THE 80TH ANNIVERSARY!

INTERNATIONAL WATER CONFERENCE®

THE 2019 IWC

Hilton in the Walt Disney World Resort®

Orlando, FL, USA
November 10-14, 2019

Conference Program Guide

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11:15 AM–12:30 PM	Keynote Session	Keynote Session		
12:30 PM–1:15 PM	Attendee Luncheon in the Exhibit Hall			
1:15–5:00 PM	ASME Session: Steam Systems	Harry Water & Sustainability Secrets	Industrial Water Treatment	Selenium & Sulfate
5:00–7:00 PM	Attendee Reception in the Exhibit Hall			
6:00 PM	IWC 80th Anniversary Dinner at Wyndham Hotel			

	INT'L BR NORTH	INT'L BR CENTER	INT'L BR SOUTH	CRYSTAL
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1:15–5:00 PM	The ELGs are Coming!	Water Projects & Overcoming Hurdles	Industrial Wastewater	Concentrate Management
5:00–7:00 PM	Attendee Reception in the Exhibit Hall			
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8:00 AM–12:00 Noon	Continuing Education Workshops (separate registration required)			
1:00–5:00 PM	Continuing Education Workshops (separate registration required)			

INFORMATION

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 80th Annual International Water Conference®. The IWC is a leading provider of technical information and training for the water and wastewater business. For the past 80 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...

80th Anniversary – during the conference there will be special events recognizing our 80th anniversary. At the Sunday reception there will be a birthday cake for all to enjoy. A celebration dinner will be held on Monday evening – tables or individual tickets can be purchased on the registration form.

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 produced water. As the technical programs 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, Jim Summerfield, has done an excellent job of assembling the technical program. Jim 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 – 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. Please feel free to share feedback with the IWC so that next year's app can continue to evolve with the conference and attendee's needs.

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 Jay Harwood and the instructors for putting together a great set of 20 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 a 100 different companies exhibiting the newest advancements in water and wastewater treatment. There will also be outdoor exhibitors.

INFORMATION

Refreshments will be provided throughout the Hall during exhibit hours courtesy of our sponsors, so be sure to grab a bite to eat while you are networking.

Keynote Speaker – our keynote speaker this year is Mr. Charles Fishman, a bestselling author of The Wal-Mart Effect and The Big Thirst. Charles is a former metro and national reporter for the Washington Post. He was a reporter and editor at the Orlando Sentinel and News & Observer in Raleigh, NC. Since 1996, he has worked for the innovative business magazine Fast Company. Charles has won numerous awards, including three times receiving UCLA's Gerald Loeb Award, the most prestigious award in business journalism.

Continuing Events – last year a number of new activities were added to the conference. This year we will continue with a golf outing on Sunday afternoon. The H2O Theatre are informal presentations by experts in their respective fields that are held during session hours. They are open to all attendees with no additional fees or advance registration.

Student Outreach – The IWC has an active Outreach Committee that provides college students that opportunity to attend this conference and workshops. Scholarships and support is provided to the students through many supporters. During the last year, a mentoring program has been initiated to offer an exchange of life long information between members. If you are interested, please discuss with the IWC staff.

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, Taylor Bombalski, and Michael Gaetano, and Kristina Emmerson. The continued success and growth of the IWC is a direct result of their hard work.

I hope you enjoy this year's conference and learn new information, engage in lively conversation with colleagues and enjoy the Orlando activities. The IWC Executive Committee and Advisory Council welcomes your feedback. Please do not hesitate to share your conference ideas with us.

Enjoy the conference!

Kenneth M. Dunn
Solenis - Retired
General Chair, 80th Annual International Water Conference

INFORMATION

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 80th Annual International Water Conference®. The CD will be mailed to you approximately two months following the conference. Additionally you may now download this content via file transfer.

Call for Papers

To participate in the 2020 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 Orlando during the IWC, we have many special events and activities planned for you. Join

your fellow conference attendees at the annual Get Acquainted Reception, held on Sunday in the Exhibit Hall to welcome you to the Conference, along with a special "birthday cake" to celebrate the 80th Anniversary IWC! Also, all registered attendees are welcome to attend the 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!

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 11. 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 34th 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 12 at 7:00 AM Sharp; meet in the hotel lobby at 6:45 AM. Distance: 3 miles – flat and easy course.

Merchandise

IWC shirts are available for sale! Pre-prints for (most) technical presentations are available at the Registration Desk. Pre-prints can be purchased for $10.00 per copy, or $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 13.

INFORMATION

ASME Co-Meetings - open to all attendees

- Monday, Nov. 11, 5:30 – 7:00 PM:
  Executive Subcommittee, Jasmine Room
- Wednesday, Nov. 13, 2:00 – 3:00 PM:
  Main Committee, Edelweiss Room
- Wednesday, Nov. 13, 3:00 – 6:00 PM:
  Water Technology Subcommittee, Edelweiss Room
- Thursday, Nov. 14, 8:00 – 5:00 PM:
  Properties Subcommittee, Fuschia Room

Social Media

Keep up on the latest details of the conference by using #IntlWaterConf and follow @EngSocWestPA 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 condensing this printed guide with abbreviations, and word limits in certain areas. In addition to helping the environment, we want to encrouage 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!

Future Conference Dates

See you next year on November 8 – 12, 2020; at the San Antonio Marriott RiverCenter, San Antonio, TX, USA

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INFORMATION

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., Elmhurst, IL

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Bechtel Corporation, Reston, VA

Michael Gottlieb
ResinTech, Inc., West Berlin, NJ

Jay Harwood
SUEZ Water Technologies & Solutions, Oakville, ON, Canada

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Stantec, Charlotte, NC

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

Tom Lawry
McKim & Creed, Sewickley, PA

Dennis McBride
Burns and McDonnell, Kansas City, MO

Ivan Morales
Integrated Sustainability, Inc., Houston, TX

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

Scott Quinlan, P.E.
GAI Consultants, Inc., Cranberry Township, PA

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

Patricia Scroggin-Wicker, P.E.
Burns & McDonnell, Chicago, IL

Jonathan Shimko
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Michael Soller, P.E., CPC, DBIA
Bowen Engineering Corporation, Indianapolis, IN

Jim Summerfield
Dupont Water Solutions, Saginaw, MI

Randy Turner
SWAN Analytical USA, Wheeling, IL

Bill Willersdorf
Veolia Water Technologies, Davie, FL

Bradley Wolf, P.E.
Berkeley Research Group, LLC, Pittsburgh, PA

IWC ADVISORY COUNCIL

Advisory Council

The IWC Advisory Council (AC) is comprised of a group of companies that provide ongoing support for the planning of a successful conference. Membership is open to companies that have an interest in water & wastewater treatment, and are willing to make a commitment to work with the IWC Executive Committee in planning the IWC. The following is a listing of the 2018 IWC AC, with representative and company website. If you would like more information on becoming a member of the IWC AC, please visit our website or contact the ESWP staff.

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Brad Crocker; www.airliquide.com

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Bowen Engineering Corporation
Michael Soller, P.E. CPC, DBIA; www.bowenengineering.com

Burns and McDonnell
Katie Bland; www.burnsmcd.com

ChemTreat, Inc.
Brad Buecker; www.chemtreat.com

CNX Water
David Weakley, II, P.E.; www.cnx.com/operations/cnx-water-assets

Culligan
Anne Arza; www.culligan.com

Duke Energy Corporation
Derek Henderson, P.E.; www.duke-energy.com

DuPont Water Solutions
Donna DeFlavis Murphy; https://www.dupont.com/water.html

Eisenmann Corporation
Fabian Solberg; www.eisenmann.us.com

Epicor Incorporated
Phil D'Angelo; www.epicorinc.com

EPRI
Jeffery Preece; www.epri.com

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Evoqua Water Technologies
Walter Kozlowski; www.evoqua.com/en/Pages/default.aspx

Fluor Enterprises, Inc.
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Tony Fuhrman; www.LGwatersolutions.com

McKim & Creed
John Van Gehuchten; www.mckimcreed.com

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Lyndsey Wiles; www.microdyn-nadir.de/en

MPW Industrial Services
Brad Tolbert; www.mpwservices.com

Nalco Water, an Ecolab Company
Matthew Flannigan; www.ecolab.com/nalco-water

North America Dow Water and Process Solutions
Donna DeFlavis
http://www.dow.com/en-us/water-and-process-solutions

OLI Systems, Inc.
Mike Kochevar, PMP; www.olisystems.com

Pulsafeeder
Larry Pannell; www.pulsatron.com

Purolite Corporation
Donald Downey; www.purolite.com/RelId/33637/Isvars/default/Home.htm

INFORMATION

ResinTech Inc.
Peter Meyers; www.resintech.com

RETEGO Labs
Les Merrill; www.retegolabs.com

Samco Technologies, Inc.
Richard Posa; www.samcotech.com

Sargent & Lundy, LLC
Matthew Heermann; www.sargentlundy.com/home

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SWAN Analytical USA
Shaun Sharrett; www.swan-analytical-usa.com

Thermax, Inc.
Ajit Dighe; www.thermax-usa.com

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www.ppchem.net

Water Online
www.wateronline.com

WC & P
www.wcponline.com

MONDAY SESSIONS

Boiler Water in a Changing Landscape

Monday, Nov. 11; 8:00 – 11:00 AM

Room: International Ballroom North

IWC Rep: Randy Turner, SWAN Analytical USA, Wheeling, IL

Session Chair: Derek Henderson, P.E., Duke Energy, Raleigh, NC

Discussion Leader: Chloe Grabowski, HDR, Missoula, MT

8:00 AM Session Introduction

The energy industry has become a changing landscape from the increase usage of renewables and natural gas. As a result of this changing landscape, boiler water has become an increasing dynamic topic. In this session, we will review and discuss some opportunities and technologies that have occurred and developed because of this changing landscape. We will cover the use of reclaim water for steam blows, the impact boiler cycling has had on deep bed condensate polishing and review studies on the use of film forming products (FFP) and film forming amines (FFA) in corrosion prevention.

8:10 AM

IWC 19-01: Steamblow Lessons Learned from Start-Up of Two Combined Cycle Power Plants in North America

Lauren Barbir, SUEZ Water Technologies & Solutions, Trevose, PA; Jeffrey Sirko, Anderson Bright, and Craig Lockhart, SUEZ Water Technologies & Solutions, Norfolk, VA

The power industry in North America has seen an increase of natural gas generation capacity over the last 10 years. For the gas plants commissioning and start-up, there are added water requirements during the steamblow. This paper will explore the lessons learned for vendor selection, planning and execution of two steamblows during 2018-2019 utilizing mobile deionization systems outfitted with remote monitoring technology. Lessons from the first steamblow were applied for the second.

8:35 AM: Discusser: Robert Bartholomew, P.E., Sheppard T. Powell Associates LLC, Baltimore, MD

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-02: The Death of Deep Bed Condensate Polishing

Peter Meyers, ResinTech Inc., West Berlin, NJ

With the ever-expanding capacity of solar and wind power, most thermal power plants are now cycling rather than operating continuously at full power. Cycling dramatically increases the transport of corrosion products and increases both corrosion and metal fatigue. Recent EPRI guidelines for combined cycle plants is to operate at elevated condensate pH, at least 9.6 and preferably 9.8 to 10.0. Although other types of power plants have lower pH guidelines, there is a general push at many older plants that do not have high chrome metallurgy to operate at higher pH as a way of minimizing FAC. The increase in amine

(or ammonia concentration) makes condensate polishing...

9:25 AM: Discusser: Colleen Scholl, P.E., HDR, Whitewater, WI

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:10 AM

IWC 19-03: On-Line Iron Studies using a Film Forming Product and a Film Forming Amine

Ken Kuruc, Hach, Loveland, CO

Film forming products (FFP) and film forming amines (FFA) continue to receive attention as a means of passivating metal surfaces in the steam cycle, especially with systems that cycle frequently. Facilities that have added these products to their cycle need to prove that their investments are effective in reducing both production and transport of corrosion products.

In two separate studies, one using a FFP and the other a FFA, a laser nephelometer is employed along with a laboratory spectrophotometer to quantify on-line concentrations of iron on a continuous basis in the steam cycle. Before and after results will be shared with respect to corrosion product transfer on...

10:35 AM: Discusser: Kevin Boudreaux, Chemtreat, Richmond, VA

10:45 AM: Author's Closure & Floor Discussion

11:00 AM: Conclusion

Zero Liquid Discharge (ZLD) – Design, Implementation, Operations and Lessons Learned

Monday, Nov. 11; 8:00 – 11:00 AM

Room: International Ballroom South

IWC Rep: Bill Willersdorf, Veolia Water Technologies, Davie, FL

Session Chair: HG Sanjay, Bechtel Corporation, Reston, VA

Discussion Leader: Holly Johnson Churman, P.E., GHD, Houston, TX

8:00 AM Session Introduction

ZLD systems are mandated or specified in a number of industrial and power plant facilities as a means to eliminate liquid discharge from the plant boundary and as a way to minimize reliance on precious water resources. ZLD systems also help facilities achieve higher sustainability goals. ZLD systems are high-recovery processes, are complex with multiple unit operations and require attention to details for successful implementation. This session includes papers discussing ZLD system implementations in various industries such as mining, power and oil & gas. The papers in the session showcase operational data, operating experience, maintenance, cost and lessons learned from design phase to operations to provide a holistic view of ZLD systems.

8:10 AM

IWC 19-04: Zero Liquid Waste (ZLW) Facility – Five Years of Full-Scale Operational Experience from Mine Water Treatment Plant

Srikanth Muddasani, Keith Benson and Kashi Banerjee, Veolia Water Technologies, Moon Township, PA

A Zero Liquid Waste plant was built in 2013 in a remote area in the mountains of West Virginia to treat mine water collected from six mines. The objective of this treatment plant was to meet strict regulatory limitations imposed by WVDEP for chlorides (<218 mg/l) discharged to surface water. The mine water is treated using advanced treatment technology to produce clean water for reuse or discharge. The Paper will describe treatment steps and operating data.

8:35 AM: Discusser: Neal Gallagher, Golder Associates, Inc., Lakewood, CO

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-05: Iatan SDE Design, Operation, Maintenance and Operational Costs

Travis Reynolds, GE Power, Knoxville, TN; Cuong Pham, Evergy, Weston, MO

After two years of successful operation, performance & emissions compliance, and greater than ninety-eight percent availability, the operating experiences and costs associated with the SDE have been quantified. This paper and presentation will discuss the SDE design approach, operation and maintenance experiences, and costs that have been observed over the past two years of operation.

9:25 AM: Discusser: Arturo Burbano, Ph.D., P.E., BCEE, GHD, Miami, FL

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:10 AM

IWC 19-06: Integrated Water and Wastewater Zero Discharge System for Liquefied Natural Gas Plant: Lessons Learned from Design, Start-Up and Operations

Josh Dewanaga P.E. and David Ciszewski, SUEZ Water Technologies & Solutions, Bellevue, WA; David Rowe, SUEZ Water Technologies & Solutions, Norfolk, VA; Lauren Barbir, SUEZ Water Technologies & Solutions, Trevose, PA

When tackling the daunting task of expanding an existing liquefied natural gas (LNG) plant and managing water demands in an environmentally sensitive area, what are the critical decisions when selecting the design and operational support model for your water and wastewater systems? For a LNG terminal on the East coast, the journey to full operations of its expansion project started six years earlier with the owner evaluating water needs and requirements for the environmental impact in the area. The decision was to select a high recovery

water treatment system and a zero liquid discharge system to minimize both water withdrawal and environmental impact...

10:35 AM: Discusser: Eric Costello, P.E., Orlando Utilities Commission, Orlando, FL

10:45 AM: Author's Closure & Floor Discussion

11:00 AM: Conclusion

Cooling Water – Advancements in Monitoring and Chemical Treatment

Monday, Nov. 11; 8:00 – 11:00 AM

Room: International Ballroom Center

IWC Rep: Scott Quinlan, P.E., GAI Consultants, Inc., Cranberry Township, PA

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

Discussion Leader: Heath Horyna, Evergy, Topeka, KS

8:00 AM Session Introduction

Effective control of corrosion, deposition and microbial growth are necessary to maintain heat transfer efficiencies and preserve the mechanical integrity of assets in recirculating cooling systems. Operational management of these three interconnected processes has become increasingly challenging with more stringent discharge limits and expanding water scarcity. The papers in this session discuss techniques for monitoring heat exchanger performance, a newly developed analyzer for online measurement of residual oxidant concentrations and an innovative chemical treatment technology to minimize corrosion of yellow metals.

8:10 AM

IWC 19-07: Heat Exchanger Performance Monitoring in Oil Refineries

Timothy Eggert, SUEZ Water Technologies & Solutions, Seal Beach, CA; Robin Wright, SUEZ Water Technologies & Solutions, Ponte Vedra, FL; Delbert Grotewold, SUEZ Water Technologies & Solutions, Boulder, CO; W. Dan Harbs, SUEZ Water Technologies & Solutions, Costa Mesa, CA

Efficient heat transfer enables refineries to make quality products economically. To proactively respond to fouling problems, an effective heat exchanger monitoring program is needed. There is no single method for developing a program, but proper evaluation and selection of exchangers are critical to the success of the program. This paper discusses techniques for detecting fouling in refinery heat exchangers. Case studies are used to illustrate various techniques that have been successfully employed in the industry.

8:35 AM: Discusser: Loraine Huchler, P.E., CMC, FIMC, MarTech Systems, Inc., Lawrenceville, NJ

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-08: TRO Analyzer Improves Biocide Measurement for Disinfection and Dechlorination Over Traditional Methods

Yanjiao (Andrew) Xie and Gang (Gavin) Wang, Thermo Fisher Scientific, Chelmsford, MA

Accurate online measurement of total residual oxidant (TRO) or disinfectant concentration is essential for achieving regulatory compliance and proper water treatment. Current online DPD colorimetric measurement for chlorine or other disinfectants has a few limitations, such as higher detection limit, larger error at low ppb level, interference from turbidity, color, Cu and Mn ions in different water matrixes, drift due to discoloring reagent and intermittent batch measurement. The newly developed TRO analyzer with ion selective electrode (ISE) technology solves these issues with significantly improved detection limit and accuracy using the EPA-approved standard method 4500-Cl I. Comparing with the colorimetric technology, the ISE based...

9:25 AM: Discusser: Mike Aberer, Evergy, Weston, MO

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:10 AM

IWC 19-09: Engineering Copper Films for Industrial Cooling Applications

Paul Frail, Ph.D., Dan Harbs and Eric Zubovic, SUEZ Water Technologies & Solutions, Trevose, PA

Advances in surface science have revealed a deeper understanding of the complex relationship between water quality, chemical treatments and passivation films. Knowledge of these relationships has already allowed the development of metal and organic corrosion control strategies for industrial cooling applications needing to minimize phosphorous contribution. Utilizing a variety of surface analytical techniques (x-ray photoelectron spectroscopy, XPS; Time of Flight Secondary Ion Mass Spectroscopy, ToF-SIMS; Transmission Electron Microscopy, TEM), Engineered Copper Films, or ECF technology, have been developed for yellow metallurgies under elevated chlorides, greater than 1500 ppm and oxidizer, greater than 0.5 residual free chlorine, conditions. ECF inhibitors represent a new...

