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1:00–5:00 PM	CONTINUING EDUCATION WORKSHOPS - ADDITIONAL REGISTRATION REQUIRED			

Welcome to the IWC!

On behalf of the Engineers' Society of Western Pennsylvania (ESWP), the IWC Executive Committee, and the IWC Advisory Council, I am proud to welcome you to the 78th Annual International Water Conference® (IWC) in Orlando, FL. The IWC remains an important source for new technical information and training in the industrial water and wastewater business, spanning numerous industrial sectors, and addressing today's most relevant technical topics.

As always you will find our technical program chocked full of hot topics from the industrial and power water and wastewater treatment worlds, including fluidized gas desulfurization wastewater and other wastewater treatment, water management and reuse, zero liquid discharge systems, trace contaminants, monitoring, mine water treatment strategies, and produced water treatment for the oil and gas industry, in addition to more traditional areas such as ion exchange, membranes, cooling water, and steam generator issues and chemistries. This year we have also added three new sessions - one on sustainability, another on wastewater fundamentals, and a third on innovative treatment technologies. We hope that each of you learn something that helps you advance in your career and profession.

Last year we debuted our first digital conference app with great success. We have updated and improved it based on your recommendations. Use it to navigate your way through the conference. It provides information on exhibitors, schedule and sessions, workshops, sponsors, papers, authors, Executive and Advisory Committees, and much more. We welcome your feedback. It is key to note that you will need to download the new app even if you still have the one from 2016 on your device.

Our technical program is the heart and soul of our conference. Its unique format includes peer review and prepared discussions for virtually every paper presented and reflects our commitment to ensuring that sharing and discussion of technical information is the primary focus of our conference. I'd like to thank this year's Technical Program Chairperson, Patricia Scroggin, for all of her hard work in coordinating this year's program. Patricia has done an excellent job in developing the program and coordinating with all of this year's Session Chairs, Discussion Leaders, Authors, and Discussers. A big thanks to all the folks who have had a role in this year's technical program for their willingness to share their time and knowledge of the industry with all of us.

Our conference also offers the opportunity for you to gain more in-depth expertise by attending 4-hour training sessions presented by experts in the field and covering a wide-range of topics for beginner and experienced level water and wastewater treatment professionals. This year we are pleased to offer 21 different workshop opportunities for you to expand your knowledge base and earn continuing education credits. I'd like to thank Ken Dunn and the instructors for putting together a great set of courses for us this year. The workshops are held post conference on Wednesday afternoon and Thursday. We will again be offering the 4 courses in basic water, ion exchange, reverse osmosis, and wet flue gas desulfurization pre-conference on Sunday afternoon, as well as post-conference. It is not too late to sign up for one or more of the workshops as registration will continue to be open at the registration desk throughout the conference.

Expect to see an extensive Exhibit Hall showcasing the latest advancements in water and wastewater treatment. Be sure to take advantage of this great opportunity to meet with over 100 different company exhibitors and learn more about what's new in water and wastewater treatment. A big thank to all of our exhibitors for their continued support of the IWC. Lunch and other re-

freshments 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.

In addition to a full technical program, we are fortunate to have Mr. Emilio Tenuta, Vice President Corporate Sustainability for Ecolab, as our keynote speaker. We always strive to have our keynote address complement our technical program by being an educational and informative presentation on a highly relevant topic. We hope that you will join us for his keynote address on Monday morning and will find Mr. Tenuta's presentation both inspiring and informative.

On a sad note, I would like to take this opportunity to recognize and remember Mike Sheedy, who was the original 2017 IWC General Chairperson, but who passed away earlier this year. Mike was a critical part of the planning effort that brought this year's conference to life and his passion, commitment, and expertise are definitely missed. Please remember him as we conduct our business this week in Orlando.

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 Kristen Musloe. The success and growth that the conference continues to experience each year is a direct result of all their hard work. You will always find at least one of them at the registration desk to answer any questions or provide any help that you might need during operating hours. I'd also like to recognize our dedicated IWC Executive Committee members for their commitment to making this year's conference a success. Every Executive Committee member is a volunteer and has spent countless hours coordinating sessions, exhibits, and workshops to make sure the conference runs smoothly. I would also like 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 Advisory Council are the key conference sponsors and allow us to provide coffee breaks, tote bags, the internet café and other items 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.

I hope that you enjoy this year's conference and value your chance to network with and learn from everyone that you meet here. I look forward to talking with many of you during our time in Orlando. I, and the rest of the IWC Executive Committee, welcome your feedback. Please do not hesitate to share your conference ideas with us.

The end of this 2017 International Water Conference marks the beginning of the 2018 IWC when we look forward to seeing you again in Scottsdale, AZ. Have a great conference!

Sincerely,

Debbie Bloom

Happily Retired

General Chair, 78th Annual International Water Conference

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 almost 1,000 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.

What Makes the IWC Different?

All papers presented at the IWC are carefully peer reviewed for quality and to ensure no commercial aspect is evident. In addition to the broad educational and networking opportunities being offered, the IWC invites you to participate through our unique Prepared Discussion program. Each paper presentation at the conference is followed by a Prepared Discussion – a thoroughly considered, different perspective on the topic. This is followed by an open floor discussion when all audience members and presenters can fully interact - ask questions, seek clarification, and raise alternative viewpoints, in essence – learn more!

THE IWC APP

Download the IWC APP, your go-to app for everything IWC!

- Access the conference schedule and customize your agenda with personal appointments
- Read the biographies of speakers and session managers
- Check out the exhibitors and locate their booth easily through the interactive map
- Get important updates and exciting offers through push notifications
- See who's attending and share contact information by networking with other attendees

In the Apple Store or Google Play Store download the CrowdCompass AttendeeHub App on the device you are bringing to the event!

Don't have IOS or Android? For web access on your computer or Blackberry, visit: https://event.crowdcompass.com/iwc17

1. Open the AttendeeHub app and click on "Search for Events" and search for "IWC"
2. Download the IWC 17 app.
3. Once opened, click on the three lines on the top left hand corner and click, "log in for more features."
4. Fill in your information and you will be emailed a verification number.
5. Type in the verification number that was emailed to you in the app and experience all the benefits of the IWC 2017 app.

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!

Merchandise

IWC shirts and hats are available for sale! Pre-prints for (most) technical presentations are available at the Registration Desk. Pre-prints can be purchased for $5.00 per copy, or $40 per 1GB flash drive with all the available papers, discussions and author's closures. Also, you can find copies of previous years' IWC Proceedings for $55 per volume

Attendee Receptions

To help you enjoy your stay in Orlando during the 2017 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. Also, all registered attendees are welcome to attend the Receptions on Monday and Tuesday evenings 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!

If your spouse is accompanying you to the IWC, please be sure to properly register them at the Registration Desk to gain admittance into these events.

Spouses' Welcome Breakfast

For spouses who are traveling with conference registrants, the IWC will host a Welcome Breakfast on Monday, November 13 at the Hilton Hotel. 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 31st 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 14 at 7:00 AM Sharp; meet in the hotel lobby at 6:45 AM. Distance: 3 miles – flat and easy course.

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 Sessions, the Exhibit Hall, and International Water Conference® social functions. In addition, important local phone numbers have been printed on the back of your badge for your use. To avoid any confusion with access to the events, please refrain from personalizing your official IWC name badge with any stickers, ribbons, etc., not provided by the Registration Desk.

