, Australia; Dirk Steinhilber, LANXESS Deutschland GmbH, Koeln, Germany

Australia published " The Intergovernmental Agreement on a National Framework for Responding to PFAS Contamination" in February 2018. This policy agreement provided for a consistent approach to PFAS contamination between the Commonwealth and the Australian States. Australia had recognized the risk of PFAS contamination early on, phasing out fire foams and other materials made with these compounds as far back as 2003. Consequently there are many installations already in place for the removal of these compounds.

This case study will demonstrate the effective removal of high levels of PFAS compounds in impounded waste water waters from the Fiskville County Fire Authority (CFA) Training College in regional Victoria , Australia. The college was closed in early 2015 due to the detection of contaminated water on the site and indications of regional health concerns. Remediation steps were put in place and it is considered the first time in Australia that high levels of PFAS compounds have been removed to the lowest limit of reporting for PFAS .

Multiple stages of water treatment for a 125,000 gallon per day system were required due to the presence of dissolved organics, metals and suspended solids, in addition to the PFAS contamination. Major challenges at this site/ project were high levels of PFAS compounds with variable feed composition, that had to be removed to the lowest limit of reporting for PFAS for both short and long chain compounds. On top of this, treated water quality had to meet stringent EPA standards for continuous discharge.

Perfluorobutyrate (PFBA), one of the "short chain" versions of these "forever chemicals" was the most prevalent and was the basis of breakthrough criteria. Short chain PFAS compounds are considered more difficult to remove.

Removal of the PFAS compounds was largely achieved using a robust multi-barrier ion exchange process (IX) in combination with conventional pre-treatment technologies. The IX configuration included a regenerable industry standard macroporous weak base resin followed by a single use highly selective anion resin designed specifically for the removal of these compounds in a lead lag configuration.

This paper will illustrate the use of both regenerable IX technology and highly selective single use resins for the removal of PFAS chemicals to non-detectable and/or very low regulatory limits.

Discusser: Harsh Ashani, Wilson Engineers, Tempe, AZ

TIME: 10:20 AM

IWC 21-72: Developing Technology Evaluation for PFAS Treatment

Kristen Jenkins, P.E., OLI Systems, Inc., Parsippany, NJ ; Beth Landale, P.E., GHD, Farmington Hills, MI; Ryan Thomas, Ph.D., GHD, Niagara Falls, NY; Alessandra Murphy and Daniel Beck, GHD, Detroit, MI; Kishor G. Nayar, Ph.D., GHD, Houston, TX; Grant Trigger, B.Eng., JD, RACER Trust, Detroit, MI

Revitalizing Auto Communities Environmental Response (RACER) Trust manages the environmental remediation and facilitates redevelopment of the former General Motors (GM) Powertrain manufacturing facility site at Willow Run in Ypsilanti, Michigan. Currently the water generated from a groundwater collection system is sent to the local Publicly Owned Treatment Works (POTW). The groundwater contains per and polyfluoroalkyl substances (PFAS), and Perfluorooctane sulfonate (PFOS) in particular was present above the Michigan water quality standard. Conventional alternative treatment technologies for the detected PFAS were evaluated in order to develop a cost-effective treatment process, which included granular activated carbon (GAC) and ion exchange (IX). Results of bench testing and alternatives evaluation for these conventional technologies were presented in a 2019 IWC paper and presentation.

Both GAC and IX technologies result in a PFAS containing residual which may require regeneration, including PFAS destruction through incineration, or careful management in a landfill to prevent re-release to the environment. Therefore, since 2019, developing technologies have been evaluated with the objective of identifying a treatment alternative that results in destruction or complete mineralization of the PFAS. The paper will present the following developing technologies, including the results of bench and/or pilot testing completed during 2020:

Cyclopure's Dexsorb® adsorbent with PFAS destruction by ball milling Plasma, Wet air oxidation, Alkaline ozonation.

For each of the technologies, the treatment technology and results of treatment will be presented, as well as any testing performed to determine whether PFAS has been mineralized or lost through physical transfer.

In addition, during 2020, a pilot was conducted to oxidize iron and settle the precipitated iron along with any other precipitated solids. The objective of this pilot was to collect a sufficient quantity of solids to perform PFAS analysis on the solids. Lab testing results were inconclusive regarding whether PFAS were adsorbing to solids. Therefore, the pilot was performed to determine the fate of PFAS. Adsorption of PFAS to solids may result in restrictions on locations/ landfills accepting it for disposal and may increase the disposal cost.

Discusser: Cristina Piekarz, P.E., HDR, Walnut Creek, CA

Water/Wastewater: Cleaning Up The Universal Solvent

Room: SALT RIVER 6

IWC Rep: Bill Kennedy, Stantec, Charlotte, NC

Session Chair: Jeff Easton, WesTech Engineering, Salt Lake City, UT

Discussion Leader: Ramesh Kalluri, KALLURI GROUP, INC., Houston, TX

Time: 8:00 AM – 12:00 Noon

From innovative approaches for pH control to the treatment of complex organic compounds, this session shares methods and practices to aid in your water and wastewater treatment challenges.

TIME: 8:10 AM

IWC 21-73: In Hot Water: Heat Balance Modeling in Two Industrial Waste Water Treatment Systems

Shannon Brown and Eduardo Casanova, Bayer Crop Science, Saint Louis, MO; Karen Budgell, Golder Associates, Lakewood, CO; Elaina Mason, Bayer Crop Science, Muscatine, IA; Erin Milligan, Bayer Crop Science, Kansas City, MO

High temperatures in biological waste water treatment (WWT) systems can jeopardize treatment. Microbial breakdown of biochemical oxygen demand (BOD) is accomplished by enzyme catalysis. The predominant reactions occurring within this breakdown are exothermic. While they vary among species, each microbe and associated enzyme has optimal temperature ranges. When temperatures rise too far above this range, enzymatic reactions slow and eventually stop due to denaturing of the enzyme to the point where the active site no longer fits the substrate. Sometimes microbial death will also occur. Therefore, operating temperature range is an important parameter for control of activated sludge WWT processes. Engineering heat balances are performed across these systems to help quantify the heat generated and lost within the process and to identify options for bioreactor temperature control. Heat balances were conducted for two industrial WWT systems that successfully treat pesticide manufacturing effluent. These two WWT systems both operate using aerobic biotreatment, but one operates as a conventional activated sludge process and the other utilizes the UNOX biotreatment process. For these balances, analogous, simplified chemistries were used to represent the bulk chemical oxygen demand (COD) constituents and their reaction. Data regression of operational data was used to determine zero order kinetic terms that would suit the bulk chemistry. Combined with first principles, this information was used to create a semi-empirical process model for each system

that predicts temperature performance. In this paper, the methodology for using homologous chemistries to approximate the biochemical breakdown of COD in aerobic WWT systems, and incorporation of this information to create system heat balance models is explained. Performance data from the two operating industrial WWT systems, with comparison of the relative heat contributions from sensible heat, solar radiation, conductive and convective heat transfer from the environment, work, and heat associated with chemical reaction are detailed. Application of this methodology will allow creation of similar models for other WWT systems.