10:35 AM: Discusser: Jo Anna Ordonez, Solenis LLC, Wilmington, DE

10:45 AM: Author's Closure & Floor Discussion

11:00 AM: Conclusion

Miniscule Materials Matter Most

Monday, Nov. 11; 8:00 – 11:00 AM

Room: Crystal Room

IWC Rep: Ken Dunn, Solenis (Retired), Mashpee, MA

Session Chair: John Van Gehuchten, P.E., McKim & Creed Inc., Sewickley, PA

Discussion Leader: Jack Ma, Eisenmann, Crystal Lake, IL

8:00 AM Session Introduction

Part per million doesn't mean much anymore. This session will look at part per billion and lower level of metals, organic compounds and pathogens. As the water treatment industry advances the smallest of particles are now the most important and critical. These trace contaminant focused presentations cover detection, treatment, best practices and lessons learned.

8:10 AM

IWC 19-10: Monitoring for Over-Reduction of Selenium in Closed Vessel and Passive Bioreactor Treatment Systems

Russ Gerads and Ben Wozniak, Brooks Applied Labs, Bothell, WA

Biological treatment is widely considered the most cost-effective treatment solution to meet strict selenium discharge limits for industrial waste waters. This process generally relies upon anaerobic bacteria that reduce oxidized selenium species (selenate or selenite) to elemental selenium that can then be removed as a solid. However, there are a number of other unintentional selenium species that may be formed and discharged from systems if they are not properly monitored and maintained. Particularly, passive bioreactor systems run the risk of this issue as oftentimes they are designed to have minimal, if any, upkeep or monitoring. This paper will focus, specifically, on "over-reduced" selenium species or selenides (Se2-) that have been observed in effluents that underwent biological treatment and the methods for detecting and quantifying these species in wastewaters. Additionally, this paper will address the considerations that must be made to accurately measure total selenium concentrations when volatile selenides are present.

8:35 AM: Discusser: James Beninati, P.E., HDR, Pittsburgh, PA

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-11: Texas Fish Hatchery uses Ultraviolet Disinfection for Treatment of Toxic Golden Alga

Dennis Bitter, Atlantium Technologies, Sarasota, FL; Ytzhak Rozenberg, Atlantium Technologies, Inc., Israel; Greg Southard, TPWD Inland Fisheries – Analytical Services Laboratory, San Marcos, TX

Fish production at the Texas Parks and Wildlife Department (TPWD) Dundee Fish Hatchery has been adversely affected by massive fish kills involving P. parvum (golden alga/GA). In 2018, TPWD performed a bench scale test using a collimated

beam apparatus to determine effective UV doses to eliminate GA cells/toxicity. Technology trials were followed by a pilot study to evaluate the efficacy of a medium pressure UV technology to manage GA blooms in situ.

9:25 AM: Discusser: Julia Mercer, HDR, Pittsburgh, PA

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:10 AM

IWC 19-12: Industrial Potable Water Treatment – A Case Study of Monitoring and Managing Metal Concentrations to Meet EPA Lead and Copper Rule Compliance

Cristina Piekarz, HDR, Walnut Creek, CA

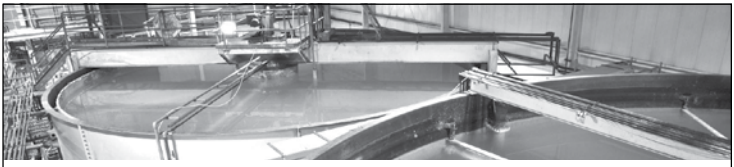
Potable water systems often receive little attention in industrial facilities. Still, all potable water systems are subject to the EPA Lead and Copper Rule. Unfortunately, organizations are unfamiliar with how to navigate through the resolution of lead and copper action limit exceedances if they occur. Along with the immediate need to educate and protect facility personnel with safe drinking water, there are a series of steps or processes that a site must go through to address the elevated metal concentrations and return to compliance in a timely manner.

This paper presents a case study for a large industrial facility in the Midwest. This facility received an action limit exceedance…

10:35 AM: Discusser: Leila Tootchi, P.Eng., Fluor, Calgary, AB, Canada

10:45 AM: Author's Closure & Floor Discussion

11:00 AM: Conclusion



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MONDAY SESSIONS

Keynote Session

Monday, Nov. 11; 11:15 AM – 12:30 PM

Room: International Ballroom Center/North

Session Chair: Ken Dunn, Solenis (Retired), Mashpee, MA

The IWC Keynote Session is the official start to the 2019 conference. In addition to the presentation of the annual awards, including the Annual Award of Merit and the Paul Cohen Award, we are pleased to have Charles Fishman, Author of "The Big Thirst" as our 2019 Keynote Speaker.

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

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 Winner is William Kennedy, P.E. Mr. Kennedy currently works for Stantec and is a frequent participant at the IWC and participates on the IWC Executive Committee.

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 79th Annual IWC. This year, we honor Kevin Brown for his presentation of IWC 18-32: Decreasing Filterable Iron Levels in an Air-cooled Condenser at a Combined Cycle Power Plant.

IWC Travel Scholarship

The IWC, McKim & Creed, Dewberry Engineers and Purolite Corporation donated $500 and a complimentary registration to four students. These students demonstrated interest and commitment to seek a career in the field of water technology. We are proud to present the following with the 2019 IWC Travel Scholarship:

- Helene Kassouf, University of South Florida
- Abhisek Manikonda, University of North Carolina at Charlotte
- Jenny Olmsted, University of Florida
- Alexandra Rubin, University of Florida

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, the IWC is pleased to announce the winners of the 2018 awards.

The First Time Presenter Award Winner is Rebecca Chapman from Frontier Water Systems for the presentation of IWC 18-59: Overcoming Challenges in Biological Treatment of Selenium Containing Wastewaters by Advancements in Bioreactor Design.

The Best Overall Paper Award Winner is Shannon Brown from Monsanto for the presentation of IWC 18-40: Learnings from Phased Installation of a Permeable Reactive Barrier for Mine Water Treatment.

Keynote Presentation

As a reporter, Charles Fishman has tried to get inside organizations, both familiar and secret, and explain how they work. In the course of reporting about water to write The Big Thirst, Fishman has stood at the bottom of a half-million-gallon sewage tank, sampled water directly from the springs in San Pellegrino, Italy, and Poland Spring, Maine, and carried water on his head for 3 km with a group of Indian villagers. Fishman's previous book, the New York Times bestseller The Wal-Mart Effect, was the first to crack open Wal-Mart's wall of secrecy and has become the standard for understanding Wal-Mart's impact on our economy and on how we live. The Economist named it a "book of the year." Fishman is a former metro and national reporter for the Washington Post, and was a reporter and editor at the Orlando Sentinel and the News & Observer in Raleigh, NC. Since 1996, he has worked for the innovative business magazine Fast Company. Fishman has won numerous awards, including three times receiving UCLA's Gerald Loeb Award, the most prestigious award in business journalism. Fishman grew up in Miami, Florida, and went to Harvard. He lives outside Philadelphia with his wife, also a journalist, their two children, their two Labradors, and their two parakeets. He likes his water from the refrigerator spigot, with ice, or splashing across the bow of a Sunfish.

ASME-Sponsored Session: Communicating Lessons Learned from Operating Steam Generating Systems

Monday, Nov. 11; 1:15 – 5:00 PM

Room: International Ballroom North

IWC Rep: Debbie Bloom, Retired, Wheaton, IL

Session Chair: Wayne Bernahl, W. Bernahl Enterprises, Elmhurst, IL

Discussion Leader: George Patrick, SUEZ Water Technologies & Solutions, Trevose, PA

1:15 PM Session Introduction

Industrial steam generating systems have been continuously in use since before any of us were born. Yet, many problems still occur with the operation of steam generating systems which cause unscheduled outages and millions of dollars. Many of these problems are all too common and well known to industry experts but uncommon and not known to those newer to steam system operations. The purpose of this session is to communicate some of these problems to the audience in hopes that they can be avoided and not learned through experience.

1:25 PM

IWC 19-13: Mechanical and Operating Problems with Deaerators

Robert Bartholomew, P.E., Sheppard T. Powell Associates LLC, Baltimore, MD

The paper provides examples of mechanical and operating problems with deaerators contributing to high dissolved oxygen and/or deaerator damage. Examples of mechanical problems presented include water entrainment in deaerator vent, failed baffles, erosion and flow accelerated corrosion (FAC) of deaerator vessel, too loose spray nozzles, too tight spray nozzles, leaking inlet water chamber and failed trays. Detection and correction of the problems requires routine deaerator inspections.

1:50 PM: Discusser: Joshua Perich, Air Products & Chemicals Inc., Allentown, PA

2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 19-14: Steam Drum: A Crucial Factor in Ensuring Proper Boiler Chemistry

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

While the boiler steam drum is often seen as simply a storage vessel where water and steam separation occurs, it is a far more complex part of the overall steam/water cycle. Mechanical and operational problems in the steam drum can have a significant impact on cycle chemistry and, therefore, the rest of the plant. Improper operation, mechanical issues, or lack of routine maintenance can cause poor steam quality, poor boiler water quality and corrosion or deposition of downstream equipment.

This paper will discuss examples of mechanical and operational problems commonly experienced with boiler steam drums and the impacts that these problems can have on cycle chemistry...

2:40 PM: Discusser: HG Sanjay, Bechtel Corporation, Reston, VA

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-15: What Does That Turbine Deposit Mean?

James Bellows, James Bellows and Associates, Maitland, FL

Impurities in steam will deposit on the steam turbine. Turbine deposition was apparent as early as the 1910s. Deposits reduce turbine efficiency and capacity, lead to corrosion, and can cause turbine imbalance. Oxides, silicates and salts are among the common deposits, but free metals can also be found occasionally. A review of turbine impurities reveals the common and uncommon species. Potential sources of these species are suggested. Turbine cleaning is discussed.

3:45 PM: Discusser: Robin Wright, SUEZ Water Technologies & Solutions, Trevose, PA

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-16: Minimizing Steam Generator Corrosion and Fouling (Preventing History from Repeating Itself)

Brad Buecker, ChemTreat, Richmond, VA

During the heyday of coal-fired power plant operation, numerous lessons were learned regarding corrosion and fouling in steam generators. Unfortunately, many of these lessons have not transferred well to personnel operating the heat recovery steam generators (HRSGs) of modern combined-cycle units. As at other industries, many experienced power employees have recently retired or will soon be retiring. With them is going much critical expertise regarding water and steam chemistry. Another contributing factor to the lack of knowledge transfer is that combined-cycle units are often minimally staffed, with few or no trained chemistry personnel. This paper discusses several of the most important issues related to high-pressure steam generation...

4:35 PM: Discusser: Randy Turner, SWAN Analytical USA, Wheeling, IL

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

Digging in the Dirt for Selenium and Sulfate

Monday, Nov. 11; 1:15 – 5:00 PM

Room: Crystal Room

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

Session Chair: John Schubert, P.E., HDR, Sarasota, FL

Discussion Leader: David Weakley II, P.E., CNX, Canonsburg, PA

1:15 PM Session Introduction

The treatment of mining influenced waters has evolved considerably from the days of adding lime and discharging to a pond. Regulators now regularly include in discharge criteria for new mines more parameters requiring higher levels of treatment. The IWC mining session will address some of those parameters, which seem to be becoming more and more prevalent. Sulfate restrictions in many areas are below 1000 mg/L and can be as low as 250 mg/L, the US EPA secondary drinking water standard. In comparison, some mining streams have been observed at over 10,000 mg/L. Precipitation with lime will only decrease the sulfate concentration to at best the saturation level of calcium sulfate, or about 1400 mg/L. Other parameters that are frequently of concern to the mining industry include selenium, a variety of metals, and nitrate nitrogen. Papers in this session describe projects involving sulfate removal, selenium removal, chromate removal and ammonia and nitrate removal. This session should be valuable not only to the mining industry, but for anyone facing treatment issues for metals, sulfate and selenium.

1:25 PM

IWC 19-17: Physio-Biological Removal of Selenium from Mining Impacted Waters

Jonathan Witt, P.E. and Alan Prouty, J.R. Simplot Company, Boise, ID; Jeremy Aulbach, P.E., Brown and Caldwell, Boise, ID

The Smoky Canyon Mine owned by the J.R. Simplot Company constructed the Hoopes Selenium Treatability Study Pilot (Hoopes TSP), which implemented physical and biological treatment to evaluate operational performance of active selenium water treatment from mine-impacted waters. The Smoky Canyon Mine is located within the Idaho Phosphate District, which is rich in sedimentary phosphate ores that are found concurrent with selenium-bearing deposits. Past mining practices have led to elevated levels of selenium in the mine-impacted waters. The physical and biological treatment processes applied include UF, RO, anaerobic biological, and aerobic biological. While these established technologies are routinely applied individually in water treatment, these technologies were applied in an...

1:50 PM: Discusser: Shannon Brown and John Pugh, Bayer U.S. - Crop Science, Creve Coeur, MO; Karen Budgell, P.E., Golder Associates, Inc., Athens, TX

2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 19-18: Removal of Heavy Metals, Ammonia and Nitrates from Mine Water – A Full Scale System

Srikanth Muddasani, Kashi Banerjee and Keith Benson, Veolia Water Technologies, Moon Township, PA

A new mine water treatment facility is currently under construction in northwest part of the USA. The objective of this treatment plant is to meet strict regulatory limitations imposed by the DEP for surface water discharge. The mine water is treated using advanced treatment technology to produce clean water for reuse or discharge. The Paper will describe influent and effluent water qualities, treatment steps and present ion exchange lab study results on heavy metals removal.

2:40 PM: Discusser: Robert Simm, Stantec, Chandler, AZ

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-19: Chromate Removal Performance using a Weak Base Anion Resin to Treat Groundwater at a Texas Remediation Site

Richard Dennis, AdEdge Water Technologies, LLC, Duluth, GA

There is a Texas wastewater remediation site that has been in operation since 2003 treating contaminated groundwater for the removal of toxic chromate. The water source contains oxidized chromium from chrome plating activities during the 1960's & 1970's. Currently, the water contains over 400 micrograms per liter (μg/L) of chromium, most of it present in the toxic Chrome VI form. Total chromium removal to less than 20 μg/L is required before the water can be injected into a nearby array of wells, the primary source of drinking water for the local population. Working with ResinTech, Inc., AdEdge Water Technologies, LLC designed, built and started up a system for...

3:45 PM: Discusser: Harley Schreiber, WesTech Engineering, Inc., Salt Lake City, UT

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-20: Mine Impacted Water Minimization Technology – 3 Years of Development

Alex Drak, Roi Zaken Porat and Tomar Efrat, IDE Technologies, Kadima, Israel; Marco Kerstholt, Royal HaskoningDHV, South Africa; Gerald van Houwelingen, Royal HaskoningDHV, Netherlands

A significant amount of water is used in the mining process, and it is often necessary to treat this water, which is characterized by neutral to low pH and moderate to high total dissolved solids content. Sulfate anions, typically present in this water, are introduced largely as a result of partial oxidation of sulfide-bearing ores (often containing pyrite). Calcium cations are also usually present in water as a result of partial dissolution of dolomitic compounds present in the waste rock. These two ions,

with combined concentration close to the gypsum saturation limit, make the treatment process of mine impacted water relatively challenging....

4:35 PM: Discusser: Holly Johnson Churman, P.E., GHD, Houston, TX

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

Harry Water and the Chamber of Sustainability Secrets

Monday, Nov. 11; 1:15 – 5:00 PM

Room: International Ballroom Center

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

Session Chair: Mel Butcher, Arcadis, Madison, WI

Discussion Leader: Ronald Ruocco, P.E., Civil & Environmental Consultants, Inc., Charlotte, NC

1:15 PM Session Introduction

The sustainability focused session boasts a panoply of topics from technology testing and case study results to a tool for aiding with capital cost justification. Session speakers originate from Research and Development to Water Technology. Regardless of what house the speakers are from, they come to share their magic and how it can help your unique industrial setting.

1:25 PM

IWC 19-21: Minimizing Data Center Water and Wastewater – A Case Study

Daniel Sampson, HDR, Walnut Creek, CA

A data center faced increasing pressure to minimize discharge from both its RO system and adiabatic coolers. The RO removes dissolved solids from raw water, allowing adiabatic coolers to operate at higher cycles. Near-term recommendations provided actions to maximize RO recovery, maximize adiabatic cooler cycles and minimize discharge. Long-term recommendations provided options to allow the recovery all or a portion of the wastewater currently discharged. This case study provides useful information for any facility that uses reverse osmosis and/or adiabatic coolers and which seeks to optimize sustainability by minimizing water usage and wastewater discharge.

A data center located in the Western US faced increasing A data center located in the Western US faced increasing pressure to minimize wastewater discharge from both the reverse osmosis system and the adiabatic coolers. The RO units remove dissolved solids from the facility's raw water, allowing the adiabatic coolers to operate at higher cycles of concentration...

1:50 PM: Discusser: John Van Gehuchten, P.E., McKim & Creed, Sewickley, PA

2:00 PM: Author's Closure & Floor Discussion

2:10 PM

IWC 19-22: Plant Water Profiler: A Tool for Understanding Water Use, Cost and Savings Potential for Manufacturing Plants

Kristina Armstrong, Mini Malhotra, Sachin Nimbalkar and Asha Shibu, Oak Ridge National Laboratory, Oak Ridge, TN; Rochelle Samuel, Saint-Gobain, Malvern, PA

In the 1746 Poor Richard's Almanack, Benjamin Franklin published "When the well's dry, we know the worth of water" (Franklin, 1746); industrial water users have begun to see the truth in these words as they examine the potential and reality of water scarcity becoming a significant business risk. Through the authors' interactions with manufacturers via the U.S. Department of Energy's Better Plants program and Strategic Analysis projects, they realized that manufacturing facilities often do not fully understand the risks to the water supply and the consequential risks to their business. Additionally, they noticed that many facilities do not know how their water is used...

2:40 PM: Discusser: Liza Grudin, P.E., ME, ENV SP., NovelEsolutions, Inc., Seffner, FL

2:50 PM: Author's Closure & Floor Discussion

3:05: Networking Break

3:20 PM

IWC 19-23: Pilot-Testing of a Sustainable Innovative Technology to Treat Emulsified Oil at a Rail Yard Facility

Eric Bergeron, Golder Associates, Inc., Sherbrooke, QC, Canada; Marie-Pier Ross-Pilon, Golder Associates, Inc., Montreal, QC, Canada; Seble Afework, CN, Concord, ON, Canada

Rail yard activities such as gas fueling, equipment cleaning and maintenance generate wastewater impacted by hydrocarbons in free –phase or in emulsion. Prior to discharge, water presenting free phase can easily be treated using gravity oil water separator (OWS). However, mechanically (by pump) or chemically (by soap) emulsified hydrocarbons present in water do not decant and OWS are useless. Most of rail yard wastewater treatment system consist in a dissolved air flotation (DAF) system that precipitate the hydrocarbons using coagulants and polymers. The process involves utilization of chemicals and need less manpower resource for operation and maintenance. Furthermore, the sludge generated contains ferric coagulant...

3:45 PM: Discusser: Chris Hertle, M.Phil, GHD, Irvine, CA

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-24: Breaking the Mold: Direct to Disc for Treating River Water

Bridget Finnegan, EIT, Veolia Water Technologies, Moon Township, PA; Behrang Pakzadeh, Ph.D., P.E., Kiewit, Lenexa, KS; William Blandford, Hydrotech, Vellinge, Sweden

Veolia's Hydrotech Discfilter is being used to treat river water, disrupting the long-standing preference for high-rate sand-

ballasted clarifiers as the first unit of operation. Ultrafiltration membranes and media filters have also been used for river water treatment, especially in less turbid surface waters and disc filtration has the potential to replace them in the market. Because many facilities use surface water as their primary water source, the technology selection for river water treatment affects a wide variety of industries, including power, downstream oil and gas and aquaculture. Direct to Disc is the name of the application where disc filters...