Please note that exhibit hall only registrations are only entitled to attend functions in the exhibit hall. They are not permitted to attend technical 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

To view a printed list of IWC registrants, stop by the IWC Registration Desk. A PDF version will also be available on the computer in the WebSpot to view and jump onto your flash drive via USB.

An electronic version of the Registration List will be available for purchase at the IWC Registration Desk the morning of Wednesday, November 15. It provides the names of all registered attendees in both Excel and comma-delimited text formats. There is a $25 fee, please provide a flash drive. Please note that the IWC has a strict policy against providing email addresses in any list.

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 join our group on LinkedIn: International Water Conference.

Conference Proceedings

All registered attendees (except Exhibit Only) will receive a CD containing the Official Conference Proceedings of the 78th Annual International Water Conference®. The CD will be direct mailed to you approximately two months following the conference. We also offer an advance download of the same content; please contact the IWC staff to obtain the log-in information.

Call for Papers

We encourage you to participate in the 2018 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. For more information on how to become active in the IWC as an Exhibitor, Advisory Council Company, Executive Committee member, please contact ESWP at 412-261-0170 ext. 13 or by e-mail at t.bombalski@eswp.com.

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

About this Guide

To conserve paper, we attempted the most efficient use of the pages in this guide. Please pardon any unorthodox page or column breaks in our attempt to conserve resources.

DOW WATER & PROCESS SOLUTIONS

Monday, November 13, 7:30–9:30 PM
Poolside
Dow Water & Process Solutions is equipped to help you run a more energy efficient, cost-effective and competitive operation. Stop by the Hilton's pool area on Monday, November 13 to meet with Dow experts. 7:30–9:30 PM: Refreshments, food and ask questions to Dow experts. Visit us in the IWC Exhibit Hall at Booth #310 to learn more.

VEOLIA

Tuesday, November 14, 7:00–8:00 AM
Poinsettia / Quince rooms, Mezzanine Level of Hilton
2017 IWC Free Breakfast Seminar: Reducing Operating Costs & Risk

Reducing life cycle cost and risk is important to all industrial facilities. Water costs continue to rise as well as discharge restrictions. Minimizing fresh water use and discharge through reuse is one way to ensure that water will be available when needed and regulatory compliance will be achieved. Veolia will present case studies and technologies of how we have helped our industrial clients improve their bottom line and manage environmental risks. And, in several instances, our solutions also assisted municipalities to meet mass loading limits on phosphates and other constituents, thereby reducing costs for them as well. Bill Willersdorf of Veolia Water Technologies with 40+ years of experience, is the planned presenter.

LANXESS

Tuesday, November 14, 7:00–8:00 AM
Azalea / Begonia rooms, Mezzanine Level of Hilton
How to control the microbiological growth in your industrial water system. Case studies with their new DGH/Bronopol Blend (PREVENTOL® DP 1021)

We will present case studies on the blend of Dodecylguanidine Hydrochloride (DGH) and 2-Bromo-2-Nitropropane-1,3 –diol (Bronopol) (PREVENTOL® DP 1021) in industrial water treatment systems. The blend combines the strong biocidal active with a surface activating biocide to provide increased microbial protection for your water system. In addition to the microbial control, the blend helps to reduce the build up of organic load on the surface of the water treatment systems. The reduction in organic load minimizes the formation of biofilms on the surface of the water treatment systems helping to prevent other problems associated with biofilms.

RETEGO Labs

Monday thru Wednesday, November 13–15; times TBA
Dogwood room - Mezzanine Level of Hilton
RETEGO Labs was established in October of 2014 to develop a rapid, robust and highly accurate field method of determining critical water quality parameters in complex municipal and industrial water and waste-water applications. THE RETEGO system for measuring critical water parameters is our leading edge technology centered on more than 20 years of scientific experience in the treatment and monitoring of industrial water and waste waters. Our tests are conducted on-site and deliver fast, accurate water monitoring within minutes without the need for specialized training or liquid reagent handling. All sample results are digitally processed, allowing electronic report distribution to anyone, anywhere a snap!

In addition to our Workshop, we will be conducting in-depth, hands

on demonstrations in our Info-Share Suite on Monday, Tuesday and Wednesday. Visit us in the IWC Exhibit Hall at Booth 109 for specific hours and additional information!

ASME Meetings

All ASME meetings, with the exception of Monday's Executive Subcommittee, are open to registered IWC attendees, no advance registration required.

- Executive Subcommittee Monday, November 13, 5:30–7:30 PM; Hibiscus Room, Mezzanine Level of Hilton
- Main Committee Wednesday, November 15, 2:00–3:00 PM; Hibiscus Room, Mezzanine Level of Hilton
- Water Technology Subcommittee Wednesday, November 15, 3:00–5:00 PM; Hibiscus Room, Mezzanine Level of Hilton
- Water Technology Subcommittee Thursday, November 16, 8:00 AM–12:00 Noon; Hibiscus Room, Mezzanine Level of Hilton
- Properties Subcommittee Thursday, November 16 8:00 AM–5:00 PM; Dogwood Room, Mezzanine Level of Hilton

IWC Executive Committee

The Engineers' Society of Western Pennsylvania would like to extend thanks and appreciation to the following members of the IWC Executive Committee for their loyal and dedicated service to planning this year's conference. It is through their efforts that we are able to present a world-class technical conference and exhibition to help broaden the knowledge of water and wastewater industry professionals from around the globe.

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

Debbie Bloom
Retired, Wheaton, IL

Ken Dunn
Solenis - Retired, Mashpee, MA

Michael Gottlieb
ResinTech, West Berlin, NJ

James (Jay) Harwood
SUEZ Water Technologies & Solutions, Oakville, ON, Canada

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McKim & Creed, Sewickley, PA

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HDR, Inc., Whitewater, WI

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Burns & McDonnell, Kansas City, MO

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Golder Associates Inc., Lakewood, CO

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GAI Consultants, Inc., Cranberry Township, PA

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Hatch Chester, Pittsburgh, PA

Patricia Scroggin
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Bowen Engineering, Indianapolis, IN

Jim Summerfield
DOW Chemical Company, Saginaw, MI

Bill Willersdorf
Veolia Water Technologies, Randolph, NJ

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

IWC Advisory Council

The IWC Advisory Council 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 participate in two meetings a year to plan the IWC. Ask the ESWP staff for details!

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Thank you to all of the sponsors of the 2017 International Water Conference®. Throughout the conference you will enjoy sponsored items such as the conference tote bag, hotel key cards, coffee breaks, hand sanitizers, welcome banners, and more. Listed below are our financial sponsors of the 2017 IWC.

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www.ppchem.net

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www.wwdmag.com

WC and P
www.wcponline.com

CHEMISTRY CONTROL IN UNFIRED INDUSTRIAL BOILERS (ASME)

Monday, Nov. 13; 8:00–11:00 AM
Room: Crystal
IWC Rep: Colleen Layman, HDR, Janesville, WI
Session Chair: Kevin Shields, Athlon Solutions, Geismar, LA

8:00 AM

Session Introduction

Unfired boilers often referred to as waste heat boilers, are commonly used in refining, petrochemical, chemical, and other industrial facilities. These boilers are typically used to cool process streams and, in doing so, generate steam. The papers in this session address recommended chemical treatment programs for these types of boilers and discuss some of the operational challenges associated with unfired boilers through case studies of waste heat generation units operating at ethylene and chemical processing plants.