Discusser: Robert Thompson, Jacobs Engineering, Houston, TX

TIME: 9:00 AM

IWC 21-74: Landfill Leachate- "Like a Box of Chocolates You Never Know What You Are Going to Get!"

Ron Ruocco P.E. Stantec, Charlotte, NC

Landfill leachate under federal guidelines is classified as industrial wastewater. Cost effective off-site or on-site alternatives are needed for treatment or mitigation preventing health issues from polluting ground water, surface water, and/ or local environments. Attention to planning for adequate leachate management, particularly for leachate discharges to publicly owned treatment works (POTW), often does not receive the necessary budget resulting in disruption to landfill operations, unexpected operating and capital costs, or even emergency expenditures! Changes in water quality standards for metals, and emerging contaminants such as nutrients, pharmaceuticals, and PFAS compounds are pressuring POTWs to discontinue acceptance of untreated landfill leachate altogether! Adequate budgeting for leachate management is essential for proactive, cost effective planning to predict, design, and implement necessary changes in alternatives for leachate treatment systems. This paper looks at the factors influencing the ever changing, landfill leachate characteristics, potential regulatory drivers, and examples of treatment systems currently used for landfill leachate as well as modifications that may be needed in the future.

Discusser: Christine Smith, Purestream Services, Salt Lake City, UT

TIME: 10:20 AM

IWC 21-75: Biofiltration Advances for Treatment of Trace 1,4-Dioxane Concentrations

Phoebe Zheng, P.E., Chao Zhou, P.E., and Brian Petty, P.E., Geosyntec Consultants, Huntington Beach, CA

1,4-dioxane is an emerging contaminant frequently detected in drinking water and wastewater, particularly in industrial wastewater from certain industries. Due to its properties, 1,4-dioxane is not removed by most water and wastewater treatment processes, and pretreatment options are currently limited to advanced oxidation processes (AOPs). However, AOP systems are complex and expensive to install and operate, and interfered by the other parameters (COD, color, TSS, etc.) present in these wastewaters. Biofiltration can potentially provide a simpler, affordable, yet effective alternative to AOPs, with metabolic treatment potentially more advantageous in operation. This paper presents the results of a two-year bench study of 1,4-dioxane removal by biofiltration. Effects of operating conditions, including biofiltration media, EBCT, and addition of a supplemental substrate were evaluated.

Discusser: Tat Ebihara, AECOM, Lombard, IL

TIME: 11:10 AM

IWC 21-76: Chemical Replacement – Managing pH with Carbon Dioxide in Place of Sulphuric Acid

Chris Milligan, PE, MSc., BSc., Adrian Beirise, PE, MSc., BSc., and Tyler Elm, MBA, MRM, BSc., Chartwater, BlueInGreen, Fayetteville, AR

Proven in older forms over decades in drinking water treatment, today's CO2 technology is being applied to a wider array of industrial wastewater applications with both economic and safety payouts for replacing strong acids such as sulfuric. Four case studies presented highlight the value proposition of using CDOX® gas-dissolution technology to control permitted wastewater stream pH in power, mining, fertilizer manufacturing, and food industry markets.

Discusser: Charan Tanneru, Tetra Tech, Houston, TX

WORKSHOPS

The IWC Workshop program (denoted with "W") is designed to provide practical information that includes a basic understanding of the topic as well as detailed case studies. They are presented by experts in their field and are loaded with technical content, not sales information. Each workshop will provide an opportunity for a technical exchange between the registrant, the instructor and other workshop participants. IWC workshops provide attendees four professional development hours (PDHs) and a certificate of completion. A separate fee of $250.00 per workshop is required. Discounts are given for multiple registrations.

SUNDAY

W-01: Water Treatment 101

Dennis McBride, Burns & McDonnell, Kansas City, MO (Bryan Hansen, P.E., Burns & McDonnell, will be presenting)

Sunday, November 7, 1-5:00 pm

Water Treatment 101 This workshop is a great introductory course covering many of the basic concepts of industrial water treatment. It will address unit operations (clarification, filtration, lime/soda ash softening, iron and manganese removal, membrane filters, and roughing demineralizers) used in water preparation for industry with emphasis on power, chemical industry, and refineries. It includes treatment of cooling water systems as well as boiler water makeup. Wastewater generated by these unit operations and their treatment and disposal will be discussed. Basic water chemistry requirements for low, medium, and high pressure boilers will also be discussed.

W-03: Ion Exchange Technology and Practical Operating Practices

Wayne Bernahl, W. Bernahl Enterprises, Elmhurst, IL

Sunday, November 7, 1-5:00 pm

Ion exchange technology is not new yet most industrial ion exchange systems do not operate at top efficiency. Ion exchange technology is often not well understood by operating personnel.

The participant of this workshop will:

- Better understand basic ion exchange equipment, operations, and resins used for water treatment operations
- Better understand what can go wrong with ion exchange systems
- Develop a logical troubleshooting approach to discover and correct operating problems.

W-05: Refinery Wastewater Treatment Concepts

Holly Churman, GHD, Houtson, TX

Sunday, November 7, 1-5:00 pm

Our Workshop Objective is to educate engineers and specialists on basic refinery wastewater treatment concepts. Outcomes will enable attendees to:

- Understand common refinery wastewater composition and treatment goals.
- Learn about conventional and advanced processes used to treat refinery wastewater.
- Understand the importance of data collection and interpretation for operations and compliance.

Skills from this workshop will enable attendees to improve their abilities to solve challenging wastewater treatment challenges in the refining sector.

WEDNESDAY

W-02A: The Wonderful World of Reverse Osmosis – 2021

Jane Kucera, Nalco Water, an Ecolab Company, Plainfield, IL

Wednesday, November 10, 1-5:00 pm

Reverse osmosis (RO) has become a very popular and useful water demineralization tool, for both waterand wastewater applications. Understanding the fundamentals of RO, particularly as applications become more challenging in the environment of reduce, reuse, and recycle, is critical to optimal operations. However, during the growth or RO applications, some of the basics have been lost in shuffle. And many times professionals and operators familiar with other demineralization technologies are now faced with operating RO systems with little or no training. Hence, this Workshop covers the basics and best practices of RO technology, from sound design to proper operating techniques. Fouling and concentration polarization, data collection and normalization, pretreatment (including membrane filtration), cleaning, and storage are just some of the topics included in this Workshop. This Workshop is intended for all who need to understand the essentials of RO to help obtain optimal performance of this technology.