4:35 PM: Discusser: Kristen Cooper, P.E., PMP, Duke Energy, St. Petersburg, FL

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

The Future of Industrial Water Treatment: Efficiency and Innovation Win the Day!

Monday, Nov. 11; 1:15 – 5:00 PM

Room: International Ballroom South

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

Session Chair: Katie Bland, P.E., Burns & McDonnell, Kansas City, MO

Discussion Leader: Chip Westaby, Turner Designs Hydrocarbon Instruments, Kirkwood, MO

1:15 PM Session Introduction

For industrial water treatment, tightening environmental regulations and water scarcity are leading to more innovative solutions for water use. Industrial facilities are looking at more options for treatment and reuse of water and wastewater, which sometimes requires a more creative approach for a cost-effective solution. In this session, we will examine several examples in industrial water treatment that required an evaluation of updated technologies and innovative solutions to make the project successful. These examples fall in various industries and cover cost and feasibility analyses of multiple treatment technologies.

1:25 PM

IWC 19-25: Greenfield Integrated Wastewater Treatment Solution, for Sasol Chemicals Complex, Lake Charles, Louisiana, USA

Anthony Gibson, Sasol LLC, Westlake, LA; Brian Arntsen, SUEZ Water Technologies & Solutions, Oakville, ON, Canada; Richard Ubaldi, SUEZ Water Technologies & Solutions, Richmond, VA

Sasol has expanded their Lake Charles, LA commodity chemicals complex capacity. To support plant operations, SUEZ designed four water treatment systems:

- Raw Water – Sabine River canal water
- Demineralized Water – Make up high purity water
- Condensate Polishing – Treats return steam condensate
- Wastewater – Combines wastewater streams

This paper will present key information related to the treatment

processes, start-up and operation, giving special attention to design recommendations required to achieve consistent treated wastewater quality.

1:50 PM: Discusser: Vina Arjomandnia, Fluor, Sugar Land, TX

2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 19-26: Advanced Wastewater Recycle at an Automotive Plant in Silao, Mexico

Brian Moore, Ph.D., Arcadis, Clifton Park, NY

A major automotive manufacturer manufactures engines, transmissions and full-size trucks at a large manufacturing complex in Silao, Guanajuato, Mexico. The Site employs approximately 6,000 personnel. Additionally, there are approximately 4,000 contracted employees on site in any given day. The site has experienced dramatic growth and is currently under construction to add nearly 3 million square feet of new production facilities.

For all freshwater the Site relies on six groundwater wells, which they must frequently rotate (in/out of service) to obtain the water needed for manufacturing operations. In addition to very high taxes for groundwater extraction, the aquifer levels are declining; the aquifer has been identified as stressed and the region isexpected to have continued growth in population, agriculture and industry (World Bank, 2004). As such, the aquifer cannot provide the additional 30-40% water required following the plant expansion....

2:40 PM: Discusser: Diane Martini, Burns & McDonnell, Chicago, IL

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-27: Leveraging Advances in Industrial Waste Water Treatment: Technology Review and Operating Case

Shannon Brown, Bayer Crop Science, Saint Louis, MO; Elaina Mason, Bayer Crop Science, Muscatine, IA

Keeping infrastructure and processes optimized for changing demands while balancing operational and maintenance costs can be challenging for industrial waste water treatment (WWT) systems. Advances in water treatment processing can be leveraged to improve performance and lower cost. A WWT system from an herbicide production facility, successfully operating since the early 1970s, is used as a basis for discussion. Analysis is conducted regarding potential impact newer water treatment technologies could have on improving this operation.

3:45 PM: Discusser: Bob Wenta, Veolia Water Technologies, Moon Township, PA

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-28: Water Balance & Water Quality for Contact Cooling Water in a Steel Mill

Kyle Vester and Diane Martini, Burns & McDonnell, Chicago, IL

Contact cooling water for hot rolling steel has varying water quality and volume requirements depending on the grade of steel required. A client desired new product lines which require better water quality and faster cooling to achieve the desired steel properties compared to generic stainless steels. Burns & McDonnell performed a water balance and quality study for a North American steel mill to determine if the existing system required upgrades to meet the new water quality and flow rates required by related upgrades to the process.

This paper will discuss the development of a water balance and the analysis of the water quality across the system. The water balance determined the existing system could not reliably provide the required flows and recommended upsizing the process cooling water pumps to meet the new demand. Analysis of the system's water quality revealed higher chlorides than expected based on source water and observed cycling within the system. Further investigation found that softener wastewater was routed into the closed system rather than to an outfall. Rerouting this waste stream to an outfall was recommended over adding a treatment system to the process cooling water system.

4:35 PM: Discusser: Ivan Morales, Integrated Sustainability, Inc., Houston, TX

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

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ASME-Sponsored Session: Preventing and Remediating Damage Caused by Chemical Excursions in Industrial Boiler Water

Tuesday, Nov. 12; 8:00 AM – 12:00 Noon

Room: Crystal Room

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

Session Chair: Vickie Olson, Honeywell Process Solutions, Sandy Springs, GA

Discussion Leader: Kirk Buecher, METTLER TOLEDO Thornton, Inc., Billerica, MA

8:00 AM Session Introduction

Upsets in boiler water cycle chemistry can create the need for extensive repairs and down time for boilers and other areas of the steam cycle. Prevention is critical to avoid this, including setting alarm limits and managing water treatment. Cleaning boilers at the best time after upsets can minimize the damage. The papers in this session cover these issues and include a case study of a chemistry excursion in a high-pressure steam generation system.

8:10 AM

IWC 19-29: Proper Use of Alarm Limits for Steam Cycle Chemistry Control

David Daniels, M&M Engineering, a Division of Acuren Inspection, Inc., Leander, TX

Steam cycle chemistry limits are often developed using a series of three Alarm Levels that increase in severity of actions to be taken. We will discuss the origin of the Action Levels, on what they were based and how to properly use these for both determining when to shut down and startup a power generating boiler.

8:35 AM: Discusser: Larry Hale, METTLER TOLEDO Thornton, Inc., Billerica, MA

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-30: Determination of the Time to Clean Industrial Boilers Based Upon Upset Feedwater Conditions

Edward Beardwood, Beardwood Consulting & Technologies, Inc., London, ON, Canada

The hydrocarbon and chemical processing industries operate a large number of low and medium pressure industrial and waste heat recovery steam generators. They are typically in the 150 to 600 psig range, while some may be as high as 900 psig. For simplicity we will define medium pressure as 600 to 900 psig and low pressure less than 600 psig. As the feedwater impurity concentrations increase and cycled percent recovery of said impurities decrease in the boiler water, the potential for tube metal overheating, resulting in reduced efficiency and eventual metallurgical failure increases. Some failures can be catastrophic, while others result in very costly forced ...

9:25 AM: Discusser: Richard Szilagyi, WesTech Engineering, Inc., Salt Lake City, UT

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-31: Low pH Excursion in 1500 psi Steam Generation System at an Ethylene Plant

Aizaz Ahmed, NOVA Chemicals Corporation, Calgary, AB, Canada; Chris Garton, Nalco Champion, An Ecolab Company, Sarnia, ON, Canada

Water treatment of steam generation system in industry is mainly managed by following available guidelines from ASME or other recognized organizations. However, there is very little information available on managing excursions from the recommended control limits. Operating steam systems outside the recommended control limits pose risk to equipment in steam system as well as to the systems utilizing steam. Under extreme conditions, an excursion may become a safety risk to plant and workers. In absence of well-defined guidelines to deal with excursions, plant operators mostly rely on their understanding of water chemistry and support from water treatment service providers. The understanding and expertise of water...

10:45 AM: Discusser: Michael Bluemle, Ph.D., Solenis LLC, Wilmington, DE

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-32: Analytical Tools to Manage Phosphate and Caustic Treatment

Randy Turner, SWAN Analytical USA, Wheeling, IL

Phosphate and/or caustic (NaOH) treatment boiler water treatment is often employed to reduce the risk of corrosion should a contaminant ingress occur. It is also used as a secondary or backup boiler water chemistry for all-volatile treatment (AVT) for the same reason. Corrosion can result in boiler tube failures, lost revenue due to lost generation and expensive repairs potentially costing utilities millions of dollars. When employing phosphate or caustic treatment the pH control range is the pH from the solid alkali without the pH influence of the amine for feedwater pH control. Therefore, the measured pH must be corrected for the influence of the amine to obtain...

11:35 AM: Discusser: Ken Kuruc, Hach, Loveland, CO

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

Reverse Osmosis: Expanding the Treatment Capabilities of Membranes

Tuesday, Nov. 12; 8:00 AM – 12:00 Noon

Room: International Ballroom North

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

Session Chair: Mitch Mueller, P.E., Black & Veatch, Overland Park, KS

Discussion Leader: Kurt Blohm, Veolia Water Technologies, Pittsburgh, PA

8:00 AM Session Introduction

Since the development of reverse osmosis (RO) membranes, advances in the technology have surpassed limits previously imposed on these applications, expanding its use in the market. Despite these advances, there are still known difficulties and limits to the use of RO membranes. This session will examine ways to overcome some of these known difficulties and limitations to allow a broader range of use for membranes. Papers within this session discuss:

- The optimization of operating conditions and utilization of chemical feeds to control scale and biofouling.
- Evaluating the performance of low-pressure membranes to remove micro pollutants.
- Selection of membrane element components to handle high temperature applications.

8:10 AM

IWC 19-33: The Contrarian Use of Chlorine to Control Biofouling in RO Membranes

Rich Franks, P.E., Alexandra Rubin and Craig Bartels, Ph.D., Hydranautics, Oceanside, CA; Peter Cartwright, P.E., Cartwright Consulting Co., Minneapolis, MN

It is well known that the reverse osmosis membrane's polyamide chemistry is incompatible with chlorine. This limitation of the polyamide chemistry is sometimes referred to as the Achilles Heel of RO membranes. In many RO systems, the absence of a continuous biocide such as chlorine leads to extreme biofouling, rapid performance degradation, frequent cleanings, extended downtime and shortened membrane life. However, regardless of this stated incompatibility, there does exist a low level of tolerance before damage to the molecular structure of the membrane causes a noticeable change in RO performance. This tolerance, which is affected by a number of variables, has gradually increased over the years as the membrane chemistry has evolved. Today's membranes are more highly crosslinked...

8:35 AM: Discusser: Ed Greenwood, P.Eng, BCEE, Wood Environment and Infrastructure Solutions, Cambridge, ON, Canada

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-34: Scale Control in a Boron Rejection System for Seawater Desalination

Caroline Sui, Anna Bandick and Jeff Melzer, SUEZ Water Technologies & Solutions, Trevose, PA; Joan Estilles, SUEZ Water Technologies & Solutions, Gava, Barcelona, Spain

High pH operation in a second-pass reverse osmosis (RO) membrane seawater desalination system for boron rejection is an effective approach to meet World Health Organization (WHO) specifications for drinking water as well as for specific crop requirements for water used for agricultural irrigation. The regulations for drinking water in some countries could be significantly more restrictive than the WHO's specifications. High pH operation, however, results in a high tendency to form mineral scales in the system, such as calcium carbonate and magnesium hydroxide. A large seawater RO (SWRO) desalination plant encountered significant scaling problems in the second pass, brackish water RO (BWRO) system. Frequent cleans in place (CIP)....

9:25 AM: Discusser: Andrew Boehmer, P.E., Black & Veatch, Ann Arbor, MI

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-35: Rejection Performance of Micro-Pollutants by Ultra Low-Pressure Reverse Osmosis membranes

Alan Sharpe, LANXESS Corporation, Birmingham, NJ; Uli Doelchow and Julien Ogier, IAB Ionaustaucher GmbH, Bitterfeld, Germany

This paper investigates the removal of micro-pollutants with an Ultra Low Pressure reverse osmosis membrane. The micro-pollutants studied were hazardous compounds established by the European Union and the EPA, including drugs, herbicides, corrosion inhibitors, contrast agents and a sugar substitute. This paper presents laboratory and pilot work (via German government funded project). The ULP membrane demonstrated a high rejection performance, supporting its intended use for applications in waste water or drinking water treatment.

10:45 AM: Discusser: Bernie Mack, Veolia Water Technologies, Natick, MA

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-36: Innovative Spiral-Wound Membrane Elements for High Temperature Desalination Applications

Elke Peirtsegaele, MICRODYN-NADIR, Goleta, CA

Water desalination has become one of the most important methods of alleviating water shortages and meeting stricter environmental regulations across the world. While spiral-wound reverse osmosis (RO) and nanofiltration (NF) membrane elements have proven very successful in a variety of desalination

applications, more and more applications are emerging that require spiral-wound membrane elements capable of handling high temperatures or extreme cleaning conditions. Because industry-standard RO and NF water elements are limited to a maximum operating temperature of 45°C (113°F), membrane manufacturers are investigating alternative materials to build high temperature elements for applications where standard RO and NF elements cannot be used....

11:35 AM: Discusser: Dileep Agnihotri, Ph.D., Watersurplus, Loves Park, IL

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

Tackling the PFAS Challenge

Tuesday, Nov. 12; 8:00 AM – 12:00 Noon

Room: International Ballroom Center

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

Session Chair: Kristen Jenkins, P.E., GHD, Duluth, GA

Discussion Leader: Tyler Butel, AdEdge Water Technologies, Duluth, GA

8:00 AM Session Introduction

Per- and polyfluoroalkyl substances (PFAS) are a class of over 5,000 synthetic compounds used in a wide variety of consumer products due to their water and stain repellent properties and thermal resistance. PFAS are very stable compounds, which persist in the environment. Increasing public awareness has led to current and proposed regulations, including drinking water and surface water. Please join us at this session to learn about PFAS, including the history of use, current regulatory status, as well as demonstrated and developing treatment technologies.

8:10 AM

IWC 19-37: My Industry Does Not Make or Use PFAS. So What Is It and Why Should I Care? An Overview of PFAS Issues for Non-PFAS Industries

Ryan Ames, P.E., Katie Jones, P.E., Leigh-Ann Dudley, P.E. and L. Alex Wall, EI, Dewberry, Raleigh, NC

Industries that do not utilize PFAS directly in their products or processes may still be affected by the presence of PFAS in other products and the environment and anticipated regulations. Per- and Polyfluoroalkyl Substances (PFAS) is a group of synthetic chemicals that is utilized for a variety of applications in industrial processes and consumer products including vapor control in plating processes, grease resistant coatings on fast food wrappers, water resistant coatings and firefighting foam. The chemical characteristics that make them useful in these applications also make them widespread and persistent in the environment because they can be transported in both air...

8:35 AM: Discusser: James Beninati, P.E., HDR, Pittsburgh, PA

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-38: An Introduction to Per and Polyfluoroalkyl Substances and Treatment

Mike Preston, P.E. and Dustin Mobley, P.E., Black & Veatch, Overland Park, KS

Per- and polyfluoroalkyl substances (PFAS) are a class of chemicals used in the manufacture of many industrial and consumer products, including firefighting foams, water-and oil-resistant coatings, cookware, cosmetics, lubricants, inks and paints. These compounds are very stable and resistant to heat and degradation, making them beneficial for use in industry and in many consumer products. They are also persistent in the environment and bioaccumulative making them a potential health concern.

Production of PFASs started in the 1940's with the invention of Teflon® and Scotchgard®. Today, there are more than 3,000 PFAS used worldwide. Their use has resulted in the pervasion of PFAS in the environment and in humans....

9:25 AM: Discusser: Mike Weatherill, Purolite Corporation, Collingwood, ON Canada

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-39: A Review of Recent Experimental Studies on PFAS Treatment

Francisco J. Barajas-Rodriguez, Ph.D. and Craig Holloway, P.E., AECOM, Austin, TX

Per- and poly fluoroalkyl substances (PFAS) pose health risks to the public which come with long-term exposure. State advisory limits range from 70 parts per trillion (ppt) down to as low as 13 ppt. Since PFAS presence is widespread, treatment of PFAS-impacted water becomes a dominant priority for many industrial entities. PFAS are highly stable due to the strong carbon-fluoride bonds and are highly miscible in water which make their treatment challenging. Therefore, conventional destructive techniques are ineffective and most treatment options rely on specialized separation strategies.

AECOM is currently involved in the development and testing of strategies to treat PFAS impacted water. One approach...

10:45 AM: Discusser: Martin Lawrence, AdEdge Water Technologies, Tampa, FL

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-40: Perfluoridated Alkyl Substances: A Historical Overview

Peter Meyers and Tom Smith, Jr., ResinTech, Inc., West Berlin, NJ

The first fluoropolymers were invented in the 1930's and found wide commercial acceptance as non stick coatings for

cookware. Both PFOA and PFOS were invented shortly thereafter with the first commercial uses being fire retardant foams and water repellents for fabrics. Since then, many other commercial uses have been found for PFAS compounds.

Per- and polyfluoroalkyl compounds, commonly known as PFAS, are a large family of synthetic chemicals that are recognized as emerging contaminants. PFAS are found in a wide range of products we use every day, including fire retardants, water repellents, car waxes and even food packaging. The two most studied and produced compounds are PFOA and PFOS, ...

11:35 AM: Discusser: Krystal Perez, P.E. and Andrew Ryder, Worley, Kirkland, WA

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

We've Got the Power!

Tuesday, Nov. 12; 8:00 AM – 12:00 Noon

Room: International Ballroom South

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

Session Chair: David Riedel, P.E., Arcadis, Philadelphia, PA

Discussion Leader: Bridget Finnegan, EIT, Veolia Water Technologies, Pittsburgh, PA

8:00 AM Session Introduction

In this session we will focus on some of the new(-ish) water and wastewater treatment challenges that the power industry is currently facing. We go beyond the buzz-acronyms of CCR, FGD and ELG to talk about boron, WET testing and others. Come to this session and get energized!

8:10 AM

IWC 19-41: Landscape of Whole Effluent Toxicity Requirements in the Power Industry

Krystal Perez, P.E., Worley, Kirkland, WA; Jeff Thomas, Electric Power Research Institute, Cincinnati, OH; Shaun Roark, Ph.D., Jacobs, Denver, CO; Elizabeth (Ellie) Traudt Middleton, Ph.D., NiPERA Inc., Durham, NC

Whole effluent toxicity requirements are a challenging subject relevant to many facilities' National Pollutant Discharge Elimination System permits. This paper shares the results of a recent literature survey conducted by the Electric Power Research Institute that was focused on capturing key permit information across multiple facilities. This work provides new insights into what the industry is seeing with regards to toxicity-based permit requirements. This paper summarizes key findings related to the extent of toxicity-related permit issues for the power industry.

8:35 AM: Discusser: John Van Gehuchten, P.E., McKim & Creed, Sewickley, PA

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-42: Electricity Dispatch of Thermoelectric Power Generation Under Short-Term Water Consumption Constraints: An ERCOT Case Study

Erik Shuster, National Energy Technology Laboratory, Pittsburgh, PA; Yash Kumar, Aranya Venkatesh, Ph.D., Rachel Hoesly, Ph.D. and Arun Iyengar, Ph.D., KeyLogic Systems, Pittsburgh, PA

LOAD (Linear Optimization and Assessment of Dispatch) model optimizes hourly power generation by minimizing generation costs and constraining water use. In this study, it allowed for analysis of impacts of water stress in ERCOT's operations during the 2018 summer season. Imposition of water constraints in drought-prone Southern Texas indicates fuel switching, electricity price increments, coal plant cycling and localized shifting of generation in the region. The study provides a framework to evaluate potential of NETL's R&D program in water-conserving cooling and treatment technologies.