8:05 AM

IWC 17-01: Total Boiler System Chemistry for Iron Oxide Generation (Corrosion) and its Crystal Growth Aggregation, Dehydration and Thermal Aging Characteristics Required For Polymer Treatment

John A. Kelly, Ph.D., United Water Consultants, West Chicago, IL

Iron (hematite), copper, and hardness recovery require certain complexing and chemisorption polymers fed to the feedwater and not the drum. Hematite particles have a maximum of water exchange sites (one per square iron oxide atom maximum) at the feedwater treatment location. Hematite particle formation occurs primarily in the condensate system and hydrates as it initially forms and releases from the metal surface. Growth occurs by coordinated water condensation between particles with dehydration/thermal aging of internal sites. Dispersants adsorb by electrostatic attraction (weak) and desorption occurs easily. Chemisorption by PAA polymer exchanges with particle water coordination sites at the particle surface.

8:40 AM

IWC 17-02: Controlling Ethylene Plant Waste Heat Boiler Chemistry During Decoking

David Puchan, Nalco Champion, An Ecolab Company, Sugar Land, TX; Tony Banweg, Nalco Water, An Ecolab Company, Naperville, IL

During the Ethylene plant decoking process, WHB steam generator blowdown is greatly increased taking the congruent pH phosphate boiler water chemistry well outside of its normal pH/PO4 control ranges. While operating in this decoking mode, alternative boiler water chemistry control limits are needed to assure that corrosion control is being maintained. This paper discusses the process for setting Ethylene plant WHB boiler water control limits during the decoking operation.

9:15 AM

IWC 17-03: Heat Exchanger Failures in a Waste Heat Steam Generation System

Edward (Ted) Beardwood, Solenis LLC, Wilmington, DE
Steam generator failures occur for a variety of reasons, and sometimes the root-cause(s) are misdiagnosed, leading to re-occurrence of the failures. Tube failures are not necessarily required to impact the degradation of system performance. The following 2 case histories will illustrate that the actual root cause failures bear no resemblance to the perceived mechanisms initially proposed. A comprehensive, detailed review of operational conditions compared to design criteria must be undertaken. This, in conjunction with a thorough metallurgical examination and complete deposit analysis is critical to understanding the failure mechanism(s) and arriving at the path forward. The remedies provided and their validations are also discussed.

REVERSE OSMOSIS: OPTIMIZING SYSTEM DESIGN WHILE MINIMIZING COSTS

Monday, Nov. 13; 8:00–11:00 AM

Room: International Ballroom South

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

Session Chair: Lyndsey Wiles, MICRODYN-NADIR US, Inc., Goleta, CA

Discussion Leader: Andrew Erickson, Burns & McDonnell, Kansas City, MO

8:00 AM

Session Introduction

Reverse osmosis (RO) was originally commercialized in the 1960s and has since developed to become a key purification pretreatment technology. Throughout the years, RO has tackled many new applications with different system types and configurations. This year's RO session takes a closer look at advancements in system design and reduction of operating costs. The session will feature a variety of presentations, including one focused on using a membrane system approach to minimize chemical usage in a zero liquid discharge (ZLD) scenario. Another presentation will discuss minimizing costs by reducing pressure drop with the use of a center port pressure vessel. A third presentation will demonstrate how RO system monitoring can maximize membrane life and minimize operating costs. As this program shows, RO is a critical technology that is continuously improved upon to meet ever-changing industry needs.

8:10 AM

IWC 17-04: Advanced Micro Filtration and Reverse Osmosis for ELG Compliance and ZLD

Mark Pastore, KLeeNwater, LLC, Sandy Hook, CT; David Martin, KLeeNwater, LLC, Elliston, VA
KLeeNwater, LLC has developed a novel approach to pretreat and concentrate wastewater streams to achieve up to 95% recovery rates using advanced membrane technologies

including but not limited to; ultrafiltration, micro-filtration, and advanced high pressure RO. The treatment approach is developed with site specific goals and limits in mind to allow for minimal chemical usage and optimal membrane performance to keep operating costs to a minimum. Two on-site pilot studies were conducted in order to determine the most cost effective treatment program to either meet ELG limits for discharge or to provide "zero liquid discharge (ZLD)" scenarios. This paper will discuss the two pilot studies in detail as well as how KLeeNwater works to meet the project goals.

8:35 AM: Discusser: Joe Guida, P.E., Fluor, Sugar Land, TX
8:45 AM Author's Closure & Floor Discussion

9:00 AM

IWC 17-05: The Center Port RO Vessel-An Underutilized Design Tool

Richard Chmielewski, P.E. and Daniel Gilson, Protec-Arisawa Americas, Vista, CA

RO systems operating at high recovery have been designed using multi-element pressure vessels. The vessels are arranged in a "tapered" array such as 4-2-1. This paper will discuss the use of center port vessel, and will give examples where a center port design is compared to a conventional design. The advantages in terms of reduced operating pressure will be demonstrated. Capital costs will be compared for the two designs and payback periods estimated.

9:25 AM: Discusser: Morgan Beveridge, Duke Energy, St. Petersburg, FL
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:10 AM

IWC 17-06: Advantages and Disadvantages of Three Different Approaches to Reverse Osmosis Performance Monitoring

Gary Engelgau and Richard Fruit, Athlon Solutions, Geismar, LA

Reverse osmosis (RO) is a highly effective water purification process. Understanding the condition of the system enables the accurate application of the decision making process to maintain the health of the membranes based on performance levels. Three approaches to performance monitoring will be discussed with advantages and disadvantages for each method. Understanding and implementation of these strategies/tactics will allow owners/operators to optimize their RO system to maximize membrane life, minimize downtime, and reduce operational costs.

10:35 AM: Discusser: Ed Greenwood, P.Eng., Wood, Cambridge, ON, Canada
10:45 AM: Author's Closure & Floor Discussion
11:00 AM: Conclusion

TRACE CONTAMINANTS, TECHNOLOGY DRIVEN ADVANCEMENTS

Monday, Nov. 13; 8:00–11:00 AM

Room: International Ballroom Center

IWC Rep: Ken Dunn, Solenis-Retired, Mashpee, MA

Session Chair: Peter Meyers, ResinTech, Inc., West Berlin, NJ

Discussion Leader: Steve McSherry, Wigen, Chaska, MN

8:00 AM

Session Introduction

The ever downward limits for regulated contaminants such as selenium, mercury, and chromium, is driving research and product development for ways to remove trace contaminants to ever lower levels. This session features papers that explore recent research and new products being used for removal of various trace contaminants.

8:10 AM

IWC 17-07: An Innovative Method for Removing Trace Metals from Industrial Stormwater at a Hard Chrome Plating Facility

Paul Eger, Global Minerals Engineering, Hibbing, MN; Tom Poplawski, Jack Beatty, and John Wagner, Diamond Chrome Plating, Howell, MI; Peggy Jones and Doug Green, American Peat Technology, Aitkin, MN

Stormwater from a plating facility with elevated levels of chromium, cadmium and zinc was treated with a peat sorption media. Treatment began in 2008 and metal removal exceeded 85% for over 3 years. Changes in procedures caused performance and media lifetime to fluctuate until 2015 when system operation was stabilized and performance returned to initial levels. The media has been removing greater than 77% of the metals for more than 2 years.