W-07: Industrial Water Reuse – New Technologies and Lessons Learned

Ed Greenwood, Wood Environment & Infrastructure, Cambridge, Ontario, Canada

Wednesday, November 10, 1-5:00 pm

The primary objective of this workshop is knowledge transfer. It is aimed at those vested in developing the next generation industrial water reuse plant. Several workshop facilitators will objectively compare competing strategies to treat and recover wastewater for reuse. With many plants approaching 10 or 15 years of operation, the field of Industrial Water Reuse is maturing. Some reuse strategies have proven to be reliable and cost-effective but some have not. This workshop will explore the reasons why and address the common issues facing water reuse. Topics include:

- Navigating the challenging and changing water treatment technology landscape – an unbiased comparison of popular treatment technologies (i.e. Clarifiers, MMF, MF, UF, GAC, IX, RO, ED, Chlorine, Ozone, AOP, UV)
- Common problems (design issues and performance issues)
- Emerging technologies and opportunities
- Optimizing cost and reliability
- Case Studies (success stories and cautionary tales)

Facilitators will encourage interactive discussion on case studies to unravel lessons learned. Participants will leave the workshop with a broad understanding of the water reuse landscape and how they might apply some of the more popular reuse strategies to develop the next generation water reuse plant.

W-08: Boiler Water Treatment for Industrial Plants

James Robinson, SUEZ Water Technology & Solutions, Horsham, PA

Wednesday, November 10, 1-5:00 pm

Participants will learn:

- How deaerators work and common errors that cause boiler feedline corrosion problems.
- Causes of downtime corrosion and steps to control it.
- The causes of flow accelerated corrosion and its control.
- The causes and control of boiler deposits and corrosion.
- The problems caused by steam contamination and steps to avoid these problems.
- The causes of condensate system corrosion and treatment technologies to control corrosion.

W-09: PFAS Treatment – Analysis, Design, Treatment and Destruction

John Peichel, SUEZ Water Technologies & Solutions, Minnetonka, MN

Wednesday, November 10, 1-5:00 pm

The objective is to educate attendees on the technical aspects of PFAS water, wastewater and groundwater contamination treatment including the challenges of water sampling, lab analysis, technology selection, lab and/or pilot testing, treatment system operation and final disposal/destruction of captured PFAS. The chemistry of PFAS is complicated due to the number of chemistry forms (4,000 + and counting) and in each case the optimum technology selection is based on the PFAS to be removed, interference of co-contaminants and the strategy for ultimate disposal and/or destruction of the PFCs.

This workshop is designed to educate attendees on the specific criteria to be considered for technology selection, optimization and effective operation. Practical consideration will be given to the applications development and common constraints often encountered in the initial sampling and water analyses. Technical details such as PFAS molecular weight will serve as method to prioritize technologies for potential cost effective treatment. This level of detail will be critical to the evaluation of activated carbon, ion exchange and reverse osmosis membranes used individually or in some combination.

THURSDAY

W-11: Recovery & Reuse of Produced Water

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

Thursday, November 11; 8:00 AM – 12:00 Noon

The objective of the workshop is to interact with the attendees to teach them:

1. The quantity of produced water available
2. The challenges in the use of the produced water
3. The importance of using the produced water (sustainability)
4. Various Commercial Technologies to help use the produced water
5. Comparison of various technologies in terms of quality of water produced and the cost of producing certain quality
6. Sustainability in the use of the produced water using Water-Energy-Green House gasses Nexium
7. How to best use the technologies
8. Best technologies to dispose waste water
9. A balance of Chemical and Mechanical Solutions
10. Resources availability for more learning

W-13: Concentrate Management for Industrial Desalination

John Korpiel, Veolia Water Technologies, Wexford, PA

Thursday, November 11; 8:00 AM – 12:00 Noon

This workshop will provide an overview of the options for managing the concentrate generated from industrial desalination processes and their associated challenges. The workshop is intended for engineers, technologists, managers, and operators who want to gain a better understanding of concentrate management, but will also serve as a refresher for those who already have experience in this area.

As fresh water sources become increasingly scarce throughout the world, industries are becoming more reliant on desalination technologies to operate in a reliable and sustainable manner. Desalination technologies are essential in industrial applications for treating challenging water and wastewater sources to generate a quality of water that is suitable for process needs and for meeting regulatory discharge water quality requirements. However, all desalination technologies generate a brine byproduct, also referred to as the concentrate or reject stream. Typically, brine has undesirable characteristics such as high salinity, high scaling and fouling potential, is corrosive, and contains concentrated contaminants and/or residual chemicals. As a result, brine is challenging and costly to concentrate, handle, treat, and dispose, and can be harmful to the environment, if not managed properly. A major challenge of applying any desalination technology in a cost-effective and sustainable manner is implementing an appropriate concentrate management strategy.

The following topics will be discussed in the workshop:

- Overview of brine management options available for disposal and beneficial reuse, including surface water discharge, deep well injection, evaporation ponds, land application, and zero liquid discharge (ZLD)
- Strategies for brine minimization using conventional and proprietary membrane-based technologies for minimum liquid discharge (MLD) applications
- Thermal technologies for reduced liquid discharge (RLD) or ZLD applications; the latter of which eliminates the brine stream, generating a solid byproduct that is suitable for disposal in a landfill or for beneficial reuse.
- The benefits, issues, and limitations of each of the brine management options and technologies
- Examples of integrated MLD and ZLD systems will be presented
- Emerging technologies for brine minimization
- Factors to consider for evaluating the options and selecting the appropriate concentrate management

W-16: Leadership & Career Skills for Tomorrow's Water Professionals

(FREE to Attend)

Jonathan Shimko, McKim & Creed, Pittsburgh, PA

Thursday, November 11; 8:00 AM – 12:00 Noon

This workshop will be interactive and will provide opportunities for participants to engage in useful dialogue to gain understanding and familiarity with the concepts presented. In addition to short presentations on each topic, participants will be asked to collaborate with each other on activities that provide simulations into real life situations. The goal of this workshop is to energize and equip each participant with skills and tools that can provide a lifetime of support and help change their career trajectory for the better. Additionally, participants will have the opportunity to interact with water industry experts and hear their stories and get their advice.

- Overview of the Water Industry
- Ten "Soft Skills" that can Lead to Success in Life and Your Career
- Essential Communication Skills
- How to Interact with a "Customer"
- Diversity & Inclusion in the Water Industry
- How to Stand out Amongst our Peers
- Maintaining a Work-Life Balance
- Industry Panel Discussion and Q/A

W-03A: Ion Exchange Technology and Practical Operating Practices

Wayne Bernahl, W. Bernahl Enterprises, Elmhurst, IL – (repeated from Sunday)

Thursday, November 11; 1:00 – 5:00 PM

Ion exchange technology is not new yet most industrial ion exchange systems do not operate at top efficiency. Ion exchange technology is often not well understood by operating personnel.

The participant of this workshop will:

- Better understand basic ion exchange equipment, operations, and resins used for water treatment operations
- Better understand what can go wrong with ion exchange systems
- Develop a logical troubleshooting approach to discover and correct operating problems.