9:25 AM: Discusser: Katie Bland, P.E., Burns & McDonnell, Kansas City, MO

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-43: Addressing Root Causes of Wastewater Treatment Performance Issues

Thomas Higgins, P.E., Ph.D., Worley, St. Augustine, FL; Tatsuji Ebihara P.E., Ph.D., AECOM, Chicago, IL

Power plant wastewater treatment plants employing conventional mixers have difficulty achieving stringent metals limits due to formation of colloidal particles that pass through clarifiers and granular media filters. Case studies are presented where adjusting pH setpoints, changing to low-shear mixers and pumps and relocating sludge recirculation to the same tank as ferric addition promoted generation of high density solid that improved metals removal performance.

10:45 AM: Discusser: Derek Henderson, P.E., Duke Energy, Raleigh, NC

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-44: Technology and Treatment for Boron Removal

Jeffery Easton, P.E., Ph.D., WesTech Engineering, Inc., Salt Lake City, UT; Dr. John McLennan, Ph.D., University of Utah, Salt Lake City, UT

Low-level boron removal from wastewater is a rising challenge for industry, and an upcoming regulatory pressure for many. Boron is a difficult constituent to remove or treat with traditional methods and processes. It is highly soluble in most forms and presents significant removal difficulty due to its small size and often uncharged nature. Traditional treatment technologies such as precipitation, coagulation, flocculation,

sedimentation, filtration (including membranes) and common ion exchange have little or no effect on boron compounds in low concentration.

This paper presents an overview of existing and new treatment technologies for the removal of boron from wastewater. Specifically-adapted technology is required to make boron...

11:35 AM: Discusser: Ereka Hunt, Kiewit, Lenexa, KS

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

The ELGs are Coming! Really. Treatment Alternatives

Tuesday, Nov. 12; 1:15 – 5:00 PM

Room: International Ballroom North

IWC Rep: Tisha Scroggin-Wicker, P.E., Burns & McDonnell, Chicago, IL

Session Chair: Thomas Higgins, P.E., Ph.D., Worley, St. Augustine, FL

Discussion Leader: Lanny Weimer, SUEZ Water Technologies & Solutions, Ormond Beach, FL

1:15 PM Session Introduction

The original ELGs were based on biological treatment for FGD wastewater and physical and chemical treatment for low volume wastes. Our first presenter as a first adopter of FGD biological treatment will share the tricks they developed to make this technology work. Reliable operation depends on monitoring wastewater composition in real time. Our next paper presents results of evaluation of real time monitoring equipment. Specific FGD wastewater characteristics or local limits can make biological treatment undesirable. ZLD is sometime selected for reliable compliance, although it can be expensive. Our next paper presents experience with membrane systems for brine concentration, making thermal evaporation feasible. Our final paper presents laboratory and conceptual design studies for treating coal pile runoff to achieve low volume wastewater effluent limits.

1:25 PM

IWC 19-45: Utility Experience on Commissioning and Operating FGD WWT

Derek Henderson, P.E., Duke Energy, Raleigh, NC; Jared Troyer, P.E. and Ray Lidke, Duke Energy, Charlotte, NC; William Kennedy, P.E., Stantec, Charlotte, NC

New flue gas desulfurization wastewater treatment (FGD WWT) systems are being installed at coal generating facilities to facilitate compliance with the Steam Electric Power Generating Effluent Limitation Guidelines (ELGs) and local National Pollutant Discharge Elimination System (NPDES) permits. These systems are comprised of multiple treatment units that provide primary,

secondary and tertiary treatment. A utility's experience in commissioning and operating these new FGD WWT systems.

1:50 PM: Discusser: Nelson Fonseca, SUEZ Water Technologies & Solutions, Oakville, ON Canada

2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 19-46: Near Real-Time Detection of Mercury and Selenium in FGD Wastewaters for Process Control

Cassandra Hutson and Craig Katkic, AECOM, Austin, TX; Naomi Goodman, EPRI, Palo Alto, CA

Some coal-fired power plants have wastewater treatment (WWT) systems to reduce the concentrations of mercury, selenium and other analytes in their flue gas desulfurization (FGD) wastewater. WWT system operators would benefit from the ability to monitor concentrations of these analytes on site and in near real-time to troubleshoot the FGD system and/or treatment processes before compliance issues arise. This paper presents results from laboratory and field evaluations of several online monitors and benchtop analyzers.

2:40 PM: Discusser: Robert Simm, Stantec, Chandler, AZ

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-47: Vortex-Assisted Nanofiltration and Reverse Osmosis for FGD Wastewater Meets and Exceeds 2015 Effluent Limitation Guidelines to Produce Reuse-Quality Effluent: Operational Findings for Maximizing Flux and Minimizing Scaling

Jonathan Liberzon, Jonathan Chen and Tzu Lung Lin, BKT, Anaheim, CA

The EPA's 2015 effluent limitation guidelines (2015 ELG) mandate treatment of flue gas desulphurization wastewater (FGD-WW) to meet selenium (Se), arsenic (As), mercury (Hg) and nitrate/nitrite (NOx) limits prior to discharge. While conventional physical/chemical and biological treatment systems may succeed in meeting discharge requirements, reuse of this effluent remains difficult due to high total dissolved solids (TDS) and corrosivity. FGD-WW also contains concentrated scale-forming compounds (mainly sulfates with various divalent metals), which cause severe membrane fouling. A novel anti-fouling membrane system (AFMS), which uses rotating, vortex-generating blades, was previously tested in the treatment of FGD-WW (Liberzon et al., IWC 2018). This system was used to batch...

3:45 PM: Discusser: David Pernitsky, Stantec, Calgary, AB, Canada

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-48: Coal Pile Runoff: A Management and Treatment Case Study to Find a Resourceful Solution

Chloe Grabowski, HDR, Missoula, MT; Chad McKnight and Chandler Shelton, Southern Company, Birmingham, AL

This paper will present a case study of a project at a large coal fired power plant in North America. The plant's coal pile runoff flows to a coal pile runoff pond and is pumped to their ash surface impoundments for treatment via settling prior to discharge. Upon closure of their impoundments, treatment of the coal pile runoff will be required to meet the plant's NPDES limits. This paper will discuss the alternatives evaluated which focused on two goals: minimize suspended solids entering the coal pile runoff pond through storm water management techniques and modify the existing coal pile runoff pond to facilitate removal...

4:35 PM: Discusser: John Peichel, SUEZ Water Technologies & Solutions, Minnetonka, MN

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

Concentrate Management

Tuesday, Nov. 12; 1:15 – 5:00 PM

Room: Crystal Room

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

Session Chair: Wayne Bates, Hydranautics, Rockton, IL

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

1:15 PM Session Introduction

MLD and ZLD systems are becoming more popular as the industry is being asked to maximize water recovery and minimize the volume of liquid concentrate (brine) that requires disposal. This session reviews current concentrate disposal methods with an emphasis on the use of membrane technologies upstream of evaporators/crystallizers. We consider these processes to be MLD (Minimum Liquid Discharge) since recoveries can be limited to 90-97% of the feed and not 100% as expected for a ZLD process.

1:25 PM

IWC 19-49: Brine Management: A Review of Options and Technologies

John Korpiel, P.E. and Kurt Blohm, Veolia Water Technologies, Moon Township, PA; Corey Skadahl, Veolia Water Technologies, Plainfield, IL

The brine byproduct from an industrial desalination process typically has high salinity, high scaling/fouling potential, is highly corrosive, and contains concentrated chemical contaminants. As a result, brine can be harmful to the environment, especially aquatic life, if not properly treated and disposed. This paper

reviews the options and technologies available for brine management, including surface water discharge, deep well injection, land application, beneficial reuse, evaporation ponds, and treatment via membrane-based and thermal technologies for minimization or zero liquid discharge.

2:05 PM: Floor Discussion

2:15 PM

IWC 19-50: Achieving Minimal Liquid Discharge (MLD) with Advanced Membrane Systems for Maximized Volume Reduction: 5X, 20X, 40X and 70X!

Malcolm Man, Benjamin Sparrow and Anisa Maruschak and Geer Qile, Saltworks Technologies Inc., Richmond, BC, Canada

This paper presents novel options, pilot test results and economics for water plant designers. Readers will learn how to concentrate brines to 130,000 mg/L total dissolved solids (TDS) with reverse osmosis membrane technology while avoiding scaling and fouling. The work is intended to inform on the widening use of membrane-based brine concentration systems in order to offset more expensive evaporative or disposal methods. Pilot results are presented for a real industrial project on scale saturated cooling tower blowdown brine at 1,800 mg/L TDS. The authors pilot tested ways to achieve multiple volume reduction factors (recovery): 5X (80%), 10X (90%), 20X (95%)...

2:40 PM: Discusser: Brandon Yallaly, P.E., Carollo Engineers, Inc., Boise, ID

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-51: Overcoming the Challenges of Concentrate Recovery Using Autonomous, Data-Driven RO

Michael Boyd, Desalitech, Newton, MA; Han Gu, Ph.D. and Megan Plumlee, Ph.D, P.E., Orange County Water District, Fountain Valley, CA; Jim Lozier, P.E., Jacobs, Tempe, AZ; Michael Hwang, P.E., Jacobs, Irvine, CA; Ran Nadav, P.E., Desalitech, Kefar-Sava, Israel

In Southern California, there are two traditional sources of potable water: imported surface water and local groundwater. These supplies are finite and in some cases over allocated (Colorado River) or over-drafted (Tulare Basin), so additional water must be obtained from non-traditional sources including wastewater effluent and seawater. Seawater is attractive because it is plentiful; however is both capital and energy intensive to desalinate to potable quality and has perceived environmental challenges associated with its abstraction and the discharge of brine produced as a byproduct of the desalination process. In contrast, the treatment and purification of municipal wastewater, either through indirect or direct potable reuse, represents...

3:45 PM: Discusser: Jason Bailey, Avista Technologies, Inc., Winston-Salem, NC

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-52: Pressure Retarded Osmosis: A Potential Technology for Desalination Energy Recovery and Concentrate Management

Joshua Benjamin, Qiong Zhang and Mauricio Arias, University of South Florida, Tampa, FL

Reverse osmosis (RO) is a treatment process widely implemented in desalination and advanced water reclamation facilities. Currently, a significant challenge with RO is reducing the energy consumption of the process and the potential environmental impacts from brine disposal. Elevated levels of energy consumption cause RO product water to be much more expensive than other conventional water sources and can prevent implementation of this crucial technology in areas under severe water stress. Pressure retarded osmosis (PRO) has been suggested as a potential technology to mitigate these issues. PRO works by extracting usable energy from the high osmotic pressure difference that exists when a highly concentrated...

4:35 PM: Discusser: Tony Fuhrman, LG Water Solutions, Torrance, CA

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

Water Projects: Overcoming the Hurdles

Tuesday, Nov. 12; 1:15 – 5:00 PM

Room: International Ballroom Center

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

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

Discussion Leader: Sam Fackrell, Bowen Engineering Corporation, Glen Burnie, MD

1:15 PM Session Introduction

Water projects have different hurdles depending upon the design, procurement and construction phases. These hurdles can pertain to unique treatment challenges, defining the roles and responsibilities of the project teams and the need to conform to moving environmental and business constraints. This session covers how different methods and procedures can be used for the successful delivery of water treatment projects.

1:25 PM

IWC 19-53: Treatment of Aerospace Machining and Inspection Wastewater

Chris Stanfill, P.E., Arcadis, Atlanta, GA; Michael Soller, P.E., CPC, DBIA, Bowen Engineering Corporation, Indianapolis, IN

Aerospace wastewater generated by machining and inspection presents unique treatment challenges. The wastewater can contain a blend of machining oil, dissolved and particulate metals, surfactants and fluorescent penetrant inspection (FPI) emulsifier and developer. The combination of the machining

and inspection water tends to emulsify the oils in the wastewater, making them difficult to remove. Additionally, the oils can hinder the metals removal processes. Further, the FPI materials often require a thorough material compatibility review for process piping and equipment due to their negative life cycle impacts on certain pipe types. Depending on the other processes performed at the facility, the wastewater may also have to meet federal...

1:50 PM: Discusser: Mark Owens, P.E., SUEZ Water Technologies & Solutions, Richmond, VA

2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 19-54: Secrets to a Successful Implementation of a Water Treatment Project

Dennis McBride, Burns & McDonnell, Kansas City, MO

There really are no "secrets" to a successful implementation of a water treatment project. The success may be boiled down to primarily good teamwork amongst all the parties involved with a joint understanding of the basis of the design decisions. Also, information provided to support the design should be accurate, reliable and cover as many of the variations as possible.

2:40 PM: Discusser: Brian Stater, Bowen Engineering Corporation, Indianapolis, IN

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-55: Water Management and Efficiency Study for Automotive Manufacturing Complex in a Water-Stressed Region

Brian Moore, Ph.D., Arcadis, Clifton Park, NY

The Saltillo South Complex in Saltillo, Coahuila, Mexico comprises one of the larger manufacturing centers for a large automobile manufacturer, including two assembly plants and an engine plant. The three plants share water resources and are supplied by four existing groundwater wells that draw from the local aquifer. The Coahuila region is home to a high density of manufacturing operations and is highly water stressed. Furthermore, production capacity at the complex is projected to increase in the future, which would push water demand close to or in excess of the complex's authorized allocation.

The objectives of the project were to assess water usage...

3:45 PM: Discusser: Ron Ruocco, P.E., Civil & Environmental Consultants, Inc., Charlotte, NC

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-56: Cogeneration – Opportunities to Improve Heat Recovery and Power Generation while Saving Water and Reducing Chemical Costs

Diane Martini and Robert Wright, Burns & McDonnell, Chicago, IL

Co-generation of heat and power is not a new concept, but as technology advances there can be real benefits to upgrading existing co-generation facilities. In many cases, projects that were not considered cost-effective in the past may become viable in areas where utility electricity prices have increased or existing equipment deteriorates. In other cases, off gases from industrial processes, landfill gas, or digester gas can be harnessed via Reciprocating Engines or Combustion Turbines (CTs) combined with Heat Recovery Steam Generators (HRSGs) to generate both heat and power.

Existing co-generation facilities can see real improvements in output and efficiency, with reductions in consumables use...

4:35 PM: Discusser: Daniel Sampson, HDR, Walnut Creek, CA

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion

The Many Faces of Industrial Wastewater Treatment

Tuesday, Nov. 12; 1:15 – 5:00 PM

Room: International Ballroom South

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

Session Chair: Mike Preston, Black & Veatch, Overland Park, KS

Discussion Leader: Ed Greenwood, P.Eng., BCEE, Wood Environment and Infrastructure Solutions, Cambridge, ON, Canada

1:15 PM Session Introduction

One of the exciting aspects of industrial wastewater treatment is that there are an endless variety of challenges to keep one engaged and learning. In our session, we have four papers representing four different challenges and multiple industries. Everything from metals reduction to high strength biological challenges, from refining, to mining, to pharmaceuticals and from physical treatment to biological treatment. It will be an interesting session that represent a good sampling of the issues encountered in industry and will, no doubt, keep you engaged.

1:25 PM

IWC 19-57: How Hot is Too Hot? Reviewing the Treatment Performance of Refinery WWTP Biological Treatment Systems Operating at High Temperatures

Mark Knight and Nicolas Hameon-Denis, SUEZ Water Technologies & Solutions, Oakville, ON, Canada; Shane Lund, SUEZ Water Technologies & Solutions, Trevose, PA; Jordan Schmidt, Brad McIlwain and Shawn Watkins, LuminUltra Technologies Ltd., Fredericton, NB, Canada

This study reviews the treatment performance and microbial ecology of two North American refinery WWTP biological treatment systems which continuously operate between 38°C to 52°C. Results from both refinery WWTP's show that biological treatment systems can effectively remove organic compounds and nitrify ammonia above 35°C which can provide certain advantages when optimizing an industrial WWTP, upgrading upstream processes or building a new green field plant.

1:50 PM: Discusser: Ivan X Zhu, Ph.D., Evoqua Water Technologies, Pittsburgh, PA

2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 19-58: New Water Treatment Technology Targets High-Strength and Toxic Wastewaters-While Producing Methane for Fuel

Bryan Kumfer and Chad Felch, Siemens Water Solutions, Rothschild, WI

Many industries use complex production processes that result in high-strength, hard-to-treat wastewaters. Examples include oil and gas refining, petrochemicals and pharmaceuticals. Their wastewaters may vary in composition, but they typically have at least one of these problematic characteristics: high levels of biorefractory compounds; toxic compounds; halogenated organics; and aromatic or aliphatic hydrocarbons.

In addition, their chemical oxygen demand (COD) levels can range widely and up to 300,000 mg/l. On top of that, some process waters/wastewaters have high salt levels, especially chlorides, requiring expensive materials of construction, making cost-effective treatment especially challenging.

Existing treatment solutions for these high-salt wastewater streams are typically incineration or gasification. The former...

2:40 PM: Discusser: Chris Hertle, M.Phil, GHD, Irvine, CA

2:50 PM: Author's Closure & Floor Discussion

3:05 PM: Networking Break

3:20 PM

IWC 19-59: Zinc – Boiling Down the Options

Christopher Huth, P.E., Pittsburgh, PA

Zinc, often overlooked as an inconsequential component of industrial wastewater, can cause serious environmental implications at high concentrations. High concentrations can

occur during upset conditions that are typically not considered during normal design and therefore not included in the wastewater treatment system design. Although many viable options regarding removal of dissolved zinc exist, this paper will assess technologies currently being used or evaluated for use in the industry including sorbents, chemical precipitation, ultrafiltration, membrane filtration and biological methods.

3:45 PM: Discusser: Joe Guida, P.E., Fluor, Houston, TX

3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 19-60: Evaluation of Alternate Process Chemistries for Removal of Arsenic and Fluoride from Industrial

Ryan Ames, P.E., Dewberry, Raleigh, NC

Arsenic and fluoride contamination can be byproducts of phosphorus mining and processing operations. A former mining and processing facility currently treats between 300 and 400 million gallons of wastewater for arsenic and fluoride annually. Wastewater is treated with a single lime system with addition of ferric chloride for coagulation and carbon dioxide for final pH adjustment. However the lime and carbon dioxide systems are complex and labor intensive. The facility was interested in identifying opportunities to optimize or modify the current process to reduce operating costs. Arsenic must be converted to arsenate prior to precipitation. This can be accomplished by adjusting pH or changing the redox potential. A series of tests were conducted to evaluate process chemistries utilizing an oxidizer in combination with various coagulants for arsenic removal. Utilizing an oxidizer to create arsenate meant that lime and subsequently carbon dioxide, could be eliminated from the existing process. However eliminating lime also eliminates the

4:35 PM: Discusser: Paul Pigeon, P.E., Golder Associates, Inc., Lakewood, CO

4:45 PM: Author's Closure & Floor Discussion

5:00 PM: Conclusion


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Making Produced Water Sustainable

Wednesday, Nov. 13; 8:00 AM – 12:00 Noon

Room: International Ballroom North

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

Session Chair: Melonie Myszczyszyn, P.Eng., PMP, Canadian Natural Resources Limited, Calgary, AB, Canada

Discussion Leader: Chris Graham, Chris Graham Consulting Inc., Calgary, AB, Canada

8:00 AM Session Introduction

The session includes papers on adapting existing technologies to the enhanced oil recovery methods in Alberta, Canada and California, USA; focused on reducing emissions and footprint, recycling produced water for agricultural purposes, while improving the projects capital and operational costs. Also, included are hands-on experience dealing with Silica and Tri-Ethylene Glycol in the boiler feedwater for the Steam Assisted Gravity Drainage (SAGD) process in Alberta, Canada.