8:35 AM: Discusser: John Schubert, P.E., HDR, Sarasota, FL

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

9:00 AM

IWC 17-08: Enhanced Coagulation for Total Suspended Solids and Total Organic Carbon (TOC) removal from the Sabine River at Lake Charles

Americus Mitchell, Fluor, Sugar Land, TX; Anthony Gibson, Sasol, Westlake, LA; Temple Ballard, SUEZ, Richmond, VA

A petrochemical facility in Louisiana requires treatment of 14.5 MGD of water to support new facility operations. Upon, a review of the water cycle in the plant, it was determined that total organic carbon and total suspended solids removal was required. To accomplish this several different laboratory studies where carried out. The studies helped to determine the type of organics and removal method. Presentation of the results and chemical selection will be provided.

9:25 AM: Discusser: Bryan Hansen, Burns & McDonnell, Centennial, CO

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

9:50 AM Networking Break

10:10 AM

IWC 17-09: The Impact of Dissolved Organic Carbon on Mercury Removal in FGD Wastewater

Mandi Richardson, Cassandra Hutson, and Gary Blythe, AECOM, Austin, TX; Srinivasan Nanda, EPRI, Palo Alto, CA
This paper will present results from an EPRI funded study to investigate the impact of dissolved organic carbon (DOC) on mercury removal in FGD wastewater treatment processes. Current investigations involve isolating organic matter from FGD wastewater samples via soil science separation methodologies to speciate the DOC present. Isolated DOC fractions will be spiked into synthetic FGD wastewater samples to quantify the impacts of specific classes of organics on mercury removal technologies.

10:35 AM: Discusser: Dave Riedel, Arcadis, Washington, D.C.
10:45 AM: Author's Closure & Floor Discussion
11:00 AM: Conclusion

ADVANCES IN ON-LINE MONITORING METHODS FOR BOILER WATER AND FGD WASTEWATER

Monday, Nov. 13; 8:00–11:00 AM

Room: International Ballroom North

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

Session Chair: Vickie Olson, Honeywell UOP, Sandy Springs, CA

Discussion Leader: Jamie Fox, Brooks Applied, Bothell, WA

8:00 AM

Session Introduction

Utility and industrial boilers require optimum water quality to minimize corrosion and scaling. Flue Gas Desulfurization (FGD) wastewater users are under environmental regulations to provide better wastewater quality. In this session, comparisons of new and developing existing technologies to continuously monitor corrosion, sulfate, chloride, mercury, selenium and arsenic will be discussed to achieve these goals.

8:10 AM

IWC 17-10: Evaluation of Online Monitors for Measurement of Treated FGD Wastewater

Mandi Richardson, Cassandra Hutson, and Craig Katkic, AECOM, Austin, TX; Naomi Goodman, EPRI, Palo Alto, CA
This paper will present information from EPRI-funded projects focused on investigating the state of the science and technology for online water quality monitors. Project activities include a vendor survey to ascertain the technological readiness of instruments, and laboratory and field evaluation of online monitors for their ability to accurately measure arsenic, selenium, and mercury concentrations in treated FGD wastewaters and to operate effectively in a field setting.

8:35 AM: Discusser: Joel Citulski, SUEZ Water Technologies & Solutions, Oakville, ON, Canada
8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 17-11: Case Study: On-Line Chloride and Sulfate Measurement by Microfluidic Capillary Electrophoresis

Akash Trivedi, METTLER TOLEDO Thornton, Inc., Billerica, MA

Corrosion due to chloride and sulfate contamination leads to unplanned shutdowns as well as repair and replacement costs in power plants. Hence, monitoring chloride and sulfate at very low ppb limits is specified in various guidelines and warranties. This paper provides a case study on on-line chloride and sulfate measurement using an analyzer based on Microfluidic Capillary Electrophoresis technology. It provides evaluation data from different power plants and compares that to cation conductivity where available.

9:25 AM: Discusser: Chris Baron, ChemTreat, Newark, DE
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:10 AM

IWC 17-12: Corrosion Product Transport Monitoring with Non-Contact Nephelometry

Randy Turner, SWAN Analytical USA, Wheeling, IL; Marco Lendi and Manuel Sigrist, SWAN Analytical Instruments, Hinwil, Switzerland

Monitoring corrosion product transport in steam and water cycles is essential to minimize corrosion. Iron corrosion products exist predominately as undissolved suspended particles therefore to measure the total iron a digestion must be performed. Currently there are no total iron analyzers available to continuously monitor total iron therefore surrogate methods such as nephelometry as well as particle monitors have been employed. This paper describes the results of research employing nephelometry to monitor corrosion product transport.

10:35 AM: Discusser: Kenneth Kuruc, Hach, Medina, OH
10:45 AM: Author's Closure & Floor Discussion
11:00 AM: Conclusion

IWC 17 RESERVE PAPER

Evaluation of On-line Liquid Sulfite Monitor for Optimizing Wet FGD System Wastewater Characteristics

Gary Blythe, P.E. and Craig Katkic, AECOM, Austin, TX; Nanda Srinivasan, EPRI, Palo Alton, CA; Ray Gansley, GE Power, Water & Process Technologies, Knoxville, TN

This paper presents results from an evaluation of an on-line liquid-phase sulfite analyzer for measuring and controlling sulfite ion concentrations in a forced oxidation wet FGD system absorber slurry. The measured liquor sulfite concentration is used for feedback control of the oxidation xair flow rate to the absorber reaction tank. Observed beneficial effects of liquid sulfite control on FGD wastewater properties include lowered concentrations of dissolved mercury, selenium, nitrate, and peroxodisulfate and greatly reduced oxidation of selenite to selenate. These benefits can lessen wastewater treatment requirements to achieve compliance with the 2015 Effluent Limitations Guidelines and avoid the introduction of oxidants in wastewater going to biological treatment.

IWC KEYNOTE SESSION

Monday, Nov. 13; 11:15 AM–12:00 Noon

Room: International Ballroom Center

Session Chair: Debbie Bloom

The IWC Keynote Session is the official start to the 2017 conference. In addition to the presentation of the annual awards, including the IWC Award of Merit, and the Paul Cohen Award, we are pleased to have Mr. Emilio Tenuta of Ecolab as our Keynote Speaker.

Following the conclusion of the Keynote Session, enjoy lunch strolling thru the IWC Exhibit Hall and visit with the many exhibitors to extend the opportunity to learn and network!

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

ANNUAL MERIT AWARD

Each year, the International Water Conference® presents the Annual Merit Award to honor outstanding individuals in the field of industrial water technology. This year's Merit Award Winner is John Schubert. Mr. Schubert currently works for HDR, and is a frequent presenter at the IWC, and Past Chair of the Conference.

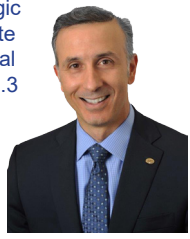
PAUL COHEN AWARD

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 76th Annual IWC. This year, we honor Randy Turner for his presentation of, IWC 16-09, EDI Versus Conventional Resin Cation Exchanges for CACE Measurement in Power Plants: An Ion Chromatography Study.

JOSEPH A. LEVENDUSKY SCHOLARSHIP

This year, Epicor Inc. donated $750 to Chris Upham, a Senior majoring in Chemical Engineering at the University of Utah.

KEYNOTE PRESENTATION



Emilio Tenuta Ecolab's strategic sustainability journey focused on corporate responsibility, internal environmental stewardship and helping more than 1.3 million customers in more than 170 countries operate more sustainably. Tenuta's 30-year tenure at Ecolab, includes 25 years of technical and marketing management experience in various industries including Food and Beverage, Pharmaceutical, Lodging, Healthcare, Primary Metals and Automotive. He is actively involved in advancing global sustainability practices, with a significant focus on water stewardship. In partnership with Trucost – and a multi-stakeholder advisory group – Tenuta led development of the Water Risk Monetizer, industry's first financial modeling tool to assess water-related risks.