H2O THEATRE PRESENTATIONS

The H20 Theatre is back this year! These informal presentations are presented by experts in their respective fields, and done in an informal setting, open to all attendees. There is no additional fee to attend, and advance registration is not required. All presentations are conducted in the Salt River Ballroom Foyer. Just pull up a chair and hear from the following... (Check the on-site schedule board as presentations can be added during the conference!).

Monday, November 8

1:30 PM: Electro-deionization technology for conductivity after cation ex-change measurement in Power and Industrial plants

Presented by Swan Analytical USA, Steve deVilleneuve

2:00 PM: Key Rules for Effective Reverse Osmosis Cleaning

Take the guesswork out of RO cleaning by following these four simple rules. Cleaner selection and determination of when to clean will also be discussed.

Avista Technologies, Mike Graver

2:30 PM: Direct nanofiltration hollow fiber membranes for reduction of carbon & chemical footprint

Presented by NX Filtration, Umang Yagnik

Tuesday, November 9

9:00 AM: Data Normalization and Cleaning Procedures

This presentation will discuss the value and procedure to normalize data. As well as, developing the optimum cleaning standard operating procedure.

Presented by American Water Chemicals, Mike Lee

10:00 AM: Direct nanofiltration hollow fiber membranes for reduction of water footprint in industrial markets

Presented by NX Filtration, Umang Yagnik

10:30 AM: Surviving and Thriving During A Raw Material Crisis: Comparing Raw Material Alternatives Efficacy and Cost Performance

Presented by French Creek Software, Robert Ferguson

3:00 PM: Taking "Control" of Your Cooling System

Presented by ChemTreat, Prasad Kalakodimi

Wednesday, November 10

9:00 AM: Iron Fouling Prevention in a Brackish Water RO System

A holistic approach to solve iron fouling issues and proper antiscalant selection for your RO system.

Presented by American Water Chemicals, Melissa Fernandes

EXHIBITOR LISTING

The IWC Exhibit Hall features countless opportunities to learn about practical and innovative solutions for the industrial water treatment industry from industry leaders. The Exhibit Hall is located in the Salt River Ball Room of the Talking Stick Resort, and is centrally located for easy, convenient access. The Exhibit Hall plays host to our lunches on Monday and Tuesday, and evening receptions on Sunday, Monday, and Tuesday. The Exhibit Hall is open:

- Monday, November 8: 12:00 Noon - 7:00 PM
- Tuesday, November 9: 12:00 Noon - 7:00 PM

Be sure to join us for lunch on Monday and Tuesday, as well as the evening receptions on Sunday, Monday, and Tuesday. Luncheons and receptions are open to all registered attendees. An alphabetical listing of all 2021 IWC Exhibitors is provided below. On the following pages, you will find a detailed description* of our exhibitors, including contact information.

AMERICAN WATER CHEMICALS

Booth #: 409

Phone: 813-246-5448

Website: www.membranechemicals.com

American Water Chemicals (AWC) manufactures specialty chemicals for pretreatment and maintenance of reverse osmosis, nanofiltration, ultrafiltration, and microfiltration membrane systems. AWC is an international ISO 9001:2008 certified company specializing in chemical solutions and advanced analytical services for membrane separation processes. AWC has pioneered advanced membrane autopsy techniques and investigative services and supports both public and private business sectors. Our passion is to improve membrane system performance and optimize cost of operation.

AMERIWATER

Booth #: 208

Contact: Travis Tashjian

E-mail: travis.tashjian@ameriwater.com

Website: www.ameriwater.com

AmeriWater is a long-established specialist in water purification products and services with profound knowledge of the specialized water quality requirements that must be met within the industrial and commercial sectors. Our newly redesigned high efficiency sand filters remove extremely fine particles, 0.25 micron to 0.5 micron, and provide your system with the benefits of clean cooling water.

AQUA-AEROBIC SYSTEMS, INC.

Booth #: 209-211

Contact: Cheryl Kunz

Phone: 815-654-2501

Website: www.aqua-aerobic.com

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 treatment industry by providing both municipal and industrial customers around the world with advanced technologies and treatment solutions that easily adapt to changing demands.

AQUAPYR

Booth #: 315

Phone: 310-941-4484

E-mail: ali@aquapyr.com

Website: www.aquapyr.com

AquaPyr Ultra Low Waste Filters operate based on the Wet Solids Extraction process, a non-backwashing filter cleaning method, that puts an end to the wasteful use of water and money.

AQUATECH INTERNATIONAL

Booth #: 500

Contact: Larry Millar

E-mail: millarl@aquatech.com

Website: www.aquatech.com

Established in 1981, Aquatech is a global leader in water purification technology for industrial and infrastructure markets with a focus on desalination, water recycle and reuse, and zero liquid discharge (ZLD). Headquartered in Canonsburg, Pennsylvania, Aquatech has offices throughout North America, and has a significant presence worldwide through subsidiaries in Europe, the Middle East, India and China.

ATLANTIUM ILLUMINATING WATER TECHNOLOGIES

Booth #: 407

Contact: Orly Landesman

Phone: 054-670-0847

Website: www.atlantium.com

Atlantium's Hydro-Optic (HOD) UV solution takes water safety to levels never before achieved with other UV systems or with chemicals, providing industry and municipalities with a sustainable, measurable treatment option. Atlantium is a fast-growing private company whose HOD UV systems are field-proven globally with Fortune-500 companies among its loyal customers. Customer service centers are strategically placed to provide immediate, ongoing support. Our solutions are third-party validated to strict U.S. FDA and EPA regulations.

AVISTA

Booth #: 303

Contact: Ken Robinson

E-mail: info@avistatech.com

Website: www.avistamembranesolutions.com

Avista is a global brand of Kurita focused on membrane treatment solutions for reverse osmosis (RO) systems, microfiltration/ultrafiltration (MF/UF) and multimedia filtration (MMF). A global line of Avista membrane chemicals include Vitec antiscalants, RoClean membrane cleaners, Kuriverter AC chlorine scavengers, RoQuest coagulants. All Avista membrane chemicals are membrane compatibility tested and fully supported by Avista services and programs including, Avista Advisor CI, Avista Black Box, Avista Membrane Autopsy, Avista OSCAR, and the Avista

Center of Excellence.

BECHTEL

Booth #: 313

Phone: 337-569-4194

Website: www.bechtel.com

Bechtel helps our customers deliver projects of purpose that create a lasting positive legacy. These are projects that create jobs and grow economies; improve the resiliency of the world's infrastructure; connect communities to resources and opportunity; get us closer to net zero; protect U.S. and allied interests; tackle critical environmental challenges to protect people and the planet; and accelerate progress to make the world a cleaner, greener, safer place.

BOWEN ENGINEERING CORPORATION

Booth #: 501

Contact: Carolyn Shrall

E-mail: cshrall@bowenengineering.com

Website: www.bowenengineering.com

Resourceful. Responsive. Results. Bowen is a self-performing general contractor and design-builder with operation centers across the country. For over 54 years, Bowen has provided water and wastewater services to Private and Municipal owners, partnering to deliver phys-chem, biological, UV, evaporator, and recycle/reuse solutions. Bowen also has extensive experience removing PFAS constituents in groundwater, leachate and wastewater. The Bowen team has conquered the toughest water and wastewater challenges and has constructed over 1,000 treatment facilities.