8:10 AM

IWC 19-61: High Temperature Reverse Osmosis Membrane SAGD Process Design Assessment

Basil Perdicakis, Ph.D., P.Eng. and Mick McGregor, P.Eng., Suncor Energy, Calgary, AB, Canada; Matthew Petersen, Ph.D., Arcadis, Highlands Ranch, CO; Anthony J. (A.J.) Gerbino, Ph.D., OLI Systems, Cedar Knolls, NJ

Implementing high temperature reverse osmosis (HTRO) in SAGD operations in Northern Alberta confers potential multiple benefits including lower GHG emissions, costs, and plant footprint. In this project, process simulations of SAGD CPFs were developed using a combination of Aspen Plus®, Aspen HYSYS®, and OLI Flowsheet: ESP to evaluate overall plant performance. Results from this process modeling work is critical for commercial design of membrane systems, overall understanding of capital and operating costs, and determining environmental implications of incorporating the technology into a SAGD CPF.

8:35 AM: Discusser: Najib Jomaa, P.Eng., CNOOC International, Fort McMurray, AB, Canada

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-62: Successful Field Demonstration of Produced Water Treatment Using Elevated pH Reverse Osmosis Technology at an Oilfield in California

John Korpiel, P.E. and Mark Hess, Veolia Water Technologies, Moon Township, PA; Oscar Velastegui, Veolia Water Technologies, Brea, CA

A successful field demonstration was conducted to validate the treatment of produced water at a steam flood oilfield in California using elevated pH reverse osmosis technology with optimized pretreatment. The treatment process consisted of degasification, warm lime softening, lamella settling, ceramic

ultrafiltration, process cooling, weak acid cation exchange softening and elevated pH double pass reverse osmosis. The paper discusses the results of the field demonstration, the challenges faced, process optimizations implemented and lessons learned.

9:25 AM: Discusser: Rasika Nimkar and Dr. AJ Gerbino, OLI Systems, Inc., Cedar Knolls, NJ

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-63: Addressing the Omnipresent Silica Scale in SAGD Operations

René Bélanger, P.Eng., Baker Hughes Company, Edmonton, AB, Canada; Colin Johnson, P.Eng., MBA and Glen MacInnis, M.Sc., P.Chem, Baker Hughes Company, Calgary, AB, Canada; Ross Carruthers, P.Eng., MBA and Kyle Campbell, P.Eng., Suncor Energy, Fort McMurray, AB, Canada

Past IWC papers discussed silica scale control in OTSG but the omnipresence of silicate ions creates scaling concerns in other equipment like heat exchangers, evaporators and electrical submersible pumps. This paper considers an innovative dispersant for addressing silica scaling in SAGD from the reservoir to water disposal. A case study covering a successful application on heat exchangers and on-going activities on ESP and evaporators with tangible operational benefits are included in this paper.

10:45 AM: Discusser: Corbin Ralph, Ph.D., Nalco Champion, Cold Lake, AB, Canada

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-64: Life Cycle of Produced Water in the Eagle Ford Shale

Nicole Bartoletta and Russ Huffmyer, McKim & Creed, Sewickley, PA; Andy Simon and Taylor Mitchell, Pilot Water Solutions, Baton Rouge, LA

The treatment and disposal of flowback and produced water is a challenge in the upstream sector of the oil and gas industry that continuously needs to be addressed. The fate of produced water from an unconventionally drilled well depends largely on the quality of the water and the geology of the drilling location. As recycling and reuse of produced water becomes increasingly feasible in the oil and gas industry, this adds more pressure to utilize more advanced treatment methods and to increase the finished quality of the water. There are numerous methods of produced water treatment for recycling or disposal depending on the anticipated outcome and the water's level of ...

11:35 AM: Discusser: Chip Westaby, Turner Designs Hydrocarbon Instruments, Fresno, CA

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

The Membrane Future is Now

Wednesday, Nov. 13; 8:00 AM – 12:00 Noon

Room: International Ballroom Center

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

Session Chair: Lyndsey Wiles, MICRODYN-NADIR, Goleta, CA

Discussion Leader: Jane Kucera, Nalco Water, an Ecolab Company, Naperville, IL

8:00 AM Session Introduction

After reverse osmosis (RO) membranes were commercialized in the 1960s, they remained a specialty product for decades. Now, most RO products are widely considered commodities, and the membrane industry has pushed to develop further membrane technologies far beyond standard RO desalination membranes. This session explores futuristic membrane technologies and applications, including a presentation on a new way to dechlorinate water prior to RO and another on how membrane manufacturers are tackling contaminants of emerging concern (CECs). Additional topics include comparing surface water and city water for the raw feed water to multiple membrane systems and a presentation discussing a new technology: carbon nanotube immobilized membranes. Overall, this session will give the audience a good understanding of the direction of the membrane industry from both an application and a technology perspective.

8:10 AM

IWC 19-65: Membrane Performance Following Five Years of Continuous Use of a Non-Chemical Dechlorination Technology at Plant Bowen

Dennis Bitter, Atlantium Technologies, Sarasota, FL; Ytzhak Rozenberg, Atlantium Technologies, Israel; Aaron Nickles, Southern Company- Plant Bowen, Cartersville, GA

Since 2014, the medium pressure Hydro-Optic™ (HOD) ultraviolet (UV) water treatment technology has provided a 3,160 megawatt coal-fired power station with non-chemical dechlorination of reverse osmosis (RO) feed water. The technology has helped the facility to substantially minimize the use of sodium metabisulfite (SMBS) and reduce maintenance and associated costs; as well as extend RO membrane life and minimize micron filter replacement.

8:35 AM: Discusser: Phillip Locke, P.E., McKim & Creed, Clearwater, FL

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-66: Planning/Design Considerations for RO Based Boiler Make-up Water Treatment System Using River Water Source

Theping Chen, P.E., Veolia North America, Solon, OH

Three case studies of upgrading the boiler make-up water treatment plant to RO based technology and using river water as source water are discussed. These projects show the operation, water quality and financial benefits of upgrading from softener and ion-exchange based demineralization system to the RO based treatment system, as well as converting the municipal water to river water source. System performance, cost savings, and experience learned for future planning/design and implementation on similar projects are also discussed.

9:25 AM: Discusser: Anne Arza, Culligan, Libertyville, IL

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-67: Enhanced Desalination via Membrane Distillation using Carbon Nanotube Immobilized Membranes

Somenath Mitra and Sagar Roy, New Jersey Institute of Technology, Newark, NJ

This paper presents the enhanced membrane distillation for desalination with carbon nanotube immobilized membrane (CNIM). The incorporation of carbon nanotubes (CNTs) on the membrane surface favorably influence the water vapor permeability by altering the water-membrane interactions, while repelling the liquid salt-water mixture. The CNIM led to an enhancement of water vapor flux as high as 77% at a salt concentration of 200K ppm.

10:45 AM: Discusser: Sailesh Singh, P.Eng., Golder Associates, Inc., Calgary, AB, Canada

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-68: RO Membrane Permeability, Power Consumption and CEC Rejection

Alan Sharpe and Christopher Tippett, LANXESS Corporation, Birmingham, NJ

The main cost in operation of an RO system is power consumption. This paper looks at membrane permeability to quantify reduced power consumption (and higher permeate salinity) using lower pressure membranes. The paper will also present the rejection of CECs – contaminants of emerging concern – using these more permeable ultra-low-pressure membranes, including a laboratory and a pilot scale evaluation on actual effluent at a conventional sewage treatment plant in Nordenham, Germany.

11:35 AM: Discusser: Nik Mehta, MICRODYN-NADIR, Goleta, CA

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

PFAS Treatment Options and Strategies

Wednesday, Nov. 13; 8:00 AM – 12:00 Noon

Room: Crystal Rooom

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

Session Chair: Peter Meyers, ResinTech, Berlin, NJ

Discussion Leader: Dale Wynkoop, ECT2, Dublin, OH

8:00 AM Session Introduction

This session on Perfluoridated Alkyl Substances (PFAS) features four papers that cover the current strategies for addressing the presence of PFAS in water. Session hi-lights include PFAS origins, fate and transport, the range of wastewater and water matrices where PFAS contamination occurs, a discussion of regulatory issues and evolving effluent limits, current removal methods such as granular carbon and ion exchange and a preview of possible new treatment technologies such as oxidation or reduction and potential new sorbent medias.

8:10 AM

IWC 19-69: PFAS Water Treatment Considerations and Technologies

Ryan Schipper, P.E., Golder Associates, Inc., Ft. Wayne, IN; Paul Pigeon, P.E., Golder Associates, Inc., Lakewood, CO; Stefano Marconetto, P.Eng., Golder Associates, Inc., Ottawa, ON, Canada

This paper provides an overview of Per- and Polyfluoroalkyl Substances (PFAS), including a brief discussion on the regulatory drivers, environmental investigation and source analysis, with the main focus being an overview of current and developing treatment technologies. The paper includes an analysis of the applicability and limitations of the technologies in terms of level of development/deployment for various water/wastewater types, including groundwater, drinking water, wastewater and landfill leachate.

8:35 AM: Discusser: AnnieLu DeWitt, Clean Harbors, Portland, ME

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-70: Alternative Treatment Evaluation for PFAS

Kristen Jenkins, P.E., GHD, Duluth, GA; Beth Landale, P.E., GHD, Farmington Hills, MI; Grant Trigger, B.Eng., JD, RACER Trust, Detroit, MI

Regulatory attention on PFAS resulted in the discovery of PFOS above the Michigan water quality standard in a recovered groundwater from a former manufacturing site. Alternative treatment technologies were identified. Developing technologies were considered, since both activated carbon and ion exchange result in a PFAS-containing residual which must either be

incinerated or requires careful management in a landfill. A summary of bench testing conducted to date and treatment alternatives evaluation will be discussed.

9:25 AM: Discusser: Eric Klinker, Ph.D., DuPont Water Solutions, Edina, MN

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-71: Water Treatment Technologies for PFAS: Current and Next Generations

Corey Theriault, P.E. and Jeff McDonough, P.E., Arcadis, Portland, ME

The use of conventional sorbents such as granular activated carbon and anion exchange resins to address PFAS in water has become a "de facto" interim measure in response to immediate needs for PFAS removal from drinking water. GAC has nominal effectiveness on short chain PFAAs, and both GAC and AIX are relatively unproven against polyfluorinated compounds. Additionally, both GAC and AIX may struggle to handle geochemical and/or co-contaminant competition. Challenges of more comprehensive PFAS treatment and geochemical/co-contaminant competition in water treatment may be addressed using technologies such as reverse osmosis or nanofiltration; however, for larger flow systems RO/NF may have unacceptable reject ratios and the capital cost may preclude...

10:45 AM: Discusser: Thomas Mallmann, Evoqua Water Technologies, Rockford, IL

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-72: Strategies for Addressing Emerging Per- and Poly-Fluoroalkyl Substances (PFAS)

Peter D'Adamo, P.E., Ph.D., HDR, Vienna, VA

Per- and poly-fluoroalkyl substances (PFAS) have been produced since the late 1940s and are used in industrial and consumer applications (e.g. cosmetics, fire-fighting foams, food contact materials, household products, textiles, leather and apparel). Perfluoroalkyl carboxylic acid (PFCA) and perfluoroalkane sulfonic acid (PFSA) are two long-chain, sub-classes of PFASs. Examples of individual compounds that are categorized within PFCAs and PFSAs are the widely studied perfluorooctanesulfonate (PFOS) and perfluorooctanoic acid (PFOA) compounds, respectively. These legacy compounds are known to have toxic effects and are persistent in the environment. As a result, the Environmental Protection Agency (EPA) developed lifetime health advisories of 70 ng/L for both PFOS and PFOA...

11:35 AM: Discusser: Bernie Mack, Veolia Water Technologies, Natick, MA

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

Reuse for Resource – Getting More from your Precious Water Assets

Wednesday, Nov. 13; 8:00 AM – 12:00 Noon

Room: International Ballroom South

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

Session Chair: Jeffery Easton, P.E., Ph.D., WesTech Engineering, Inc., Salt Lake City, UT

Discussion Leader: Craig Mills, Aquen USA, Salt Lake City, UT

8:00 AM Session Introduction

The importance of recycle and reuse is growing every day. The availability of clean water sources is a major hurdle for growth. Closing our water cycles, reusing and renewing wastewater provides clean water resources and reduces disposal waste impact. In this session we will hear case studies of real applications of innovative methods for water reuse in industrial and municipal settings.

8:10 AM

IWC 19-73: Monovalent Cation Selective Electro Dialysis Ion Exchange Membrane

Simon Dukes, Benjamin Satterfield and George Gu, Ph.D., Evoqua Water Technologies, Lowell, MA

As the pressure on scarce water resources increases it becomes essential that we are able to use all available water in the most economical and effective way. This puts an emphasis on water that is not treatable economically by conventional means.

One area of interest is brine minimization, however scaling potential limits the potential recovery of this water, even when the limiting species for discharge is calcium or silica.

One potential process is electrodialysis with monovalent selective membranes. ED is noted for not concentrating silica and with monovalent cation selective membrane would allow the monovalent cations, primarily sodium, to be selectively concentrate without the danger of scaling, permitting ...

8:35 AM: Discusser: Donald Downey, Purolite Corporation, Paris, ON, Canada

8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 19-74: Design Complications Related to Water Recycle and Reuse in Combined Cycle Power Plants

Behrang Pakzadeh, P.E., Ph.D., Caroline Wilson, EIT and Brian Clarke, P.E., Kiewit Engineering Group, Inc., Lenexa, KS; Jason Mitchell, P.E. and Travis Brown, U.S. Water, St. Michael, MN

Water consumption can be reduced within power plants not only by selecting air cooled condensers over cooling towers, but also through the use of recycling waste streams such as evaporative cooler blowdown and quenched HRSG blowdown. In cases where water availability or discharge is more severely

restricted, internal recycling can be further enhanced through the use of wastewater treatment systems. This internal recycling can be complicated by issues related to membrane design temperatures and chemical constituent accumulation in recycled water. This paper presents operational challenges and lessons learned during startup of a new combined cycle power plant that featured systems which were designed to maximize water recycle.

9:25 AM: Discusser: Donald Thomas, SUEZ Water Technologies & Solutions, Salt Lake City, UT

9:35 AM: Author's Closure & Floor Discussion

9:50 AM: Networking Break

10:20 AM

IWC 19-75: Qualification of UF-RO for Potable Reuse

Steven Notch, Wigen Water Technologies, Minneapolis, MN; Anna Ness, CDM Smith, Jacksonville, FL; Ryan Popko, P.E., JEA, Jacksonville, FL

The interest in potable reuse technologies has been growing in recent years as the demand for potable water supplies approaches the sustainable limit. Given the projected future challenges in meeting a growing customer demand, a utility in Florida has taken a proactive approach to diversifying their water supply. The utility has launched a planned, three-phased program to investigate advanced water purification technologies that can be used to purify municipal reclaimed water to meet drinking water standards.

10:45 AM: Discusser: Roy Daly, LG Chem, Torrance, CA

10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 19-76: Reducing Footprint and Improving Water Quality for High Strength Steel Manufacturing

Benoit Tranape, Tracey Williams and Kevin Donahue, CeraMem – ALSYS Group, Waltham, MA

A steel manufacturer enables automakers to fabricate lightweight parts with increased strength. The site consists of a galvanizing line and a continuous annealing line. This paper will discuss the successful application of ceramic membranes for two separate applications: a spent caustic recycle unit and two combined oily wastewater treatment units. The main benefits of using ceramic membranes in these applications were improved product quality, resistance to upsets, smaller footprint and lower operating costs.

11:35 AM: Discusser: Gregory Madden, H2O Innovation, Champlin, MN

11:45 AM: Author's Closure & Floor Discussion

12:00 Noon: Conclusion

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. Workshops 1, 2, and 3, and 4 are offered on Sunday, and repeated later in the week – combine all three as the "basics package" for $600.00. All workshops are based on minimum number of reservations.

W1: Water Treatment 101

Sunday, November 10; 1:00 – 5:00 PM

(Offered again on Wednesday, Nov.13)

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.

Dennis McBride, Burns & McDonnell, Kansas City, MO

W2: The Wonderful World of Reverse Osmosis

Sunday, November 10; 1:00 – 5:00 PM

(Offered again on Wednesday, Nov.13)

Reverse osmosis (RO) has become a very popular and useful water treatment tool, for both water and 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. 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, 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.

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

W3: Ion Exchange Technology and Practical Operating Practices

Sunday, November 10; 1:00 – 5:00 PM

(Offered again on Thursday, Nov.14)

This workshop provides a detailed review of the various ion exchange processes for softening and demineralizing water as well as preparation for boilers, cooling, and process applications. A section on how to evaluate systems, their resin, operation, and water quality of ion exchange units is an excellent troubleshooting and informative portion of this workshop. A review of the different types of ion exchange resins available along with the newest developments and how those can be applied to provide specific water quality is a must for water treatment system operations. This is a great opportunity to ask questions and solve problems.

Wayne Bernahl, W. Bernahl Enterprises, Ltd., Elmhurst, IL

W4: Wet FGD Chemistry and Operational Impacts on Wastewater Quality Discharge: Cancelled

Sunday, November 10; 1:00 – 5:00 PM

W1-A: Water Treatment 101

Wednesday, November 13; 1:00 – 5:00 PM

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.

Dennis McBride, Burns & McDonnell, Kansas City, MO

W2-A: The Wonderful World of Reverse Osmosis

Wednesday, November 13; 1:00 – 5:00 PM

Reverse osmosis (RO) has become a very popular and useful water treatment tool, for both water and 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. 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, 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.

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

W5: Wastewater Treatment 101

Wednesday, November 13; 1:00 – 5:00 PM

In this workshop, wastewater treatment process fundamentals will be discussed for in depth understanding of how the operating & processing units work in aerobic environment to treat the waste streams from refineries and chemical plants. Object of this course is to acquire basics of how to design, an open art robust wastewater system to produce acceptable quality effluent to be discharged into an approved estuary and or in pant make up water resource for cooling tower or steam generation. Instructions will include wastewater streams inventory and selective segregation to optimize pre-treatment processing units, such as, API, CPI, DAF, and IGF units. Conventional Activated Sludge bio reactors, Moving Bed Bio-Reactors, Membrane Bio-Reactors, secondary clarifiers, and sludge dewatering etc. will be discussed. Example of a typical refinery wastewater plant will be used to enhance understanding wastewater treatment process. Approximate Subject matter outline:

- dentification of typical industrial wastewater streams
- selective segregation & characterization of wastewater streams
- explanation of WW terminology such as pH, Alkalinity, BOD, COD, TOC, TDS, Conductivity, TSS, & Turbidity
- physical / chemical treatment including Equalization, Oil/ Water/Solids Separation, pH Adjustment,
- Temperature adjustment
- biological Treatment including microbiology, Nitrification/ Denitrificataion, Activated Sludge Processes
- air Requirements
- solids production and management
- tertiary Treatment
- typical refinery wastewater treatment plant

Joe Guida, P.E. and Vina Arjomandnia, Fluor, Sugarland, TX; Josh Lawrence, P.Eng., Fluor, Calgary, AB, Canada

W6: Refinery Wastewater Treatment Concepts

Wednesday, November 13; 1:00 – 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.

Holly Johnson Churman, P.E., GHD, Houston, TX

W7: Industrial Boiler Water Treatment

Wednesday, November 13; 1:00 – 5:00 PM

This workshop is intended for those interested in industrial steam systems operating at pressures up to 1800 psig. While some basic theory is covered, the main focus of the course is to provide practical information that can be used to avoid common system problems. The course covers deaerators, boilers, steam turbines and condensate systems from both mechanical operation and chemical treatment aspects. The causes of deposition and corrosion as well as water quality and monitoring guidelines and chemical treatment options are discussed in an informal atmosphere.