PRE-COMMISSIONING OF COMBINED CYCLE PLANTS (ASME)

Monday, Nov. 13; 1:15–5:00 PM

Room: Crystal

IWC Rep: Debbie Bloom, Retired, Wheaton, IL

Session Chair: Bob Bartholomew, Sheppard T. Powell Associates, LLC, Baltimore, MD

Discussion Leader: Doug Dewitt-Dick, Global Water Experts, Kemah, TX

1:15 PM

Session introduction

This session presents an overview of the recently published Consensus on Pre-Commissioning Stages for Cogeneration and Combined Cycle Power Plants, developed by the Water Technology Subcommittee of the ASME Research and Technology Committee on Water and Steam in Thermal Systems. Other featured papers present experience and case studies on commissioning sample panels at combined cycle plants, condensate polishing systems for combined cycle power plants and specifications for combined cycle power plants.

1:25 PM

IWC 17-13: Consensus on Pre-Commissioning Stages for Cogeneration and Combined Cycle Power Plants

Edward (Ted) Beardwood, Solenis LLC, Wilmington, DE
The Combined Cycle Task Group for the Water Technology Subcommittee of the ASME Research and Technology Committee On Water and Steam in Thermal Systems have prepared this 90 page report (ISBN: 978-0-7918-6126-4) and is now available to the public. The presentation will introduce the elements of the consensus report and highlight some of its features. This document provides guidance on design, procurement, and pre-commissioning activities that will result in the construction of a plant with steam/water-wetted surfaces that are as clean and corrosion-free as practical. Issues can surface during the commissioning of a combined cycle power plant that cause unintended delays, cost overruns, increased post start-up maintenance, and depreciation of equipment. Consensus recommendations have been developed to minimize these risks and improve long-term reliability. The material contained in the document is also transportable and transferable to other steam generation systems.

1:50 PM: Discussers: Edward Sylvester, Jr., ChemTreat, Nashville, TN; Glenn Matys, ChemTreat, Canada

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

2:15 PM

IWC 17-14: Commissioning New Sample Panels and Online Analyzers for HRSG Plants

Carl Feichtel and Robert Bartholomew, Sheppard T. Powell Associates, LLC, Baltimore, MD
Sample conditioning, online analysis and immediate corrective actions are essential during startup for protection of critical steam and water components. This paper presents past experiences of events and actions taken during startup and commissioning of sample conditioning and online chem-

istry monitoring panels for new combined cycle HRSGs. Proper programming, calibration, panel maintenance and continuous surveillance are needed. Risks from unit trips, condenser leaks, polisher exhaustion and other upsets also are addressed.

2:40 PM: Discusser: David Daniels, M&M Engineering Associates, Leander, TX
2:50 PM: Author's Closure & Floor Discussion
3:05 PM: Networking Break

3:20 PM

IWC 17-15: Planning Ahead to Minimize Chemistry Challenges During Combined Cycle Power Plant Commissioning

Colleen Layman, HDR, Whitewater, WI
This paper will explore the factors that should be considered when planning for commissioning of combined cycle power plants focusing on items related to the steam/water cycle chemistry. It will address items that should be considered during the design and construction phases of the project including equipment specification, design for testing and commissioning, shop inspections, and cycle chemistry process and procedure development. The discussion will include best industry practices and lessons learned from commissioning experiences.

3:45 PM: Discusser: James Bellows, James Bellows and Associates, LLC, Maitland, FL
3:55: Author's Closure & Floor Discussion

4:10 PM

IWC 17-16: Selecting the Best Path Forward: Condensate Polisher Position Paper

Bryant Purse, Brian Clarke,P.E., Brad Buecker, and Charles Statler, Kiewit Engineering Group Inc., Lenexa, KS
When evaluating whether or not condensate polishers are essential for natural gas combined cycle plants, the primary factor has been the capital investment of the equipment. However, research has shown that in some cases the perceived high cost of condensate polishers is typically quite minimal compared to their benefits. This paper will present the life cycle cost of a condensate polisher and give justifications for when they are needed at new facilities.

4:35 PM: Discusser: John Kelly, Ph.D., United Water Consultants, Chicago, IL
4:45 PM: Author's Closure & Floor Discussion
5:00 PM: Conclusion

WASTEWATER MEMBRANES: ADVANCING MUNICIPAL AND INDUSTRIAL RECYCLING AND REUSE

Monday, Nov. 13; 1:15–5:00 PM

Room: International Ballroom South

IWC Rep: Scott Quinlan, GAI Consultants, Cranberry Township, PA

Session Chair: Daniel Sampson, HDR, Vallejo, CA

Discussion Leader: David Weakley II, GAI Consultants, Homestead, PA

1:15 PM

Session introduction

Membrane technology plays an increasingly critical role in wastewater recycling and reuse. While straightforward in theory, practical applications require attention to detail. This session provides detail by focusing on case studies, beginning with the use of municipal tertiary treatment water to replace drinking water. The discussion then shifts to industrial processes with a case study of a high recovery secondary RO at a refinery and then a case study of ceramic membranes to treat and reuse metal- and oil-contaminated wastewater. The session closes with a novel wastewater membrane design that may provide benefit to a variety of industries.

1:25 PM

IWC 17-17: Switching from Drinking Water to Municipal Tertiary Wastewater for Industrial Plant Makeup: Design Progression through Installation and Operation

Mitch Mueller, Black & Veatch, Overland Park, KS; Melanie Blake, Koch Membrane Systems, Inc., Wilmington, MA
Tertiary wastewater is being used at industrial facilities to deal with water scarcity issues. This paper describes steps leading to selecting tertiary wastewater as makeup for an industrial facility, selecting a treatment approach, pilot testing, system design, startup and operation and other considerations when using tertiary wastewater. Final design consisted of ultrafiltration and reverse osmosis treatment for cooling tower and boiler makeup, and a phosphate reduction system to meet wastewater discharge permit limits.

1:50 PM: Discusser: Brittany Hohman, P.E., Veolia Water Technologies, Moon Township, PA

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

2:15 PM

IWC 17-18: A Unique High Recovery Secondary RO to Resolve Refinery Source Water and Brine Disposal Issues

Ed Greenwood, P.Eng., Wood, Cambridge, ON, Canada; John Christiansen, P.E., Wood, Houston, TX; Dan Kwiecinski, P.E., Wood, Albuquerque, NM; Scott Denton, The Holly Frontier Companies, Artesia, NM; Robert Kimball, Wood, Denver, CO
Amec Foster Wheeler designed and constructed a unique high recovery Secondary RO system at a Refinery in New Mexico to resolve source water and wastewater disposal limitations. The new system is directly coupled to the Primary RO System and operates beyond the solubility limits for

Silica and Calcium Sulfate by using a unique high recovery three stage array with both permeate and concentrate recycle loops to optimize performance.

2:40 PM: Discusser: Michael Bluemle, Ph.D., Solenis LLC, Wilmington, DE

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

3:05 PM: Networking Break

3:20 PM

IWC 17-19: The Use of Ceramic Membranes to Reuse Waste Water Contaminated with Cr VI and O&G and to Allow for Production Capacity Expansion

Benoit Tranape, Tracey Williams, and Chris Roy, Veolia Water Technologies, Waltham, MA

Metal equipment manufacturers typically generate quantities of waste rinse waters from finishing processes containing Chromium VI, Oil and Grease, Total Suspended Solids, and surfactants (COD) among other contaminants. This paper discusses the application of a ceramic based membrane process to effectively process these pretreated contaminated wastewaters in a single step process, removing Cr, TSS, O&G, and a portion of the surfactants, allowing for up to 80% of the wastewater to be recycled through RO treatment.