BRENNTAG NORTH AMERICA

Booth #: 405

Phone: 510-816-4903

E-mail: bliotta@brenntag.com

Website: www.brenntag.com

Your Partner in Solutions for Industrial and Commercial Water Treatment with stocking locations throughout The Americas. Experienced and dedicated team members will be happy to apply their application knowledge to provide solutions for your toughest water

related challenges. Our broad product line includes dispersants & antiscalants, coagulants, flocculants, biocides, scale inhibitors, corrosion inhibitors, defoamers, permanganates, filtration media, NSF certified products and facilities, plus products for heavy metals removal and odor control. Source from the Experts!

BROWN AND CALDWELL

Booth #: 506
Contact: Tom Sandy
E-mail: asandy@brwncald.com
Website: www.brownandcaldwell.com

Brown and Caldwell is an environmental engineering, consulting, and construction management firm offering a full suite of industrial water treatment services that include full-service and life-cycle delivery of environmental projects from upfront planning and permitting through construction, operations, and maintenance. With one of the strongest resumes in industrial water management and engineering in the United States, Brown and Caldwell brings our clients technical excellence, creativity, and responsiveness translating directly to effective solutions and cost savings.

BURNS & MCDONNELL

Booth #: 305
Phone: 816-839-4906
E-mail: dkmcbride@burnsmcd.com
Website: www.burnsmcd.com

At Burns & McDonnell, our engineers, architects, construction professionals, scientists and consultants do more than plan, design and construct. With a mission unchanged since 1898 — make our clients successful — our more than 8,000 professionals partner with you on the toughest challenges, constantly working to make the world an amazing place.

CHARTWATER

Booth #: 508
Contact: Chris Milligan
E-mail: chris.milligan@blueingreen.com
Website: www.chartcleanwater.com

ChartWater (BlueInGreen, AdEdge, and ChartCryo Centers of Excellence) is a global manufacturer and service provider of engineered solutions for municipal water treatment and industrial process applications. Our portfolio of proven products, processes, and engineering expertise provides customers with single-point responsibility for complete solutions that enable water professionals to achieve their objectives with the lowest combination of risk and costs while driving enhanced outcomes for people, communities, and the planet. Proven Innovation. Effective. Efficient.

CHEMTREAT

Booth #: 200
Phone: 804-935-2000
E-mail: events@chemtreat.com
Website: www.chemtreat.com

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.

COOLING TECHNOLOGY INSTITUTE

Booth #: 212
Phone: 970-593-8637
E-mail: jfritz@tpitx.com
Website: www.cti.org

The Cooling Technology Institute (CTI) is a nonprofit, self-governing association, dedicated to benefitting the public by leading the way in advocating and promoting the use of all environmentally responsible cooling technologies. CTI encourages education on all technologies, development of codes, standards, guidelines, independent performance verifications and certification programs, research, and technological information exchange. CTI is a strong advocate for dialog on the benefits of cooling technologies with government agencies and other organizations with shared interests.

DAVID H. PAUL, INC.

Booth #: 217
Contact: Charles Bedford
E-mail: cbedford@dhptraining.com
Website: www.dhptraining.com

David H. Paul, Inc. (DHP) is a water treatment training and consulting company specializing in membrane water treatment. From its incorporation in 1988, DHP has been 100% committed to providing practical, cost-effective, unbiased high-tech water treatment training and technical services.

DUPONT WATER SOLUTIONS

Booth #: 300
Contact: Algeria Morris-Sowah
E-mail: Algeria.morrissowah@dupont.com
Website: www.dupontwatersolutions.com

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.

EMERGING COMPOUNDS TREATMENT TECHNOLOGIES

Booth #: 513
Contact: Patrick McKeown
Phone: 203-318-7817
Website: www.ect2.com

At ECT2, we combine advanced treatment technology, unmatched real-world experience, and a relentless pursuit of excellence to deliver impressive results whether your biggest challenge is the contamination itself, site restrictions, timeline pressures, a very public spotlight – or all of the above. ECT2 specializes in PFAS and 1,4-Dioxane Treatment Technology with the most sustainable and cost effective methods on the market.

FEDCO

Booth #: 412
Phone: 734-241-3935
E-mail: rweaver@fedco-usa.com
Website: www.fedco-usa.com

FEDCO specialises in high performance pumps and energy recovery devices for ZLD, SWRO and BWRO applications. We offer a complete suite of low pressure pumps, high pressure feed and circulation pumps, and turbocharger ERDs. Our pumps and turbochargers are rated to 120 bar (1800 psi) for Ultra High Pressure (UHP) RO, making it possible to concentrate brines to 120,000 mg/L using tried and tested technology. Higher recovery, better performance – powered by FEDCO.

FEDERAL SCREEN PRODUCTS

Booth #: 504
Phone: 905-677-4171
E-mail: info@federalscreen.com
Website: www.federalscreen.com

Federal Screen Products is your industry leader water and wastewater treatment partner helping you lower your maintenance and operational costs. With over 20 years of experience, we are a custom manufacturer and fabricator of wedge wire screens delivering high-quality products, competitive pricing, and unmatched customer service. Through advanced manufacturing capabilities and exceptional engineering, we produce screens in a variety of configurations and slot sizes to meet your specific application needs.

FLEXITALLIC

Booth #: 510
Contact: Louis Gonzales
Phone: 281-841-0794
E-mail: lgonzales@flexitallic.com
Website: www.flexitallic.com

The Flexitallic Group is committed to its mission of "Making the world safer and cleaner through engineered sealing solutions". We strive to achieve our mission by providing best-in-class sealing solutions that allow our customers to operate their plants, complete projects, and start up from turnarounds safely and efficiently. Our goal is to help customers achieve zero leaks on startup and throughout the operating cycle

EXHIBITOR LISTING

FRENCH CREEK SOFTWARE

Booth #: 202

Contact: Rob Ferguson

E-mail: RobFerguson@FrenchCreekSoftware.com

Website: www.frenchcreeksoftware.com

French Creek develops and distributes software tools for water treatment chemists featuring Visual Chemistry(TM) and the iconic French Creek 3D untreated versus treated safe operating range profiles. Applications covered include the industry standard WaterCycle(R) for cooling, hyd-RO-dsoe(R) for reverse osmosis, DownHole SAT(R) for production chemistry, MineSAT(tm) for process waters, and WatSim(TM) for Pb and Cu minimization in potable water. Private label, DLLs, and controller ready UNIX libraries available. Serving the industry since 1989.

GOLDER ASSOCIATES, INC.