Jim Robinson, SUEZ Water Technologies & Solutions, Trevose, PA

W8: Trouble Shooting an Ion Exchange Mixed BeD: Cancelled

Wednesday, November 13; 1:00 – 5:00 PM

W9: Successful FGD Wastewater Treatment System Design and Operations

Wednesday, November 13; 1:00 – 5:00 PM

Flue Gas Desulfurization Wastewater Treatment systems are complex processes that comprise of multiple components such as physical/chemical operations, bioreactors, and filtration to address regulatory requirements. This workshop will dive into the design, build, and operation of these systems with experienced instructors. We will review what goes into designing the FGD wastewater treatment systems focusing on unit operations through key influent characteristics to monitor. We will dive into construction layouts that have demonstrated success and issues that have been encountered in the design/build of these systems. Lastly, we will cover hands on operating experience with these new systems to provide individuals the tools and lessons learned for successful operations and maintenance of an FGD WWT.

Derek Henderson, P.E. Duke Energy, Raleigh, NC; William Kennedy, P.E., Stantec, Charlotte, NC

W10: Water Treatment 201

Thursday, November 14; 8:00 AM – 12:00 Noon

This course reviews the topics covered in Water Treatment 101 and build on those to provide design and technical details on designing water treatment systems using supplier's equipment information. Unit processes covered in this course are pretreatment softening using lime and soda ash, sodium cycle ion exchange for softening, demineralization of pretreated raw water using cation/ anion/ mixed bed ion exchange systems, reverse osmosis, and EDI. Boiler water chemistry guidelines and chemicals feeds for boiler chemistry control for high-pressure power plant boilers, combined cycle plants, and industrial boilers (up to 1500 psi) will be discussed. Advanced wastewater treatment concepts for power plants, industrial plants, and refineries will be included with recycle and reuse when feasible.

Americus Mitchell, Sundt Construction, Inc., Tempe, AZ; Sunil Sajja, Fluor, Sugarland, TX

W11: Electrodeionization (EDI)

Thursday, November 14; 8:00 AM – 12:00 Noon

Electrodeionization (EDI) is a hybrid of two well-known processes, ion-exchange deionization (IX) and electrodialysis (ED). It was developed to allow the production of deionized water without the use of the hazardous acid and caustic that is required to regenerate ion exchange resins. EDI is now over 30 years old and is used extensively in many industries, especially in the production of deionized water for pharmaceutical formulations, power generation and manufacture of microelectronics/semiconductor devices. It is usually employed as a polishing demineralization step with reverse osmosis (RO) upstream as the roughing demineralizer. This workshop will start by reviewing the principles of the EDI process, how it differs from IX, how EDI modules are constructed, and EDI feed water requirements. It will then focus on practical aspects of EDI system design, operation, maintenance and troubleshooting. This is an introductory course that requires no prior exposure to electrodeionization or electrodialysis. Some prior knowledge of basic water chemistry will be helpful.

Jon Wood, Evoqua Water Technologies LLC, Lowell, MA

W12: Industrial Water Reuse – A Roadmap for the Future

Thursday, November 14; 8:00 AM – 12:00 Noon

The primary objective of this workshop is knowledge transfer. It is aimed at those that are vested in developing "the industrial water reuse plant of the future" by unbiasedly comparing the more efficient and cost-effective methods to recover water. The workshop will address common issues facing industrial water reuse and compare treatment strategies. Topics will include:

- The three key aspects of water chemistry that drives design
- Options to get from point A to point B
- an unbiased comparison of the more popular water reuse flowsheets
- (i.e. membranes vs non-membrane approach)
- Navigating the changing water treatment technology landscape
- an unbiased comparison of the more popular treatment technologies (i.e. Clarifiers, MMF, MF, UF, GAC, IX, RO, ED, Chlorine, Ozone, AOP, UV)
- Emerging technologies and opportunities
- "Fit for purpose" water reuse strategies
- Optimizing cost and reliability
- Lessons learned and avoiding pitfalls

Facilitators will present on significant developments in the field of water reuse, relevant case studies that demonstrate successes and lessons learned that impact the design of the next generation of water reuse plants. Participants will leave the workshop with a broad understanding of the industrial water reuse landscape, why certain technologies are useful, how they work and how the capabilities of water reuse systems have grown in recent years.

Ed Greenwood, P.Eng, BCEE, Wood Environment and Infrastructure Solutions, Cambridge, ON, Canada

WORKSHOPS

W13: Arsenic and Selenium in Wastewater Treatment

Thursday, November 14; 8:00 AM – 12:00 Noon

Changes in regulations in the coal-fired power industry and existing standards in the mining industry are but two examples of increased regulatory focus on arsenic and selenium. These ions have not been the focus of emphasis for widespread industrial treatment in the past. Numerous new technologies have been promoted for use in the treatment of arsenic and selenium. However, it is difficult for the environmental personnel responsible for making intelligent decisions in this area to assess the real potential of treatment technologies to cost-effectively achieve the desired goals. This course will provide the background necessary for those concerned with arsenic, selenium or both to make sound decisions about the technical direction of treatment options.

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

W14: Contaminants A to Z

Thursday, November 14; 8:00 AM – 12:00 Noon

The number of trace contaminants found in water supplies continues to grow with new information regarding emerging contaminants such as PFAS and incidental contaminants such as pesticides, pharmaceuticals, and personal care products taking the stage alongside naturally occurring contaminants such as arsenic, gross alpha and problematic manmade inorganic contaminants such as mercury and lead. This years workshop includes (almost) every trace contaminant found in water with extensive back ground papers and information provided for each contaminant in electronic form. As such it is a powerful reference tool that every water treatment professional should have on their desktop. For each and every trace contaminant, the following information is provided:

- Facts about the contaminant including health risks
- How it got into our water supply and what form(s) it is found in
- The federal MCL or limits from health advisories or those set by various states
- Treatment methods including BAT's
- Relevant papers and other information about the contaminant such as species diagrams, Pourbaix diagrams, health risks, treatment results, chemistry, etc. (provided on USB stick, CD, or link to cloud based storage)

This workshop is a MUST ATTEND for anyone who works in the field water treatment, especially those of us responsible for identifying solutions to water problems. There is no other source of information about Trace Contaminants that is more complete or better organized.

Peter Meyers, ResinTech, Inc., West Berlin, NJ

W15: Drinking Water and Waste Water Operator Training: Cancelled

Thursday, November 14; 8:00 AM – 12:00 Noon

W16: UF, RO, and EDI Maintenance and Cleaning

Thursday, November 14; 8:00 AM – 12:00 Noon

This presentation covers the following topics for ultrafiltration (UF), reverse osmosis (RO), and continuous electro-deionization (CEDI)

- A very brief description of the technologies
- Best practices for extending membrane/module life
- Common practices in data collection and interpretation
- Best practices for off-line clean-in-place (CIP) processes, including why cleaning is important, what should trigger CIP, common foulants, preparation of cleaning solutions, standard cleaning procedures, tips and shortcuts, and when off-site membrane cleaning should be considered.
- Membrane and module autopsies, when they are needed, and how to interpret the results.

Robert Cohen, Evoqua Water Technologies, Rochester, NY

W3-A: Ion Exchange Technology and Practical Operating Practices

Thursday, November 14; 1:00 – 5:00 PM

This workshop provides a detailed review of the various ion exchange processes for softening and demineralizing water as well as preparation for boilers, cooling, and process applications. A section on how to evaluate systems, their resin, operation, and water quality of ion exchange units is an excellent troubleshooting and informative portion of this workshop. A review of the different types of ion exchange resins available along with the newest developments and how those can be applied to provide specific water quality is a must for water treatment system operations. This is a great opportunity to ask questions and solve problems.

Wayne Bernahl, W. Bernahl Enterprises, Ltd., Elmhurst, IL

W17: Chemical Metering Pump and Systems Fundamentals: Cancelled

Thursday, November 14; 1:00 – 5:00 PM

W18: HRSG and High-Pressure (>900 PSIG/60 BAR) Boiler Water Treatment and Operation

Thursday, November 14; 1:00 – 5:00 PM

This workshop will explain high-pressure (>900 psig/60 bar) steam boiler and HRSG steam/water cycles, deaeration, chemistry monitoring, and chemical treatment for controlling deposition, under deposit corrosion, flow accelerated corrosion (FAC), carryover, and other deposit- and condensate, feedwater, evaporator and boiler water treatment- related problems. The course will also cover select corrective actions. Operators, chemists, utility plant supervisors, managers, and engineers can all benefit from the practical information provided in this course.

David Daniels, M&M Engineering Associates, Leander, TX

W19: Building a Best Practice Cooling Water Program

Thursday, November 14; 1:00 – 5:00 PM

This interactive workshop focusses on the common issues associated with open recirculating cooling water systems in the form of corrosion, microbiological fouling and deposition related to scale formation and fouling. These issues are commonly referred to as the Cooling Water Triangle. Along with the issues that face cooling systems, the Best Practice cooling water treatment chemistries from past, present and future trends will be presented in detail. From this review, participants will be able to determine the Best Practice Cooling Water Program for their application. This workshop is recommended for operators, utility managers, and technical service engineers. Participants should bring a representative water analysis (makeup and recirculating tower water) and cooling system information (metallurgy, hottest skin temperature) for an in-session exercises and review.

Jo Ordonez, Solenis, Kyle, TX

W20: Acid Mine Drainage: Origin, Causes, and Environmental Impacts and Recycle and Reuse Technologies: Cancelled

Thursday, November 14; 1:00 – 5:00 PM

W21: Chlorine Dioxide: Chemistry, Generation, Analysis, Environmental Issues and Applications

Thursday, November 14; 1:00 – 5:00 PM

- About ClO2 – What is It & Why is it Used?: Health & Safety, Reaction Chemistry, Generation Chemistry & Equipment, Analytical, and Environmental Considerations
- Applications: Potable Water Disinfection, Biofilm, Cooling Tower Treatment, Closed Systems – Thermal Storage, Side Stream Filtration, Influent Disinfection, Alkaline Whitewater in Paper Mills, Steel Batch Mini Mills, and Hydraulic Fracturing
- Specific Topics: Corrosion, Demand Testing, and Cl2 vs. ClO2
- Q & A

Practical Chlorine Dioxide: Volume I – Foundations Book Provided

Greg Simpson, Pureline, Houston, TX

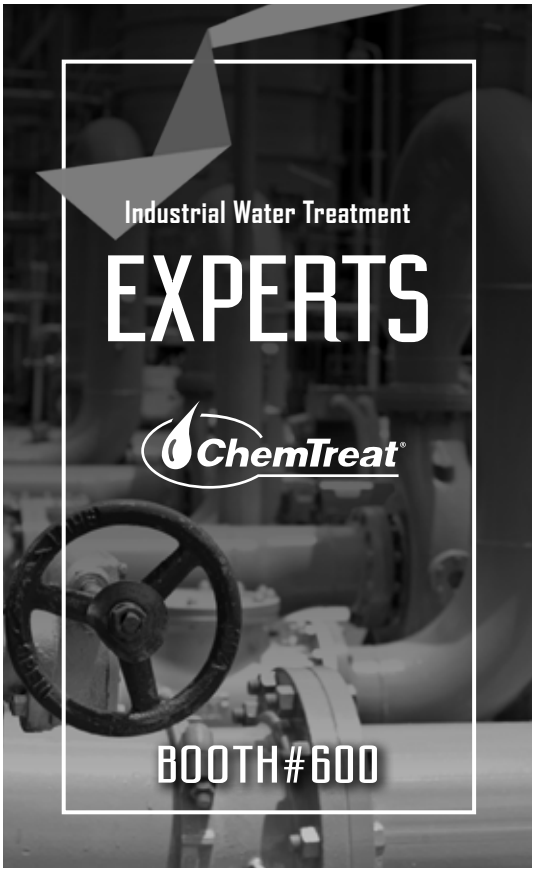
W22: RO Design Software - Concept to System Design

Thursday, November 14; 1:00 – 5:00 PM

The use of RO and IX system design software is common in the water treatment industry. All manufacturers of RO membranes and IX resins offer design software that allows rapid and accurate system designs, often used as the basis of warranty performance, to model operating performance, or to compare process variables (and decisions on overall design). These design software packages have evolved with new capabilities, new inputs, outputs, and even design of integrated systems involving multi-step process sequences like UF to RO to IX. The Workshop will expose attendees to some available design software (IMS, LewaPlus, and WAVE), with an emphasis on modern RO design software. The workshop will present the basic concepts in RO process, explain manufacturer design guidelines,

membrane aging models, overcoming design warnings, and a variety of system configurations (and power consumption options). The workshop will provide exposure to design steps for brackish water applications (low and high salinity), single and 2 pass SWRO systems, high recovery (>90%) RO systems, and integrated UF, RO, IX systems.The workshop will cover how certain high recovery RO systems compare with classic RO designs on critical metrics such as permeate salinity, power consumption, and water savings. Attendees will learn how different membranes (standard pressure, low pressure, and ultra-low pressure) impact permeate salinity, flux, and power consumption. The workshop will include a hands on design laboratory (attendees will design a high recovery RO systems using design software from several membrane manufacturers).

Alan Sharpe, Lanxess Chemicals, Inc., Birmingham, NJ



H2O THEATRE

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 Grand 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 11, 2019

- 2:30 PM: Daryl Briggs, Aquafortus Technologies Limited

  Aquafortus Non-Thermal Brine Management
  Aquafortus provides an economical non-thermal brine management solution to industries handling high salinity wastewater. With 60% lower OPEX than thermal solutions. Aquafortus uses a novel solvent extraction technology that crystallizes out salts from brine while recovering 98% of the water for reuse. It is used for brine management, ZLD or MLD applications. Industries that can benefit from Aquafortus include: oil & gas, mining, thermal power generation, chemical refineries and wherever high salinity wastewater is produced.

TUESDAY, NOVEMBER 12, 2019

- 9:30 AM: Jason Bailey, Avista Technologies
- 10:30 AM: Jimmy Gallmann, Hubbard Hall
- 11:00 AM: Daryl Briggs, Aquafortus Technologies Limited

  Aquafortus Non-Thermal Brine Management
  Aquafortus provides an economical non-thermal brine management solution to industries handling high salinity wastewater. With 60% lower OPEX than thermal solutions. Aquafortus uses a novel solvent extraction technology that crystallizes out salts from brine while recovering 98% of the water for reuse. It is used for brine management, ZLD or MLD applications. Industries that can benefit from Aquafortus include: oil & gas, mining, thermal power generation, chemical refineries and wherever high salinity wastewater is produced.

- 1:30 PM: Pete O'Connell, Pall Water

  PFAS Removal from Water with Membranes"
  PFAS (Per or Polyfluoroalkyl Substances) are receiving increased attention lately. Federal standards lag behind many states that passed regulations for drinking water and

discharge. Conventional methods of removal include carbon and resins, which are often only partially effective, passing a percentage of the compounds. Pall Water participated in a pilot study in 2018, proving membranes effectively remove all PFAS to non-detect, including short-changed ones. This talk discusses the issue, the pilot and equipment available.

- 2:00 PM: Robert Ferguson, French Creek Software

  One of our customers received a government edict to cease discharging RO concentrate. Applications specific Simulation programs validated the blending of RO concentrate with the current cooling water make-up as a means to work off the brine rather than through direct discharge. An RO modeling program, a cooling water simulation program, and a brine modeling system were used to to develop water flows, cooling water limits and a treatment program. The simulation was completed in under twenty minutes including data entry.

- 2:30 PM: Michael Lee, American Water Chemicals, Inc.

  Membrane System Foulant Identification
  This presentation will discuss the methods to identify membrane system foulants, and how to develop a proper cleaning procedure to restore the membranes to factory specifications.

3:30 PM Daniel Shannon, PureLine

Responsible Water Management
The presentation and discussions will build on the foundation of how to stop the use of Halogens and non-oxidizing biocides; moves that will improve the water industry's safety and environmental profile geometrically. A pathway from the unrestrained use of these products and to a "better way" without them, HOW TO DO IT, How YOU can help make a monumental change in the water management industry, greatly improving our environmental and safe working credentials.

4:00 PM Mike Weatherill, Purolite Corporation

Innovative use of Ion Exchange Resin For Effective PFAS Removal
This presentation will cover sources, regulations and treatment options for PFAS chemicals from drinking water supplies. This is a very important topic as these impurities are being detected in a wide range of areas. We invite you to learn about using Ion Exchange resin to treat and remove PFAS impurities including some real world case study results.

Water Technologies & Solutions

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EXHIBITORS

IWC Exhibit Hall

The IWC Exhibit Hall features countless opportunties to learn about practical and innovative solutions for the industrial water treatment industry from industry leaders. The Exhibit Hall is located in the Grand Ballroom 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:

- Sunday, November 10: 5:00–7:00 PM
- Monday, November 11: 11:30 AM–1:30 PM and 5:00–7:00 PM
- Tuesday, November 12 11:30 AM–1:30 PM and 5:00–7:00 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.

A listing by booth number of all 2019 IWC Exhibitors is provided below. On the following pages, you will find a detailed description* of our exhibitors, including contact information.

*For descriptions that are in excess of 75 words, additional content may be found on the IWC website or APP.

Outdoor Exhibit Space

Back for 2019, we have our outdoor exhibit area featuring mobile displays, each with their own focus. Our IWC Outdoor Exhibit draws companies in the water industry who want to highlight their mobile technology. Please make time to visit the outdoor exhibits, located just outside the foyer of the Grand Ballroom. The Outdoor Exhibit Hours are open during all Exhibit Hall hours. Featured companies include:

- Pall Water
- PetroH2O LLC / Aquafortus
- PureLine
- SUEZ Water Technologies & Solutions
- WesTech Engineering, Inc.

EXHIBITORS

100	Parkson Corporation
101	ChemTrac, Inc.
102	COCHRANE® by Newterra
103/105	Neptune, part of PSG, a Dover Company
104/106	Avista Technologies
107	RETEGO Labs
109	AmeriWater
111	United Conveyor Corporation
112	GEMU Valves
113	Plastocor Inc.
200	Johnson March Systems, Inc.
201/203	SUEZ Water Technologies & Solutions
202	Fluidra USA
204	Grundfos Pumps Corporation
205	Bowen Engineering Corporation
206	Aquafortus Technologies Limited
207	Protec-Arisawa
208/210	Aqua-Aerobic Systems, Inc.
209	ChemScan, Inc.
211	ENCON Evaporators
212	Advisian, Worley Group
213	Canadian Water Technologies
214	Hubbard-Hall Inc.
215	KleeNwater, LLC
300	Turner Designs Hydrocarbon Instruments, Inc.
301/303	LANXESS Corporation
302	Aquatech International
304	MICRODYN-NADIR
305	DMP Corporation
306	Höganäs Environment Solutions
307	American Water Chemicals, Inc.
308	Fuel Tech, Inc.
309	PureLine
310	AdEdge Water Technologies
311	Sumitomo Electric Industries Ltd.
312	Duraflow LLC
313	Stantec
314	Howden
317/416	Purolite Corporation
400	Golder Associates Inc.
401	ResinTech, Inc.
402	Graver Water / Ecodyne Ltd
403	SAMCO Technologies
404	IDE Technologies
405/407	DuPont Water Solutions
406	Solenis LLC
408	SnowPure Water Technologies
409	Tomorrow Water (BKT)
410	Univar Solutions
411	Waterco
412	Brown and Caldwell
413/417	Wigen Water Technologies

EXHIBITORS

500	Veolia Water Technologies
501	WesTech Engineering, Inc.
502	Thermax, Inc.
503	Global Chem-Feed Solutions, LLC
504	OLI Systems, Inc.
505	Burns & McDonnell Engineering, Inc.
506	Jacobi Carbons, Inc.
507	Athlon, A Halliburton Service
508	Watson Marlow Fluid Technology Group
509	Intuitech, Inc.
510	U.S. Water
511	Delta Pure Filtration
512	Saltworks Technologies
513/515	Eisenmann Corporation
516	Brenntag North America
600/602	ChemTreat, Hach, Pall Water and USP Technologies
601	Justeq LLC
603	Federal Screen Products Inc.
604	WaterColor Management
605	Stenner Pump Company
606	Cooling Technology Institute
607	Aqueousvets
608/610	3M Separation and Purification Sciences Division
609	Barr Engineering, Co.
611	Evoqua Water Technologies
612	Filtra-Systems Company LLC
613	Flexitallic
614	Itochu Chemicals America Inc.
615	David H. Paul, Inc.
700	Swan Analytical USA
701	French Creek Software
702/704	Nalco Water, an Ecolab Company
703	METTLER TOLEDO
706	Pulsafeeder, Inc.
707	MPW Industrial Services
708	Atlantium Technologies Inc.
709	Frontier Water Systems LLC
710	Brooks Applied Labs
712	H2O Innovation
713	ECT2

EXHIBITORS

3M SEPARATION AND PURIFICATION SCIENCES DIVISION

Booth #: 608/610
Contact: Denise King
Phone: 512-297-9470
E-mail: dking3@mmm.com
Website: www.3m.com/highflow and www.3m.com/membrana

3M Separation and Purification Sciences offers innovative solutions to tackle your toughest industrial filtration challenges with consistency you can count on; we've been in the filtration business for more than 90 years. 3M High Flow Series filters deliver effective filtration in a compact size. 3M Liqui-Flux Membrane Modules are an economical, reliable solution for water treatment applications. 3M Liqui-Cel products offer efficient dissolved gas control in a compact design. Visit our booth to find out more.