3:45 PM: Discusser: Holly Churman, GHD, Houston, TX

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

4:10 PM

IWC 17-20: Use of a Novel Membrane Technology to Treat Industrial Process and Waste Waters

James Peters, PPG Industries, Monroeville, PA

This paper will review a novel composite single layer membrane that provides high flux, excellent separation capabilities and durability. The presentation will review intrinsic membrane properties that create a durable, fouling resistant and high flux membrane. Lab scale and pilot field tests will be reviewed in a variety of industries. The case studies will focus on how the new filtration technology met real world customer needs allowing scale-up to larger field tests or commercial units.

4:35 PM: Discusser: Adhiraj Joshi, Aquatech International, LLC, Canonsburg, PA

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

5:00 PM: Conclusion

MAKING CONNECTIONS: WASTEWATER FUNDAMENTALS ACROSS INDUSTRIES

Monday, Nov. 13; 1:15–5:00 PM

Room: International Ballroom North

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

Session Chair: Jane Kucera, NALCO Water, an ECOLAB Company, Naperville, IL

Discusser: Steve McSherry, Wigen, Chaska, MN

1:15 PM

Session introduction

The objective of this session is to introduce the audience to the fundamentals of wastewater laying the groundwork for active participation in the more detailed presentations in the other technical sessions of the conference. Wastewater is the final step of water treatment in any facility and is absolutely critical to the ultimate sustainable operations of that facility. Cooling towers, boiler systems (pretreatment and blowdown), desalters, tank drainings, cleaning, and other operations generate wastewater in almost every industry. Prior to its final disposition, this wastewater must be treated rather than directly discharged. The session will begin with a discussion of water analytics. Correctly analyzing and characterizing wastewater is critical to understanding and managing a waste treatment plant and successfully controlling the effluent quality. The session will then discuss three typical types of wastewater from key industries including: refineries, power plants, and produced water. The papers will help the attendees understand the fundamental aspects of each of these wastewaters from the 10,000 foot level, including where the waste comes from, issues related to various sources, how to treat it, and various options for discharge or reuse.

1:25 PM

IWC 17-21: Analyzing a Water Analysis

Dennis McBride, Burns & McDonnell, Kansas City, MO

The process of designing, operating, and troubleshooting a water treatment system almost always begins with a water analysis. This analysis may be performed in a specialty laboratory, in a plant lab, or by personnel in the field. Each method has its advantages as well as disadvantages. Unfortunately, many times the analysis may be flawed (e.g. does not balance ionically), reported poorly (e.g. reported units not included in the report), or misunderstood by the recipient charged with its use (e.g. recipient does not consider the units reported, critical species may change in transport to the lab). This paper will talk about the differences between a potable and an industrial water analysis, which chemical species may be critical in an industrial water analysis, the importance of reporting and understanding the units, normal variability in various samples (i.e. well water versus surface water), as well as some tricks in evaluating the analysis for balance and completeness.

2:15 PM

IWC 17-22: Water and Wastewater Fundamentals: Petroleum Refineries

Harley Schreiber and Floyd Griffiths, WesTech Engineering, Inc., Salt Lake City, UT

Wastewater generated in refineries can present challenging treatment problems. The wide range of constituents can include suspended solids, dissolved metals and organics as well as oils and grease. Pretreatment of raw water and processing of plant wastewater requires fundamental knowledge of physical, chemical and biological separations methods and associated equipment. Although general in nature, this paper will form a sound foundation by which the reader can build their knowledge base and apply this to other wastewater treatment challenges.

3:20 PM

IWC 17-23: Power Plant Wastewater Treatment – A Fundamentals Introduction

Jeff Easton, Jaron Stanley, and Rick Szilagyi, WesTech Engineering, Inc., Salt Lake City, UT

Power plants use large amounts of water for cooling, material handling, cleaning and waste removal. Significant amounts of wastewater are produced requiring treatment prior to reuse or discharge. Understanding the basic flowsheets and treatment methods can be quite useful for those new to the industry or those who would like a better understanding of power plant wastewater needs. This presentation discusses wastewater sources and waste constituents including effluent requirements, treatment methods and basic flow sheets.

4:10 PM

IWC 17-24: Wastewater Fundamentals: Produced Water

Jason Burney, Ph.D., Carol Batton, Michael Weberski, and Michelle Samuels, Nalco Champion, an Ecolab Company, Naperville, IL

Produced water refers to water returned as a byproduct associated with oil and gas extraction processes and is an industrial waste stream. The quality varies widely depending upon geography, well age, and hydrocarbon type of the producing site. Produced water management is key to protecting the environment, reducing future fresh water demands and helping control production costs. This paper presents a produced water overview identifying components, handling challenges, and treatment strategies for different end uses.

ZLD INDUSTRIAL APPLICATIONS

Monday, Nov. 13; 1:15–5:00 PM

Room: International Ballroom Center

IWC Rep: Jonathan Shimko, Tetra Tech, Pittsburgh, PA

Session Chair: Mike Preston, Black & Veatch Corporation, Oakland Park, KS

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

1:15 PM

Session introduction

Zero liquid discharge is goal that is being pursued across a variety of industrial applications. The application of ZLD water management and treatment systems in various settings can be informative and stimulate cost effective applications from one industry to another. This Session will consider ZLD approaches in refining, electronics, mining, and power. Hear how they applied different ZLD approaches and what they learned in the process.

1:25 PM

IWC 17-25: Refinery Wastewater Treatment: From API to Evaporator

Americus Mitchell, Sunil Sajja, and Joseph Guida, P.E., Fluor, Sugar Land, TX

The design of refinery wastewater treatment plants is an engineering task, which requires experience in refinery operations and knowledge of wastewater treatment systems and equipment. This knowledge and experience was tested in the design of a Zero Liquid Discharge System for a refinery in the Middle East. Normal design issues such as removal of free/emulsified oil and residual organics are compounded by requirements of downstream units. These issues along with other details will be discussed.

1:50 PM: Discusser: Jim Beninati, HDR, Pittsburgh, PA
2:00 PM: Author's Closure & Floor Discussion

2:15 PM

IWC 17-26: Three Years of Full Scale Operational Experience from a Zero Liquid Waste (ZLW) Treatment Facility

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

A Zero Liquid Wasteplant was built in 2013 in a remote area in the mountains of WV to treat mine water collected from six mines. The objective of this treatment plant was to meet a strict regulatory limitation imposed by DEP 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.

2:40 PM: Discusser: Craig Van Dyke, SUEZ Water Technologies & Solutions, Bellevue, WA
2:50 PM: Author's Closure & Floor Discussion
3:05 PM: Networking Break

3:20 PM

IWC 17-27: Zero Liquid Discharge in Thin Film Transistor Manufacturing

Bruce Bishkin, SUEZ Water Technologies & Solutions, Bellevue, WA; Arthur Lin, Chunghwa Picture Tubes, LTD, Taoyuan City, Taiwan

Chunghwa Picture Tube is one of the world's leading manufacturers of flat screen displays. Due to increasingly stringent environmental regulations their operation at Longtan, Taiwan was required to stop discharging wastewater containing ammonia and fluoride. Biological and membrane technology were employed to reduce their wastewater to 40 m3/h. The remaining volume was reduced to a land fillable solid using evaporation technologies including mechanical vapor recompression (MVR), falling film evaporation, and forced circulation crystallization.