Booth #: 301

Phone: 720-252-9835

Website: www.golder.com

Golder has joined forces with WSP Global to form Earth and Environment Services, one of the largest, most diversified environmental services consultancies in the US. Golder provides water/wastewater treatment services to mining, power, oil and gas, manufacturing, waste, and remediation site clients across the US and the world, including planning, design, construction, startup and long-term operations. Golder has supported the IWC for 14 years, including EC, AC, Exhibiting and Awards and Emerging Topics committees.

GRUNDFOS PUMPS

Booth #: 207

Contact: Fatima Figueroa

E-mail: fafigueroa@grundfos.com

Website: www.grundfos.com

We pioneer solutions to the world's water and climate challenges and improve quality of life for people.

H2O INNOVATION

Booth #: 306

Contact: David Faber

E-mail: david.faber@h2oinnovation.com

Website: www.h2oinnovation.com

H2O Innovation is a complete water solutions company focused on providing best-in-class technologies and services to its customers. The Corporation's activities rely on three pillars: Water Technologies & Services delivers equipment and services to municipal & industrial water, wastewater, and water reuse customers, Specialty Products manufactures and supplies specialty chemicals, consumables and engineered products, and Operation & Maintenance provides contract operations and associated services for water and wastewater treatment systems.

HERON INNOVATORS, INC.

Booth #: 316

Phone: 916-408-6601

E-mail: info@heroninnovators.com

Website: www.heroninnovators.com

Heron manufactures Suspended Air® Flotation (SAF®) water treatment systems. SAF® is flotation without dissolved air®. Performance is not limited by changing conditions (e.g. gas solubility, pressure, temperature, etc.) & the physics that constrain traditional process systems (DAF, IAF, IGF, enhanced clarification, CAF, etc.). As Heron customers say, "It just always works." SAF®'s common uses include Algae and Silt Removal, Biosolids Removal & Thickening, Enhanced Clarification, Filtrate Clarification, Oil/Water Separation, Primary/Secondary Treatment, Surface Water Treatment, Reclamation.

HÖGANÄS ENVIRONMENT SOLUTIONS

Booth #: 417

Phone: 215-620-1439

Website: www.hoganas.com/environmental

Höganäs Environment Solutions (HES) is a part of Höganäs AB - the world's largest producer of iron powder. HES produces a modified zero valent iron (ZVI) media called Cleanit LC-Plus. Cleanit media is useful for removal of metals and metalloids such as Selenium, Chromium, Arsenic, and Lead. Cleanit systems are currently in the bid, pilot, or installation process for applications such as RO reject treatment, CCR dewatering, FGD wastewater, mining, and groundwater pump and treats.

HOWDEN

Booth #: 205

Phone: 716-812-3043

E-mail: jason.stoklosa@howden.com

Website: www.howden.com

Howden offers the most complete product line and broadest depth of experience for Mechanical Vapor Recompression (MVR) and municipal water treatment blowers and compressors. From the world renowned Roots Rotary PD Blower, to unique ExVel turbo fans and efficient Turblex® centrifugal compressors, Howden brings decades of experience from thousands of installations across numerous industries employing MVR and water treatment processes. Howden combines our technology and engineering expertise to deliver trusted solutions optimizing your vital processes.

IDE WATER TECHNOLOGIES

Booth #: 204

Contact: Daphne Lavi

E-mail: daphnel@ide-tech.com

Website: www.ide-tech.com

IDE specializes in the development, engineering, construction, and operation of some of the world's largest and most advanced membrane desalination and thermal facilities, industrial and municipal water treatment plants. For over 60 years, IDE has collaborated with various partners and constantly invested in technological innovation to find effective ways to reduce costs, minimize environmental impact, and provide sufficient water resources. Our technologies are game-changing power solutions that transform your industrial wastewater challenges into valuable assets.

JACOBI CARBONS, INC.

Booth #: 206

Phone: 412-400-0981

E-mail: jim.knepper@jacobi.net

Website: www.jacobi.net

Jacobi Carbons, the largest manufacturer of coconut-shell activated carbons, offers activated carbons based on coal, coconut shell and wood. AquaSorb GAC/PAC is optimal for drinking water applications: T&O, DBP compliance, and VOC removal with full tech & lab support. Our Resinex division offers a complete portfolio of high quality ion exchange resins. This includes many different ion exchange, adsorbent, and catalyst type products for a variety of applications. (215) 546-3900 or email infous@jacobi.net.

JUSTEQ LLC

Booth #: 502

Phone: 224-515-8352

Contact: Daniel Shim

E-mail: daniel@justeq.com

Website: www.justeq.com

Justeq, LLC sells Justeq07, 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. In addition, Justeq07 is much less corro-sive, is compatible with supplemental chemicals, has a shelf life for over a year, and requires no additional equipment. Contact us today to learn more.

KROFTA TECHNOLOGIES

Booth #: 514

Contact: Jim Gallmann

E-mail: jim.gallmann@krofta.com

Website: www.krofta.com

Krofta Technologies is a design/build/supply organization within the water and wastewater industry. In addition to Dissolved Air Flotation (DAF) equipment sales, Krofta supplies ancillary wastewater treatment equipment, DAF Rentals, Water Treatment Chemistry, as well as Spare Parts and Maintenance Services for our installed base across North America.

KURITA AMERICA

Booth #: 511

Contact: Nathan Bach

E-mail: n.bach@kurita-water.com

Website: www.kuritaamerica.com

Kurita America helps our customers meet the challenges that water availability and water quality have on regulatory, operational, and business environments. By combining our innovative equipment and sustainable chemical programs, Kurita America develops

integrated water treatment solutions designed to prevent unscheduled downtime and improve system efficiency. Coupled with our automation programs, our pre-treatment equipment helps reduce excess water and energy consumption for efficient use of our precious natural resources.

LANXESS CORPORATION

Booth #: 408-410

E-mail: firuza.mir@lanxess.com

Website: www.lewatit.com

LANXESS is a leading global solution provider for water treatment and liquid purification. For more than 80 years our Lewatit® ion exchange resins and adsorbers are 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.

MANN+HUMMEL WATER & FLUID SOLUTIONS

Booth #: 503

Phone: 805-570-5125

E-mail: h.parsley@microdyn-nadir.com

Website: www.microdyn-nadir.com

MANN+HUMMEL Water & Fluid Solutions (previously MICRODYN-NADIR) is a membrane manufacturer that delivers the membrane products to meet your water and process needs. Offering the widest range of membrane products, including MF, UF, NF, and RO in flat sheet, spiral-wound, and hollow-fiber configurations, as well as MBR technology for treatment of water and wastewater. Vision: to solve the world's water and fluid challenges so that together we can create a safe, sustainable, and healthy planet.

MPW INDUSTRIAL SERVICES GROUP INC.

Booth #: 403

Contact: Mandolyn Rentschler

Phone: 740-928-0213

E-mail: mrentschler@mpwservices.com

Website: www.mpwservices.com/industrial-water-services/

MPW provides reliable water solutions featuring innovative and custom base-load systems to improve water quality and reduce operating costs.