ADEDGE WATER TECHNOLOGIES

Booth #: 310
Contact: RJ Cavagnaro
Phone: 678-835-0052
Fax: 678-835-0057
E-mail: sales@adedgetechnologies.com
Website: www.adedgetech.com

Founded in 2002 and headquartered just north of Atlanta, Georgia, AdEdge Water Technologies specializes in the design, development, fabrication, and supply of water treatment solutions, specialty medias, legacy and innovative technologies that remove a wide range of contaminants from water.

AMERICAN WATER CHEMICALS, INC.

Booth #: 307
Contact: Michael Lee
Phone: 813-246-5448
Fax: 813-623-6678
E-mail: mlee@membranechemicals.com
Website: www.membranechemicals.com

American Water Chemicals® (AWC) was created in 1993 by a group of membrane desalination experts in response to the demand for more reliable membrane treatment chemicals and services. Over the years, our unique understanding of water chemistry has earned us a worldwide reputation for resolving complex operational issues. AWC® has become renowned as one of the most trusted suppliers of membrane chemicals for RO/NF systems. Our goal is to enable our customers to meet their increasing water production demands, cope with concentrate disposal restrictions, and reduce their energy consumption through the use of our membrane antiscalants, cleaning chemicals and biocides.

EXHIBITORS

AMERIWATER

Booth #: 109
Contact: Jackie Cody
Phone: 937-461-8833
E-mail: jackie.cody@ameriwater.com
Website: www.ameriwater.com

AmeriWater is an industry leader in the design, manufacture, installation and supply of water purification systems and services for industrial applications. We work closely with industrial clients to solve the complex challenges related to water quality requirements, to increase productivity, reduce costs and produce the highest quality product.

AQUA-AEROBIC SYSTEMS, INC.

Booth #: 208/210
Contact: Rebecca Johnson
Phone: 815-639-4426
Fax: 815-654-2508
E-mail: rebecca.johnson@aqua-aerobic.com
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 industry by providing both municipal and industrial customers around the world with advanced technologies and treatment solutions that easily adapt to changing demands. From enhanced nutrient removal to primary filtration, ultra low phosphorus removal or even water reuse, Aqua-Aerobic has proven solutions that offer the lowest cost of ownership with life-time customer service. Learn how Aqua-Aerobic technologies can increase efficiency, save time, and lower costs.

AQUAFORTUS TECHNOLOGIES LIMITED

Booth #: 206
Contact: Jessica Lam
Phone: +64 21 153 6446
E-mail: jessica@aquafortus.com
Website: www.aquafortus.com

Aquafortus provides a non-thermal brine management solution to industries handling high salinity wastewater. Aquafortus uses a novel solvent extraction technology that crystallizes out salts from brine while recovering 98% of the water for reuse. It is used for brine management, ZLD or MLD applications. It can be used in industries such as: oil & gas, mining, thermal power generation, chemical refineries and wherever high salinity wastewater is produced.

EXHIBITORS

AQUATECH INTERNATIONAL

Booth #: 302
Contact: Larry Millar
Phone: 724-746-5300
E-mail: millarl@aquatech.com
Website: www.aquatech.com

Aquatech is a global leader in water purification technology for industrial and infrastructure markets focusing on desalination, water recycle and reuse, and zero liquid discharge. We offer a large portfolio of water management services designed to help plant personnel and end user organizations get the most out of their water treatment systems. At Aquatech, we strive to provide technological leadership and performance excellence to the global water industry, and support our customers with service excellence and sustainable solutions.

AQUEOUSVETS

Booth #: 607
Contact: Rob Craw
Phone: 925-967-5232
E-mail: rcraw@aqueousvets.com
Website: www.aqueousvets.com

AqueoUS Vets® is a solutions provider of water/wastewater treatment and delivery systems. We are committed to providing the highest level of representation, service, and project management to the water and wastewater industry. We serve government agencies (federal, state and local) as well as the private industrial/commercial sectors. We are a federal and state certified, 100% veteran owned and operated small business and can help our clients satisfy Service-Disabled Veteran-Owned Small Business participation requirements.

ATHLON, A HALLIBURTON SERVICE

Booth #: 507
Contact: Gretchen Blank
Phone: 225-744-8024
Fax: 225-673-1970
E-mail: gretchen.blank@halliburton.com
Website: www.athlonsolutions.com

Athlon, a Halliburton Service, provides industrial water and process treatment solutions to refinery, petrochemical, and ammonia/fertilizer operations, including cogeneration plants where effective water treating is critical to combined cycle operations. Our treatment programs combine specialty chemicals, on-site service and engineering support to help customers meet their goals. For our customers, water treatment becomes an investment in value delivery through process improvements and cost avoidance.

EXHIBITORS

ATLANTIUM TECHNOLOGIES INC.

Booth #: 708
Contact: Dennis Bitter
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Fax: +97229925005
E-mail: dennisb@atlantium.com
Website: www.atlantium.com/en/

Atlantium's patented Hydro-Optic (HOD) UV technology offers a safe and proven alternative to chemicals for the effective treatment of bacteria, microorganisms, and viruses or chemical decomposition in freshwater, brackish water, or seawater. HOD UV consistently monitors water quality, UV intensity and adjusts the UV dose rate. This advanced control and monitoring approach is unique to HOD UV and assures system performance, biosecurity, and water safety through a cost-effective non-chemical solution.

AVISTA TECHNOLOGIES

Booth #: 104/106
Contact: Jason Bailey
Phone: 336-269-4218
E-mail: jbailey@avistatech.com
Website: www.avistatech.com

Avista Technologies is a trusted expert in membrane system chemistry and global process support for Reverse Osmosis and Micro/Ultra Filtration membrane systems and Multimedia Filtration. Reverse Osmosis products include: Vitec® antiscalants, RoClean®, AvistaClean® membrane cleaners and RoCide® biocides. AvistaClean® MF cleaners restore MF/UF membrane performance when generics are no longer effective.

BARR ENGINEERING, CO.

Booth #: 609
Contact: Ellie Schofield
Phone: 952-832-2600
E-mail: eschofield@barr.com
Website: www.barr.com

Barr's staff of 800 provides engineering and environmental services to clients in the energy, mining, power, and manufacturing industries; to those in the public sector; and to others with complex problems. Our areas of expertise include air quality permitting, environmental management and compliance assistance, water-supply and wastewater-treatment design, water resources management, permitting and design for hazardous- and solid-waste facilities, contaminated-site assessment and remediation, engineering design, and process and materials handling design. Incorporated as an employee-owned firm in 1966, Barr has offices in Minneapolis, Duluth, and Hibbing, Minnesota; Ann Arbor and Grand Rapids, Michigan; Jefferson City, Missouri; Bismarck, North Dakota; Salt Lake City, Utah; Denver, Colorado; and Calgary, Alberta.

EXHIBITORS

BKT

Booth #: 409
Contact: Howard Tran
Phone: 714-578-0676
E-mail: ht@bkt21.com
Website: www.bkt21.com

BKT offers a broad range of solutions for separatiing, concentrating and dewatering in manufacturing processes, and recovery (reuse, recycle) applications. BKT's FMX anti-fouling membrane system can recover more under the most challenging conditions and can handle high density, high solids, and high viscosity applications. The FMX system helps prevent membrane fouling by using rotating blades to generate vortices that prevent solids from building up on the membrane surface.

BOB JOHNSON & ASSOCIATES

Booth #: 503
Contact: Belinda Denman
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Website: www.bjja.com

For over 50 years, Bob Johnson & Associates has been a full-service water treatment company serving its clients with solutions based on best in class equipment, chemicals, resin regeneration and a holistic approach to preventative maintenance. With a regeneration plant and chemical blending facility strategically located in Houston, Bob Johnson is positioned to support resin regeneration services for MBDI and condensate polishers in power and petrochemical facilities in the gulf coast and beyond.

BOWEN ENGINEERING CORPORATION

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Resourceful. Responsive. Results. Bowen is a self-performing general contractor with operation centers across the country. For over 50 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. Working across multiple industries, the Bowen team has conquered the toughest water and wastewater challenges and has constructed over 1,000 treatment facilities.

EXHIBITORS

BRENNTAG NORTH AMERICA

Booth #: 516
Contact: Brian Liotta
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Website: www.brenntagwater.com

Brenntag Water Treatment your Partner in Solutions for Industrial, Commercial and Municipal Water Treatment with stocking locations throughout the US and Canada. Our 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, as well as products for heavy metals removal and odor control

BROOKS APPLIED LABS

Booth #: 710
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Website: brooksapplied.com

Brooks Applied Labs has supported the inorganic analytical needs of the power, mining, and agricultural sectors for over 30 years through application of compliance and novel proprietary technologies. BAL leads the field of metals speciation analyses which plays a key role in understanding fate and transport of contaminants as well as process optimization and troubleshooting. Our deep level of scientific understanding as well as a comprehensive knowledge base empowers our scientists to be partners throughout your enterprise. Expect more from your analytical service provider, expect a partner.

BROWN AND CALDWELL

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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 for you.

EXHIBITORS

BURNS & MCDONNELL ENGINEERING, INC.

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We are a full-service engineering, architecture, construction, environmental and consulting solutions firm, based in Kansas City, Missouri. Our staff of 7,000 includes engineers, architects, construction professionals, planners, estimators, economists, technicians and scientists, representing virtually all design disciplines. We plan, design, permit, construct and manage facilities all over the world, with one mission in mind: Make our clients successful.

CANADIAN WATER TECHNOLOGIES

Booth #: 213
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Website: www.canadianwatertechnologies.com

Canadian Water Technologies (CWT) is a western Canadian company that designs and manufactures water treatment equipment for industrial markets with a specialty in membrane-based systems, including UF, NF, RO, and EDI. CWT provides all stages of water processing from pre- to post-treatment, as either standalone equipment or integrated as turnkey packages. These water treatment solutions can be produced as skid-mounted units or as complete building packages.

CHEMSCAN, INC.

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ChemScan, Inc. designs and manufactures analyzers for water and wastewater monitoring. The ActivTrac single parameter analyzers provide reliable and accurate measurement of Polymer, Molybdate, Ortho Phosphate, Silica, Copper, Hexavalent Chrome, Sulfite, Manganese, Chloramine, Ammonia and more. With the recent acquisition by In-Situ, Inc., ChemScan, Inc. now offers sensors and probes that measure: Level, Salinity, pH/ORP, Pressure, Turbidity, Chloride, Rhodamine WT Fluorescence Intensity, Temperature/Conductivity, Total Suspended Solids, Dissolved Oxygen (RDO), Ammonium, Blue Green Algae-Phycocerythrin, Nitrate.

EXHIBITORS

CHEMTRAC, INC.

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Chemtrac designs and manufacturers instrumentation for monitoring critical water treatment applications. Their online particle counters detect insoluble particulate at low ppt levels, and are used for continuous corrosion product transport monitoring in the steam cycle, as well as for RO pretreatment filter performance monitoring and optimization. Chemtrac is a global leader in providing streaming current charge measurement technology for coagulant feed control, and offers online analyzers for chlorine, pH, Turbidity, TSS, ORP, and organics monitoring.

CHEMTREAT, HACH, PALL WATER AND USP TECHNOLOGIES

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Danaher Corporation has formed a diverse portfolio of water quality optimization companies that – as a united platform, can significantly impact the way its customers approach water. Through strong customer partnerships, we advance the quality and delivery of water. Our collective expertise, products, and services provide the innovative analytical and treatment solutions you need to be confident in delivering the best water, with the greatest efficiency, every time. Please visit www.dhwaterquality.com/ to learn more about each of our brands, ChemTreat, Hach, Pall Water and USP Technologies.

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COCHRANE® BY NEWTERRA

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COCHRANE® by newterra is more than a name; it's an industrial water treatment legend. Throughout the world today, you'll find thousands of COCHRANE by newterra systems hard at work. Put our proven performance and experience to work in your boiler room or for any industrial water treatment and reuse applications that require reliable, on-spec solutions. We make it simple.

EXHIBITORS

COOLING TECHNOLOGY INSTITUTE

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CTI's mission is to advocate and promote the use of environmentally responsible cooling technologies: wet cooling towers; air-cooled condensers; indirect cooling; and hybrid systems, by encouraging: Education on these technologies, Development of codes, standards, and guidelines, Development, use, and oversight of independent performance verification and certification programs, Research to improve these technologies, Advocacy and dialog on the benefits of cooling technologies with Government Agencies and other organizations with shared interests and Technical information exchange

DAVID H. PAUL, INC.

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Since 1988, David H. Paul, Inc. has 100% focused on providing excellent, practical, cost-effective, unbiased high-tech water treatment training and technical services specific to high-tech water treatment, primarily membrane and high purity water treatment technologies. DHP has vast experience with most industrial and municipal water treatment, including: Power Generation, Pharmaceutical/biotech, Microelectronics/semiconductor, Manufacturing, Beverage, Oil & Gas, Drinking water, Governmental agencies and many others

DELTA PURE FILTRATION

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Delta Pure filtration, located in Ashland, VA, is an ISO 9001 certified manufacturer of filter cartridges and systems for water and process liquids. We provide standard and custom filter cartridges to remove sediment and a variety of contaminants. Applications include: water purification, chemical processing, food and beverage, waste water, metal plating and membrane pre-filtration.

EXHIBITORS

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DMP is the premier provider of integrated wastewater treatment solutions. For over 45 years, we have been dedicated to helping our industrial customers solve their most difficult water treatment issues economically. At DMP, we take the worry out of wastewater by getting you into compliance and keeping you in compliance, saving you money, and helping you use water more efficiently. Visit us at https://www.dmpcorp.com to learn more.

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DuPont Water Solutions is the global leader in sustainable separation and purification technologies, offering a broad portfolio of ultrafiltration, reverse osmosis, ion exchange, and electrodeionization products. We are helping customers across industries and countries make real progress in ways that not only improve productivity, efficiency, and profitability, but also minimize waste, energy consumption, and environmental impact.

DURAFLOW LLC

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Duraflow is a world leading supplier of tubular polymeric cross flow tubular microfiltration membrane modules. Designed with a large 1 inch diameter tubes, their membranes can operate under conditions outside of the range of other membrane configurations. Combining their membranes with Duraflow's precipitation chemistry knowledge offers a simplified process to replaces a conventional clarifier, multimedia and UF pretreatment for conditioning feed water for an RO membrane system. There are a thousand systems operating today.

ECT2

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Since its formation in 2013, ECT2 has become a leading provider of novel treatment products for water and vapor. ECT2's products are specifically designed to efficiently mitigate the environmental impacts of emerging contaminants. Its SORBIXTM line is the world's most cost-effective and sustainable solution for the removal of PFAS-contaminated water. ECT2 employs a team of over 50 staff engineers, researchers, manufacturers, and operators across North America and Australia.

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Eisenmann is an Internationally recognized environmental systems integrator, basically we design and build plants, for treatment and destruction of hazardous and toxic compounds in gases, liquids and solids. A healthy environment and state-of- the-art production are not a contradiction. Rather, they go hand in hand – thanks to sophisticated technologies that enable ecologically sound processes. With over 2,500 custom built solutions we can put our experience to work for you!

ENCON EVAPORATORS

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Manufacturer of evaporators and dryers for industrial wastewater minimization, hauling & disposal cost reduction, and process stream concentration.

EXHIBITORS

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Evoqua Water Technologies is a leading provider of mission-critical water and wastewater treatment solutions, offering a broad portfolio of products, services and expertise to support industrial, municipal and recreational customers. Evoqua has worked to protect water, the environment and its employees for more than 100 years, earning a reputation for quality, safety and reliability. Headquartered in Pittsburgh, Pennsylvania, the company operates in more than 160 locations across nine countries, serving more than 200,000 installations.

FEDERAL SCREEN PRODUCTS INC.

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FEDERAL SCREEN PRODUCTS manufactures Wedge Wire screen and fabricated Wedge Wire products for straining, screening, filtering and media retention in water purification, conditioning and waste water equipment. Federal Screens takes pride in their high quality products, reliable customer service, prompt deliveries and competitive pricing.

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Filtra-Systems, the trusted adviser to thousands of successful multinational manufacturers in over 37 nations who want, need and appreciate custom-engineered industrial filtration & separation products, systems and technology.

FLEXITALLIC

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Flexitallic is the industry leader and sealing expert in manufacturing metallic, semi-metallic and sheet gaskets for all industries. Developer of the spiral wound gasket in 1912, Flexitallic is synonymous with quality and innovation; proven true by their revolutionary products such as Thermiculite®, Change®, and Change – HF® gaskets. Flexitallic offers a variety of products for multiple industries globally. Stop by their booth and see for yourself why Flexitallic is the most trusted name in industrial sealing.

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Founded in 1980, FLUIDRA designs and manufactures pressure vessels in polyester resins reinforced with fiberglass for aquariums, aquaculture, food and beverage industry, mining , irrigation, water treatment, wastewater treatment, and desalination. The use of fiberglass in all our processes provides a great mechanical resistance to traction, flexion and compression, presenting specific resistance higher than steel. Besides, the material withstands electrolytic and chemical attack and is ideal for saline and aggressive environments.

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FRONTIER WATER SYSTEMS LLC

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Frontier Water Systems develops, designs, and manufactures specialty engineered equipment for the targeted removal of selenium, nitrate, arsenic and mercury from water and wastewater associated with power generation and mining. Frontier Water's systems employ proprietary biological treatment processes, which provide unparalleled efficiency in terms of equipment footprint and water quality. Our advances in biological metals removal technology are saving heavy industry hundreds of millions of dollars today, while providing the cleanest water possible to our lakes and rivers.

FUEL TECH, INC.