3:45 PM: Discusser: Jeffery Preece, EPRI, Charlotte, NC
3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 17-28: Thermal Evaporative Systems for Volume Reduction and Water Balance

Todd Whiting, Purestream Services, a Swire Company, Salt Lake City, UT

As coal-fired steam generation power plants face new challenges in meeting the EPA's Effluent Limitation Guidelines (ELGs) for certain power plant waste streams, thermal evaporation processes, like Purestream's AVARA thermal evaporation system, provide viable solutions for volume reduction, discharge compliance and zero-liquid discharge applications. In 2016 and 2017, in association with EPRI, Purestream Services participated in several power plant demonstrations that focused on the application of AVARA thermal evaporation technology for flue-gas desulphurization (FGD) wastewater treatment. This presentation will provide an overview of these commercial demonstrations and review a portion of the data accumulated and associated with the projects.

4:35 PM: Discusser: Christian Haussmann, P.E., Water Systems Specialists, Inc, Seattle, WA
4:45 PM: Author's Closure & Floor Discussion
5:00 PM: Session Conclusion

PRODUCED WATER EXPERIENCES, AND IMPROVED EVALUATION TECHNIQUES FOR THERMAL ENHANCED OIL RECOVERY SYSTEMS

Tuesday, Nov. 14; 8:00 AM–12:00 Noon

Room: Crystal

IWC Rep: Debbie Bloom, Retired, Wheaton, IL

Session Chair: Ivan Morales, Devon Canada, Calgary, AB, Canada

Discussion Leader: Mike Dejak, Eco-Tec, Calgary, AB, Canada

8:00 AM

Session Introduction

Papers being presented will relay applicable knowledge to Evaporator performance in a brownfield practical case study, OTSG performance evaluation including scale inhibitor selection, assessing cleanliness and maintenance requirements, and mitigation of off spec water conditions to minimize integrity impact to the OTSG's. Improved ion exchange audit methods to make it current with existing technologies, and overview of the measurement of a key indicator in Produced Water as Oil in Water (are also discussed).The session will cover Operational hands on experience, plant design evaluation, and measurement techniques for Produced Water systems.

8:10 AM

IWC 17-29: Water Balance Optimization for an Oil Sands Producer in Western Canada

Greg Mandigo, Aquatech International, Hartland, WI

Water and energy are clearly interdependent and this is never more apparent than in the steam-based enhanced oil recovery projects of Western Canada. In such processes, an extremely high value must be placed on water recovery: higher water recovery leads directly to higher available steam generation rates and consequentially, higher levels of oil production. This is especially true for projects that use once-through steam generators for steam production. Such systems have historically been designed with produced water treatment systems that achieve the necessary OTSG feed water quality but simultaneously have little water treatment infrastructure for the recycle of OTSG blowdown. This paper studies the optimizations made to one such brownfield Oil Sands project in Alberta and details how a VTFF evaporation system was designed to realize the value of water.

8:35 AM: Discusser: Dave Pernitsky Ph.D., P.Eng., Stantec, Calgary, AB, Canada

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

9:00 AM

IWC 17-30: Monitoring and Evaluating Scale Formation in Once-Through Steam Generators

René Bélanger, P.Eng., Baker Hughes, a GE company, Sturgeon County, AB, Canada; Daniel Di Bon, P.Eng., Baker Hughes, a GE company, Calgary, AB, Canada; Stephen Wight, Baker Hughes, a GE company, Fort McMurray, AB, Canada

Online and analytical methods have been developed for

monitoring and evaluating the amount of scale or fouling formation in once-through steam generators so that the equipment integrity is not compromised by over-heating due to excessive scale/fouling while maximizing steam output for oil production. This paper reviews the advantages and limitations of these monitoring practices which provide the decision makers with a higher level of confidence in assessing their equipment cleanliness and scheduling maintenance requirements.

9:25 AM: Discusser: Tom Reinders, M.Eng., P.Eng., Devon, Calgary, AB, Canada
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:20 AM

IWC 17-31: Optimizing Lime Softening Chemistry for SAGD Produced Water Application

Ron Maltman, Nalco Champion, An Ecolab Company, Calgary, AB, Canada; Corbin Ralph, Nalco Champion, An Ecolab Company, Bonnyville, AB, Canada

Lime softening approaches to water treatment have been around for many decades. The understanding of lime softening chemistry in a carbonate buffer environment is well understood. Lime Softening was adopted for use in the Thermal/SAGD space of the Canadian Oil Sands. This approach has provided acceptable results for many years. With the change in production stimulation practices, the traditional chemistry approaches that have been employed no longer provide the water quality for final hardness polishing.

10:45 AM: Discusser: Martin Grygar, Integrated Sustainability Consultants Ltd., Calgary, AB, Canada
10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 17-32: Measurement of Oil in Water and Water Soluble Organics in SAGD Produced Water

Martin Godfrey, Nalco Champion, An Ecolab Company, Eagan, MN; Logan LaRocque and Corbin Ralph, Nalco Champion, an Ecolab Company, Fort McMurray, AB, Canada

Water produced from the Steam Assisted Gravity Drainage (SAGD) process for heavy oil production must be recycled for steam generation. The produced water contains both oil and functionalized hydrocarbons that are soluble in water. Both the oil in water and the soluble organic material cause a variety of deposition problems that can be costly production bottlenecks, most notably produced water cooler fouling and steam generator coke formation. The present study focuses on methods for field analysis of the organic components in the produced water. Commercially available instruments were used with techniques suitable for routine analysis. Two main detection methods were studied, fluorescence and infrared absorbance.

11:35 AM: Discusser: Greta Zornes, Ph.D., CH2M, New Orleans, LA
11:45 AM: Author's Closure & Floor Discussion
12:00 Noon: Conclusion

INNOVATIVE TREATMENT TECHNOLOGIES

Tuesday, Nov. 14; 8:00 AM–12:00 Noon

Room: International Ballroom Center

IWC Rep: Jim Summerfield, DOW Chemical Company, Saginaw, MI

Session Chair: Bryan Hansen, Burns & McDonnell, Centennial, CO

Discussion Leader: Brad Spindler, Wunderlich-Malec Engineering, Green Bay, WI

8:00 AM

Session Introduction

Development of new treatment technologies and application of existing technologies in innovative ways will always be of interest throughout the industry. Reduction of capital and operating costs as well as environmental impacts is spurred on those willing to think outside the box and try something different. This session includes papers that touch on technologies that can be applied in a variety of applications including a non-phosphorous cooling water treatment program, ceramic ultrafiltration membranes, electrodialys is reversal, and multi-effect desalination adsorption.

8:10 AM

IWC 17-33: Implementation of a Non-Phosphorous Cooling Water Treatment Program for an Open Recirculating Cooling System with Highly Stressed Heat Exchangers

Robin Wright, SUEZ Water Technologies & Solutions, Ensenada, PR; Timothy Eggert, SUEZ Water Technologies & Solutions, Seal Beach, CA; Caroline Sui and Robert Hendel, SUEZ Water Technologies & Solutions, Trevose, PA; Alexander Lazariciu, SUEZ Water Technologies & Solutions, Walnut Creek, CA

This paper discusses the implementation of a non-phosphorous chemical treatment program which is now being used successfully in an open-recirculating cooling system with highly stressed heat exchangers. The case study focuses on a reactor cooling system where traditional chemical programs failed to provide adequate protection against scaling, fouling, and corrosion. The improved treatment approach provides excellent deposit and corrosion control, even without the need to utilize sulfuric acid for pH adjustment.