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. For more permanent industrial solutions, MPW's Build, Own, Operate and Maintain

NALCO WATER

Booth #: 400

Contact: Chel Lancaster

E-mail: chel.lancaster@ecolab.com

Website: www.ecolab.com/nalco-water

Nalco Water, an Ecolab company, is represented at IWC by our Global Heavy Industries unit, serving the essential Power, Primary Metals, Chemical, Downstream and Mining segments. Nalco Water helps customers achieve their profitability, productivity and sustainability goals by delivering world-class enterprise-wide, integrated and digitally connected process solutions. Stop by the Nalco Water booth to learn more about ECOLAB3D, our virtual platform that joins performance data from across your enterprise to provide real-time, actionable insights.

NX FILTRATION

Booth #: 414

Phone: 778-899-7334

E-mail: u.yagnik@nxfiltration.com

Website: www.nxfiltration.com

NX Filtration manufactures novel direct nanofiltration (dNF) hollow fiber membranes for retention of micropollutants, organics, color, and selective salts, in addition to viruses, bacteria, and turbidity. dNF membranes offer a one-step solution for treatment of surface water, ground water, and wastewaters for drinking water production and water reuse. dNF systems require less energy and a much lower chemical consumption compared to traditional membrane systems. NX Filtration also offers ultrafiltration (UF) and microfiltration (MF) membranes.

OLI SYSTEMS, INC.

Booth #: 505

Contact: Jordan Pearce

Phone: 713-231-4822

E-mail: Jordan.Pearce@olisystems.com

Website: www.olisystems.com

OLI Systems is an established global leader in delivering comprehensive, process optimization solutions for water chemistry based industrial applications that enhance engineering productivity, operational efficiency and sustainability while mitigating risk. As the pioneer in electrolyte/water chemistry science and its applications to industrial processes, OLI Systems delivers the most rigorous and accurate process modeling and simulation insights and intelligence with its extensive chemistry property database, differentiated thermodynamic and kinetic models and proven software platforms.

OLYMPIA TECHNOLOGY LLC

Booth #: 312-314

Contact: Brandt Rouse

E-mail: brouse@whitesenergy.com

Website: www.whitesenergy.com

Olympia Technology is a service company focusing on technology and processes related to waste reduction and reuse. We aim to help our customers understand their options dealing with waste and to provide solutions that help the environment and their bottom line.

PUREFLOW FILTRATION & OZONE DIVISIONS

Booth #: 210

Contact: Michael Kennedy

E-mail: info@waterbypureflow.com

Website: www.waterbypureflow.com

Since 1973, Pureflow Filtration Div. has specialized in the removal of heavy metals, radionuclides, sulfides, and organics from industrial water sources, and process streams with flow rates from 10 gpm to 10,000 gpm. Pureflow Ozone Div. is the exclusive Engineering Partner of Primozone for the U.S.A. & Canada. The partnership combines Primozone's unparalleled ozone generator that is revolutionizing the ozone industry with a proven water and wastewater process / system engineering team.

PUROLITE CORPORATION

Booth #: 317-416

Contact: Hilary Valentine

Phone: 610-668-9090

Website: www.purolite.com/index

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. Established in industrial and potable water treatment, Purolite brings more new products to the market than any other resin company. We focus exclusively on resin technology, and have the largest, most knowledgeable technical sales force. Purolite can help

RESINTECH, INC.

Booth #: 401

Contact: Melissa Roberts

E-mail: mroberts@resintech.com

Website: www.resintech.com

ResinTech Inc. is a US manufacturer and globally recognized leader in the field of ion exchange for water and wastewater treatment. The company produces a broad range of IX resins, carbons, selective adsorbents, water filtration cartridges, and ultrapure lab water systems. It also offers off-site resin regeneration, RO membrane restoration, and comprehensive lab services. ResinTech's premium US-made products and legendary technical support help dealers and operators worldwide achieve optimal water quality for virtually every application.

SAC INCORPORATED

Booth #: 413

Phone: 602-206-4055

Website: www.sacincorporated.com

SAC is a leader in the integrated delivery of process piping solutions (including fabricated carbon steel pipe, stainless steel pipe, structural racks, and pipe supports) . By leveraging our expertise in design, engineering and fabrication, we are able to utilize our resources to better identify and mitigate risk, assess needs and design custom solutions to meet the demand of the most complex projects.

EXHIBITOR LISTING

SAFBON WATER TECHNOLOGY, INC.

Booth #: 213-215
Contact: Alan Daza
E-mail: info@safbonwater.com
Website: www.safbonwater.com

Backed by 30+ years of experience and many successful projects - SafBon Water Technology - is a global integrated solutions provider for advanced water & wastewater treatment systems serving the Industrial and Municipal markets.

SALTWORKS TECHNOLOGIES

Booth #: 516
Phone: 604-628-6508
E-mail: geer.qile@saltworkstech.com
Website: www.saltworkstech.com

Saltworks provides cutting-edge products and solutions for industrial wastewater treatment and desalination. Our goal is to treat the toughest wastewater at the lowest total cost and environmental footprint. We focus on recycling and reuse, removing specific contaminants, and concentrating brine for minimal and zero liquid discharge.

Our product range includes chemical, membrane, and thermal technologies, robust sensors, and smart process controls. We sell worldwide, with an established history of designing, building, and operating full-scale plants.

SAMCO TECHNOLOGIES INC.

Booth #: 402
Phone: 716-743-9000
E-mail: sales@samcotech.com
Website: www.samcotech.com

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

STANTEC

Booth #: 310
Phone: 980-229-3583
E-mail: bill.kennedy@stantec.com
Website: www.stantec.com

Local strength, knowledge, and relationships, coupled with world-class expertise, allows Stantec to go anywhere to meet clients' needs in creative and purposeful ways. The Stantec Industrial Water team actively serves the power, oil & gas, mining, agriculture, food & beverage, pharmaceutical and high-tech manufacturing industries, facilitating safe, compliant, reliable, and cost-effective solutions to address water challenges. As active members of the communities in which we live and serve, Stantec's professionals design with community in mind.

STENNER PUMP COMPANY

Booth #: 507
Contact: Amber Lee
E-mail: tradeshowmanager@stenner.com
Website: www.stenner.com

USA manufacturer with 3-day lead time. Established in 1957 in Jacksonville, Florida, the Stenner Pump Company manufactures self-priming peristaltic metering pumps for reliable and accurate injection of liquid solutions. Compact or robust pumps with various activation modes; custom OEM pumps and select pumps available as a tank system or meter system. All pumps offer tube replacement without tools. Many pumps offer leak detection, back-up pump capability, output relays and a totally enclosed housing.