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Multipollutant, APC technologies include low NOX combustion systems, ESP upgrades, NOXOUT® and HERT™ SNCR systems, Advanced SCR systems, ULTRA® ammonia generation process, and TIFI® programs to improve boiler efficiency while reducing slagging, corrosion, SO3, and GHG emissions. Water treatment technologies include DGI™ Dissolved Gas Infusion Systems using Oxygenation and a patented nozzle for cost-effective approach over conventional industrial aeration, and Redox chemical additives for effective control of mercury emissions for wet FGD scrubbers.

GEMU VALVES

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GEMÜ Valves, an ISO9001 certified company, is a leading world-wide manufacturer of high quality valves, measurement and control systems. The GEMÜ Group has been manufacturing innovative products and customized solutions in and around the field of process media control since 1964. GEMÜ's ground breaking design and leading-edge manufacturing technology provides engineered solutions to complex process challenges. GEMÜ's overriding philosophy is to ensure that every customer contact is a quality experience.

GOLDER ASSOCIATES INC.

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Renowned for excellence in geosciences and environmental engineering, Golder is a global, 100% employee-owned firm with over 50 years of successful client service. Over 6,500 professionals flourish in an environment where collaboration and innovation are fostered. The Golder Water Treatment Group has a strong commitment to technical excellence with extensive experience in technology evaluation, design, permitting, construction and operation of complex water treatment solutions in mining, power, manufacturing, solid waste, and food and beverage industries.

GRAVER WATER / ECODYNE LTD

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Graver Water Systems / Ecodyne Ltd has designed and manufactured water & wastewater treatment solutions for the Power, Petrochemical and industrial markets for over 70 years. We are the leader in Condensate Treatment with our Deep Bed Polishers, Filters, and Powdex precoat filter/demineralizer systems. Coupled with Pretreatment (clarifiers, lamellas, filters, hot process), Makeup Demin (UF, RO, EDI, Packed Bed IX, degasifiers) and oil/water separators. No matter the challenge, our systems will be your solution.

GRUNDFOS PUMPS CORPORATION

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Grundfos, based in Bjerringbro, Denmark, is a global leader in water pump technology. To complement its global presence, Grundfos is committed to the American market with regional headquarters in the Houston, Texas area. The company's purpose—pioneer solutions to the world's water and climate challenges and improve quality of life for people—inspires over 1,200 employees across North America to deliver the world to the next generation in a better state than we inherited.

EXHIBITORS

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H2O Innovation designs and provides state-of-the-art, custom-built and integrated water treatment solutions based on membrane filtration technology for municipal, industrial, energy and natural resources end-users. The Corporation's activities rely on three pillars which are i) water & wastewater projects, and services; ii) specialty products, including a complete line of specialty chemicals, consumables and specialized products for the water treatment industry; and iii) operation and maintenance services for water and wastewater treatment systems.

HÖGANÄS ENVIRONMENT SOLUTIONS

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Höganäs Environment Solutions (HES) manufactures patented engineered iron media, Cleanit-LC Plus. Cleanit media is applied for removal of metals such as selenium, hexavalent chromium, arsenic, base metals, and radionuclides by reduction and adsorption. HES also manufactures patented Cleanit-EC electrodes. Compared to steel plate electrodes, Cleanit-EC reduces electrical consumption by up to 60%; doubles removal efficiency & can be customized for target contaminants. In addition to metals removal, Cleanit-EC is effective for removal of organics, color and silica.

HOWDEN

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EXHIBITORS

HUBBARD-HALL INC.

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Customer-driven since our founding in 1849, we're proud of our 99.8% product consistency, 94.8% on-time shipments, and 88.9% customer retention rate. Our wastewater treatment expertise has proven results that help companies maintain compliance with strict EPA discharge standards. Hubbard-Hall technical experts make house calls and provide treatability studies; to ensure our chemistry is the right solution for you. We believe in doing the right thing, even if it's the harder thing.

IDE TECHNOLOGIES

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A world leader in water treatment solutions, IDE specializes in the development, engineering, construction and operation of enhanced desalination and IWT plants. Our track record spans across more than 50 years, includes ground-breaking, reliable and sustainable IWT solutions, and some of the largest membrane and thermal desalination plants worldwide. With +400 plants in +40 countries, IDE partners with municipalities, petroleum and mining companies, refineries and power stations, delivering ~3M m3/day of high-quality water worldwide.

INTUITECH, INC.

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Intuitech has specialized in the design and manufacture of pilot plants for almost twenty-five years. We have standardized flocculation, sedimentation, ozonation, granular media filtration, and biofiltration pilot plants available for purchase or lease. We have also constructed pilot plants for UF, RO, DAF, physchem, aeration, and many other unique process for end users, consulting engineers, and OEM's. We can build a customized pilot plant for your process.

ITOCHU CHEMICALS AMERICA INC.

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Itochu specializes in separation and purification processes in the water, food, beverage, biochemical and pharmaceutical industries. Exclusive distributor of ION EXCHANGE RESINS, manufactured by Mitsubishi Chemical, for use in water softening, demineralization, condensate polishing, UPW, and specialty applications. Feature Uniform Bead resins with high uniformity.

JACOBI CARBONS, INC.

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JOHNSON MARCH SYSTEMS, INC.

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JUSTEQ LLC

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Justeq07 is a revolutionary new biocide that is more effective and more economical than chlorine bleach or any other water treatment biocides. Justeq07 penetrates into slime masses and breaks up the mass from within. This property makes Justeq07 more effective than bleach on algae and slime control.

KLEENWATER, LLC

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KLeeNwater is joint venture between Environmental Energy Services, Inc. and ProChem, Inc. We offer wastewater treatment systems and supplies, including: microfiltration, reverse osmosis membrane treatment, continuous flow wastewater systems, and specialty ion-exchange systems. All systems are tailored to the client's individual needs, fully automated, and equipped with customized web-based remote monitoring to meet the most stringent specifications. Our mission is "cost reduction through volume reduction".

LANXESS CORPORATION

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LANXESS Corporation, part of the Liquid Purification Technologies business unit is one of the world's foremost suppliers of products for treating water and other liquid media. Its portfolio includes Lewabrane® membrane elements for reverse osmosis, Lewatit® ion exchange resins, Gigamem® ultrafiltration, and Bayoxide® iron oxide adsorbers.

METTLER TOLEDO

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METTLER TOLEDO Thornton is a leader in pure and ultrapure industrial water monitoring instrumentation used in power applications. Thornton's leading market position is demonstrated by its innovative analytical instruments and sensors for the measurement parameters of conductivity & resistivity, TOC, (optical) dissolved oxygen, sodium, silica, Degassed Conductivity, and pH in a variety of cycle chemistry and make up water applications. Thornton innovation continues with the introduction of the 3000CS for on-line chloride and sulfate measurement.

MICRODYN-NADIR

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MICRODYN-NADIR is a leading membrane manufacturer with a vision to help our customers Make Clean Water. Headquartered in Wiesbaden, Germany, MICRODYN-NADIR has locations in the Americas, Europe, and Asia. The company delivers the membrane products to meet all your water and process needs. We offer 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.

MPW INDUSTRIAL SERVICES

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MPW offers a variety of industrial cleaning, water treatment and facility and environmental services to thousands of clients throughout North America. Our diversified industrial services are applicable to a wide array of customer needs and enable clients to prosper in today's competitive environment.

EXHIBITORS

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Nalco Water, an Ecolab company, is the leading global provider of water management solutions and expertise to maximize operating performance and minimize water and energy use for industrial and institutional customers. Nalco Water's broad suite of industry-leading technologies and advanced chemistries are designed to meet today's complex water management needs.

NEPTUNE, PART OF PSG, A DOVER COMPANY

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Neptune is a premier provider and manufacturer of chemical-metering pumps, chemical-feed systems and chemical-injection accessories. Neptune offers single-source, end-to-end solutions – technologies specifically engineered for water treatment applications that will help increase operational performance, improve system efficiencies and deliver the peace-of-mind reliability customers expect.

OLI SYSTEMS, INC.

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OLI Systems is an established global leader in delivering comprehensive, process optimization solutions for water chemistry based industrial applications. As the pioneer in electrolyte/water chemistry science and its applications to industrial processes. With the industry leading water chemistry process modeling portfolio of software, professional services, technical support, rich domain expertise, and tailored application solutions. OLI Systems can optimize multiple water chemistry-based processes in oil & gas, power generation, metals & mining, chemicals, water treatment, and industrial markets."

PARKSON CORPORATION

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Parkson is a supplier of equipment and solutions for industrial and municipal wastewater applications. We design, engineer and assemble products that provide customers with advanced screening, biological, filtration and biosolids management solutions. Parkson products are widely used in diverse industrial segments such as food & beverage, power, mining, pulp & paper, chemical, and more. Our highly trained field service team is capable of completely rebuilding aging equipment or retrofitting equipment to include the latest technological advancements.

PLASTOCOR INC.

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Plastocor, Inc., specializes in the turnkey field application of protective coatings to main surface condensers and BOP heat exchangers. Services include tubesheet cladding, tube-end coating and coating the full length of the tube ID with our patented tube coating process. To eliminate air inleakage, condenser flanges can be coated and sealed. Corrosion protection of waterboxes, BOP heads, channels/cover plates, service water and circulating water piping are provided. To date, over 3,500 tubesheets coated, eight (8) million tube-ends coated, 500,000 tubes coated full length and 900 waterboxes coated. EXTENDED LABOR AND MATERIAL WARRANTIES INCLUDED.

PROTEC-ARISAWA

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PULSAFEEDER, INC.

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Pulsafeeder, has been the recognized leader in fluid handling technology, including diaphragm, mechanical diaphragm, solenoid actuated metering pumps, peristaltic pumps, cooling tower controllers, and chemical feed system pumping technologies. Our extensive product breadth enables us to provide the convenience and efficiency of single-source solutions across various industries. With our global network of representatives, Pulsafeeder assures that products and local support are available for total customer satisfaction.

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PureLine is a company rich in water process technology expertise with a focus in biological control/disinfection, destruction of bio-recalcitrant organics, and interface disruption in liquid/liquid and liquid/solids separation applications. Our core physical products include a complete range of chemical and electro-chemical oxidants, and the chemical and mechanical means of treating water in a variety of industrial applications.

PUROLITE CORPORATION

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Purolite Corporation 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 solve your process challenges.

RESINTECH, INC.

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ResinTech manufactures a broad range of ion exchange resins, activated carbons, and selective adsorbents for water and wastewater treatment. An industry leader for over 30 years, ResinTech has led the way in ion-exchange research and development. Our premium quality media, legendary technical support, and patented technologies help dealers and operators worldwide ensure optimal water quality for a wide array of applications. Together with its corporate subsidiaries ACM Technologies and Aries FilterWorks, the ResinTech family of companies provide products and services to support all phases of IX resin life cycle from media formulation to ion-exchange application to resin regeneration.

RETEGO LABS

Booth #: 107
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The RETEGO Labs TTR-2 is a robust spectrometer that allows users the abilities to analyze and predict the scale tendencies in a wide range of water matrices. Legionella bacteria are often linked to waters that produce scale buildup in pipes, water heaters, cooling towers and tank reservoirs. Water high in scale tendencies can lead to the presence of biofilm where Legionella spp. Can grow. By monitoring both the scaling factors and microbial presence in the water, systems operators can ensure proper treatment and prevention methods are being provided.

SALTWORKS TECHNOLOGIES

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Website: www.saltworkstech.com

Saltworks Technologies is an award-winning industrial water treatment company that delivers cost-effective and innovative solutions to make clean water, concentrate brine, and achieve minimal liquid discharge (MLD) and zero liquid discharge (ZLD). With plants sold worldwide and repeat orders from major international customers, Saltworks has an established history of delivering and operating full-scale water treatment systems.

SAMCO TECHNOLOGIES

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Engineering, process design and manufacture of water, waste and process separation systems for the chemical, power, pulp/paper, mining and petro-chemical industries. Ion exchange, DuPont Upcore/Amberpack, membrane reverse osmosis, ultra filter, micro filter.

SNOWPURE WATER TECHNOLOGIES

Booth #: 408
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Website: www.snowpure.com

SnowPure Water Technologies, manufacturer of Electropure EDI modules, supplies an array of water purification and process components directly to system integrators in 65 countries. Our technologies include: EDI, DC Power Supplies, NF, UF, RO, Ion-Exchange Membranes (IXM), ED, UV, and Gas-Transfer Membranes (GTM). With decades of exporting experience and industry knowledge. SnowPure works closely with OEMs to help optimize system design and performance to ensure quality processes and product specification.

SOLENIS LLC

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Solenis is a leading global manufacturer of specialty chemicals for the pulp, paper, oil and gas, chemical processing, mining, biorefining, power and municipal markets. The company's product portfolio includes a broad array of process, functional and water treatment chemistries as well as state-of-the-art monitoring and control systems. These technologies are used by customers to improve operational efficiencies, enhance product quality, protect plant assets and minimize environmental impact. Headquartered in Wilmington, Delaware, the company operates 41 manufacturing facilities strategically located around the globe and employs a team of 5,200 professionals in 120 countries across five continents. For additional information about Solenis, please visit www.solenis.com.

EXHIBITORS

STANTEC

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Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind. We care about the communities we serve—because they're our communities too. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe. Stantec trades on the TSX and the NYSE under the symbol STN. Visit us at stantec.com or find us on social media.

STENNER PUMP COMPANY

Booth #: 605
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Website: www.stenner.com

Established in 1957, the Stenner Pump Company manufactures reliable peristaltic metering pumps. Introducing the new S40 addition to the S Series smart pump line. The S Series interfaces with process control systems utilizing a 4-20mA output signal and three output relays. The pump has multiple operational modes and programmable communication such as tube leak, tube change and the ability to transfer operation to a backup pump. Stenner pumps are self-priming and offer toolless tube replacement.

SUEZ WATER TECHNOLOGIES & SOLUTIONS

Booth #: 201/203
Contact: Carolyn Johansen
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E-mail: carolyn.johansen@suez.com
Website: www.suezwatertechnologies.com

SUEZ's Water Technologies & Solutions business unit has a comprehensive set of chemical, equipment and digital enabled services and products. We help our customers optimize water resources and overcome process challenges. We work with customers across all industries, including food and beverage, power, and oil and gas to help solve their toughest water, wastewater and process challenges. Visit www.suezwatertechnologies.com.

SUMITOMO ELECTRIC INDUSTRIES LTD.

Booth #: 311
Contact: Takashi Harada
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Website: www.global-sei.com/poreflon/

Sumitomo Electric Industries provides wastewater treatment solutions with proprietary hollow fiber MF/UF membranes made of PTFE (polytetrafluoroethylene). The membranes are robust and tough, having excellent thermal and chemical stability. The membranes are tolerant to high content of oil in feed water, enabling to treat oily wastewater without pre-treatments. Those are ideal solutions to industrial wastewater treatment applications including oil & gas, mining, power, food & beverage and others.

SWAN ANALYTICAL USA

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Swan Analytical USA manufactures online continuous monitoring analytical instruments for high purity water and potable water. Measurements include trace sodium, trace silica, trace Dissolved Oxygen, Conductivity/Resistivity, pH/ORP, SAC 254, phosphate, nitrate, ammonium, hydrazine, TOC, chlorine, bromine, fluoride and turbidity. Swan's analyzers deliver high precision with ease of operation. Contact us at info@swan-analytical-usa.com, Tel: 847-229-1290, www.swan-analytical-usa.com

THERMAX, INC.

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

TURNER DESIGNS HYDROCARBON INSTRUMENTS, INC.

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Turner Designs Hydrocarbon Instruments is unparalleled in its expertise for the measurement of hydrocarbons in water and soil. Our customers enjoy the benefits of our worldwide exposure, product development, and distribution network. We have a wide range of models available to fit a wide range of water process and measurement requirements. We provide highly skilled field support from a global dealer and service network in North America, Asia, Europe, West Africa, and the Middle East.

U.S. WATER

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Website: www.uswaterservices.com

By combining our innovative equipment and sustainable chemical programs, we can develop 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.

UNITED CONVEYOR CORPORATION

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United Conveyor Corporation (UCC) provides highly-engineered material handling and environmental solutions for power generation and industrial applications worldwide. This includes Fly Ash, Bottom Ash, Air Pollution Control and WastewaterTreatment technologies. We work closely with customers to conceptualize, design, and supply systems that meet their individual plant needs. Our company's success is based on providing our Customers with the highest level of innovations, system reliability and customer service throughout the life of their system.

UNIVAR SOLUTIONS

Booth #: 410
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Website: www.univar.com

Optimizing water treatment procedures requires an understanding of treatment options and foresight to determine the ideal chemicals and additives for each situation. Univar Solutions offers a comprehensive portfolio of water treatment additive components and specialty chemicals from leading suppliers around the world. Our team of technical water treatment specialists can assess current chemical applications processes and recommend performance optimizing and cost reducing alternatives. Combining water treating expertise and a broad product portfolio with the largest distribution network in the nation, we are the answer for innovative water treatment solutions.

VEOLIA WATER TECHNOLOGIES

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Veolia Water Technologies specializes in technological solutions to provide a complete range of services required to design, maintain, and upgrade water and wastewater treatment facilities for industrial clients and public authorities.

WATERCO

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Waterco is a leading manufacturer of a wide range of FRP pressure vessels employed as media filters and contact chambers for use in water treatment. Standard vessels are built to 4 bar and can be built to 10 bar to accommodate higher pressure requirements. Vertical sizes range from 24″ to 118″ in diameter (3 sq. ft. to 76 sq. ft.). Horizontal vessels are 79″ in diameter and range from 12′4″ to 28′3″ long (70 sq. ft. to 172 sq. ft.) All vessels offer deep-bed and deep-deep bed options to maximize media bed depths and/or media volume.

WATERCOLOR MANAGEMENT

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WaterColor Management has been underwriting insurances for Water Treatment and Water Handling Businesses since 1986. The range of insureds within our group of companies varies from one- person water businesses to worldwide organizations with thousands of employees. WaterColor Management provides the most specialized insurance contracts for the Water Treatment and Water Handling Industry, and to keep our water industry clients' losses to a minimum by offering risk management and loss control services.

WATSON MARLOW FLUID TECHNOLOGY GROUP

Booth #: 508
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Website: www.watson-marlow.com

As the global leader in peristaltic pump technology, Watson-Marlow Fluid Technology Group provides safe, accurate and reliable chemical metering pumps to all markets. Or pumps cover a range from 0.1 ml/min to 475 gpm against pressures as high as 232 psi. The risk of siphoning and gas locking, common in diaphragm pumps, is eliminated. Our peristaltic pumps have no valves, diaphragms, rotors or stators which fail. Watson-Marlow Qdos metering pumps are an easy, drop-in replacement for diaphragm pumps with only one replacement part.

WESTECH ENGINEERING, INC.

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WesTech Engineering is a premier manufacturer of water and wastewater treatment process equipment for industry. Many of our mobile pre-engineered treatment designs are currently deployed in wide ranging applications. These mobile units provide fast installation, modular design, and can be up and running quickly. Piloting is available with onsite equipment operations and process integration. Additional treatment capability for existing plants or remote site requirements for water treatment are among applications for these versatile process solutions.

WIGEN WATER TECHNOLOGIES

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Wigen Water Technologies is a leading manufacturer of membrane systems, from MF/UF to NF and RO. We also manufacture ion exchange systems, pressure filters and GAC adsorbers enabling us to provide fully integrated water treatment solutions.

WORLEY

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Global engineering leaders WorleyParsons and the Jacobs Energy, Chemicals and Resources division, including the former CH2M Industrial Water team, recently came together as a new brand – Worley. We provide our customers with full consulting, engineering, procurement, and construction capabilities. Worley's expertise includes the full water envelope for power plants, oil, gas, chemical, mining, and other industrial systems providing you with world-class solutions at an optimized cost and value.