SUEZ WATER TECHNOLOGIES & SOLUTIONS

Booth #: 302-304
Contact: Heather Blount
Phone: 713-560-9160
Website: www.suezwatertechnologies.com/

SUEZ Water Technologies & Solutions has a comprehensive set of chemical, equipment and digital enabled services and products. These help our customers optimize water resources and overcome process challenges. We help industries solve their toughest water, wastewater and process challenges. We work with customers across all industries, including food and beverage, metals and mining, power, chemicals and pharma, oil and gas downstream and petrochemicals, upstream oil and gas, pulp and paper, and utilities. Visit www.suezwatertechnologies.com

SWAN ANALYTICAL USA

Booth #: 404
Contact: Shaun Sharrett
E-mail: info@swan-analytical-usa.com
Website: www.swan-analytical-usa.com

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 focuses on providing a complete measuring system, with each analyzer coming with transmitter, sensors and fluidics pre-mounted on a stainless steel back plate. All analyzers are factory tested and calibrated for immediate

THERMAX INC.

Booth #: 203
Contact: Ajit Dighe
Phone: 248-921-0779
E-mail: ajit@thermax-usa.com
Website: https://www.thermaxglobal.com

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 environ-ment businesses. Thermax Chemical portfolio is backed by over four decades of R&D experience, and in-depth knowledge of customer requirements. The business is Asia's leading manufacturer and exporter of ion exchange resins and is a pioneer in chemicals for water & wastewater treatment , oil field...

TURNER DESIGNS HYDROCARBON INSTRUMENTS, INC.

Booth #: 509
Contact: Chip Westaby
Phone: 713-885-4209
E-mail: cwestaby@oilinwatermonitors.com
Website: www.oilinwatermonitors.com

Turner Designs Hydrocarbon Instruments, Inc. is the worldwide leader in the application of field portable, la-boratory, and online continuous process monitors for measuring and monitoring of algae and hydrocarbons in water. Our monitors are based in UV and visible fluorescence plus ultrasonic technology. Monitoring sea, river and lake water intake , steam condensate, cooling and waste water for oils, fuels and algae are common uses.

UCC ENVIRONMENTAL (FORMERLY UNITED CONVEYOR CORPORATION)

Booth #: 411
Contact: Dawn Williams
E-mail: contactucc@unitedconveyor.com
Website: www.unitedconveyor.com

UCC Environmental (UCC) is a global leader in environmental solutions for solids handling, wastewater treatment and pollution control technologies in power generation and heavy industrial markets. 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.

UNIVAR SOLUTIONS

Booth #: 308
Contact: Corey Newsom
E-mail: corey.newsom@univarsolutions.com
Website: https://www.univarsolutions.com/industries/water-treatment

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 disinfectants from the best manufacturers. Univar Solutions also offers an array of value-added services that includes custom storage and delivery, waste management, and more. Stop by our booth and learn how global scale and local service can benefit your operation.

VEOLIA WATER TECHNOLOGIES

Booth #: 201
Contact: Jill Browning
E-mail: jill.browning@veolia.com
Website: www.veoliawatertech.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.

WESTECH ENGINEERING, LLC

Booth #: 309-311
Contact: Ian Fife
E-mail: ifife@westech-inc.com
Website: www.westech-inc.com/

For almost half a century, WesTech has provided process solutions for water treatment, liquid/solids separation, and biological treatment to municipal, industrial, and minerals clients worldwide. Treatment is available for surface waters, drinking water, groundwater, wastewater, and industrial process water. WesTech specializes in retrofits, replacements, and upgrades of all equipment. Many of our solutions are available for temporary mobile/rental applications with plant operation services. With over 500 employees around the world, WesTech is ISO 9001 certified.

WIGEN WATER TECHNOLOGIES

Booth #: 515-517
Phone: 303-884-0694
E-mail: michael.bourke@wigen.com
Website: www.wigen.com

Wigen Water Technologies, part of the Metawater group of companies, has the technologies and expertise to provide complete water treatment solutions. Our products include the range of membrane filtration systems, from UF, NF to RO and media filters for all of your filtration needs. Adsorption systems include GAC and ion exchange. From high purity industrial water and drinking water to wastewater treatment and reuse, we can provide the technology to meet your water treatment needs.

WORLD WATER WORKS

Booth #: 415
Contact: Andrea Otto
E-mail: andrea.otto@worldwaterworks.com
Website: www.worldwaterworks.com

World Water Works, Inc. is a global designer and manufacturer of advanced water and wastewater treatment solutions with design focus on performance, flexibility and longevity to yielding the best water quality at the lowest life cycle costs. The company was incorporated in 1998 recognizing the need for ethical product commitment and continual innovation in water technology. We are a passionate and adaptable company providing value through expertly engineered solutions and technologies.

ZENVIRO TECH US INC.

Booth #: 214-216
Contact: Fabian Solberg
E-mail: fabian.solberg@zenvirotech.com
Website: www.zenvirotech.com

Our engineered solutions enable environmental compliance, solve critical operational challenges and drive bottom line value. Complex applications and problems solved is what we do. Providing next generation fit to purpose solutions for air, water and waste while delivering these systems with high uptime reliability has become synonymous with Zenviro Tech. Our US team continuously support all stages of a project and Made in USA is how its done.

EXHIBITOR LISTING BY BOOTH NUMBER

Booth #	Company Name
200	ChemTreat
201	Veolia Water Technologies
202	French Creek Software
203	Thermax Inc.
204	IDE Water Technologies
205	Howden
206	Jacobi Carbons, Inc.
207	Grundfos Pumps
208	AmeriWater
209-211	Aqua-Aerobic Systems, Inc.
210	Pureflow Filtration & Ozone Divisions
212	Cooling Technology Institute
213-215	SafBon Water Technology, Inc.
214-216	Zenviro Tech US Inc.
217	David H. Paul, Inc.
300	DuPont Water Solutions
301	Golder Associates, Inc.
302-304	SUEZ Water Technologies & Solutions
303	Avista
305	Burns & McDonnell
306	H2O Innovation
308	Univar Solutions
309-311	WesTech Engineering, LLC
310	Stantec
312-314	Olympia Technology LLC
313	Bechtel
315	AquaPyr
316	Heron Innovators, Inc.
317-416	Purolite Corporation

Booth #	Company Name
400	Nalco Water
401	ResinTech, Inc.
402	SAMCO Technologies Inc.
403	MPW Industrial Services Group Inc.
404	Swan Analytical USA
405	Brenntag North America
407	Atlantium Illuminating Water Technologies
408-410	LANXESS Corporation
409	American Water Chemicals
411	UCC Environmental
412	FEDCO
413	SAC Incorporated
414	NX Filtration
415	World Water Works
417	Höganäs Environment Solutions
500	Aquatech International
501	Bowen Engineering Corporation
502	Justeq LLC
503	MANN+HUMMEL Water & Fluid Solutions
504	Federal Screen Products
505	OLI Systems, Inc.
506	Brown and Caldwell
507	Stenner Pump Company
508	Chart Industries / BlueInGreen
509	Turner Designs Hydrocarbon Instruments, Inc.
510	Flexitallic
511	Kurita America
513	Emerging Compounds Treatment Technologies
514	KROFTA TECHNOLOGIES
515-517	Wigen Water Technologies
516	Saltworks Technologies