8:35 AM: Discusser: Jasbir Gill, Nalco Water, an Ecolab Company, Naperville, IL

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

9:00 AM

IWC 17-34: Ceramic Ultrafiltration Membranes with Improved Economics, Operability, and Process Design Flexibility

Brian Wise, Dr. Stanton Smith, and Dr. Winnie Shih, Nanostone Water, Inc., Eden Prairie, MN

With the latest advances in ceramic ultrafiltration (CUF) membrane manufacturing the capital costs are now competitive to polymeric hollow fiber UF (PUF) membranes. CUF membranes have longer life, are more robust, and have shown a freedom from operational limitations that plague PUF membranes, i.e., maintaining a high flux rate in cold water and sustainable operation in a wide range of water

quality conditions. Case studies presented to highlight these features in a variety of applications.
9:25 AM: Discusser: Lars Ellingson, Burns & McDonnell, Centennial, CO
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:20 AM

IWC 17-35: A Case Study of the First Installation of a New Electrodialysis Reversal (EDR) Technology

Jeff Tate, Agape Water Solutions, Inc., Harleysville, PA; Erik Caldwell, Northeast Water Services, Inc., Foxborough, MA
A new and innovative Electrodialysis Reversal (EDR) Technology was recently introduced to treat high TDS waters. The next ED was developed by the leader of Electrodeionization (EDI) modules, and utilizes a unique membrane and mechanical design. The first commercial system was recently installed. This paper will review the technology and challenges of the first installation. This includes the application of the technology to recover Reverse Osmosis concentrate waste water, system design and first year performance.
10:45 AM: Discusser: Jofre Santos, Jr., CHEM. ENG., B.SC.,Wunderlich-Malec Engineering, Green Bay, WI
10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 17-36: Concentration & Crystallization at Ultra-Low Temperatures/Pressures Powered by Low-Grade Waste Heat Adsorption

Kristav Childress and Joseph Ng, Medad Technologies Pte Ltd, Singapore; Kim Choon Ng, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia
Ultra-Low-Temperature Adsorption Crystallization (ULTAC), is a new distillation technology powered by very low-grade (75-85°C) waste (or renewable) heat. ULTAC provides both low pressure and cooling as part of the adsorption process. It can be used for concentration, crystallization and to achieve Zero Liquid Discharge (ZLD).AD-recovered water has low TDS for high-value applications such as boiler feed water.
11:35 AM: Discusser: Mike Marlett, Aquatech, Canonsburg, PA
11:45 AM: Author's Closure & Floor Discussion
12:00 Noon: Conclusion

FROM WASTE TO WATER – INDUSTRIAL WATER REUSE SUCCESS STORIES

Tuesday, Nov. 14; 8:00 AM–12:00 Noon

Room: International Ballroom South

IWC Rep: Mike Soller, Bowen Engineering, Indianapolis, IN

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

Discussion Leader: Mark Owens, SUEZ, Richmond, VA

8:00 AM

Session Introduction

Dirty wastewater comes from many different places. Treating the water for reuse is a valuable solution for facilities challenged with a limited supply. This session includes 4 papers describing innovative applied technology that has enhanced the economic viability and operation of their plant. These papers describe the treatment of various influents or difficult to discarded waters and how they were recycled for reuse.

8:10 AM

IWC 17-37: Conductive Plastic Evaporator Tubes – New Chances for the Water Business

Dirk Moses and Thomas Orth, Technoform Kunststoffprofile GmbH, Lohfelden,Germany

Evaporator tubes are one of the basic components in thermal water treatment applications. Until today, these tubes are made of metal. But now plastics become more and more attractive as heat exchanger materials, especially in harsh chemical environments. Unfortunately, their field of application is limited due to their thermal and mechanical properties. New polymer composites overcome these drawbacks and show good mechanical properties together with excellent thermal performance and outstanding fouling resistance.

8:35 AM: Discusser: Evan Claytor, SUEZ, Richmond, VA

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

9:00 AM

IWC 17-38: Start-up of Zero Liquid Discharge System to Recycle and Reuse Biotreated Effluent

Yakup Nurdogan, Ph.D., P.E., Bechtel, Pueblo, CO; James Earley, Ph.D. and Charles Oclassen, Battelle, Pueblo, CO; Paul Usinowicz, Ph.D., P.E., BCEE, Technical Advisor, Delaware, OH; Craig Myler, Ph.D., P.E., Bechtel, Reston, VA

The Pueblo Chemical Agent-Destruction Pilot Plant is constructed to destroy mustard agent by hot water hydrolysis followed by caustic neutralization. A zero-liquid discharge (ZLD) system was constructed to recover the water from the biotreated hydrolysate. The ZLD system includes an evaporator, crystallizer, and dewatering system to remove dissolved and suspended solids from biotreated effluent. The ZLD system was started in July 2016. More than 80% of the water is recovered and recycled to be reused by the agent hydrolysers, cooling towers, reverse osmosis units, biotreatment system, and offgas treatment system scrubber.

9:25 AM: Discusser: Brandon Delis, P.E., Dewberry Engineers, Inc., Charlotte, NC
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:20 AM

IWC 17-39: Egypt's First Zero Liquid Discharge Plant: A Case Study

Hossam El-Fahmy, Egyptian Ethylene and Derivatives Company, Alexandria, Egypt; Nageswara Rao Mikkilineni, Aquatech International, Cannonsburg, PA

The first integrated Zero Liquid Discharge (ZLD) plant, a landmark water treatment project installed at Egyptian Ethylene and Derivatives Company (ETHYDCO) in Alexandria was designed and supplied by Aquatech. The ZLD system included a Microfiltration system, a High Efficiency Reverse Osmosis (HEROTM) technology for achieving 97.5% recovery across the membrane system. Permeate from the HEROTM units treated through Fractional Deionization system to produce demineralized water. The reject from the HEROTM and the regeneration waste water is treated through Brine Concentrator and crystallizer to achieve complete ZLD. The Plant was commissioned in April 2016 and in operation since then. The fresh water demand was reduced by 70%, from 2600 to 800 M3/HR.

10:45 AM: Discusser: Ed Greenwood, P.Eng., Wood, Cambridge, ON, Canada
10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 17-40: Water Optimization in Combined Cycle Power Plants

Lucas Davis, Brad Buecker, Behrang Pakzadeh, and Brian Clarke, P.E., Kiewit Engineering Group Inc., Lenexa, KS

This paper reviews water usage and water discharge for a typical Greenfield 1x1 natural gas fired combined cycle power plant to determine what equipment provides the most water savings. The engineered equipment costs, auxiliary power requirements, water usage and water discharge are reviewed from a preliminary engineering standpoint and are intended to give readers enough information to make knowledgeable decisions regarding project costs and water savings, specifically the risks and benefits of internal water recycling.

11:35 AM: Discusser: Rudy Labban, P.E., SUEZ, Richmond, VA
11:45 AM: Author's Closure & Floor Discussion
12:00 Noon: Conclusion

TREATMENT CONSIDERATION AND APPROACHES FOR FGD WASTEWATER TREATMENT

Tuesday, Nov. 14; 8:00 AM–12:00 Noon
Room: International Ballroom North
IWC Rep: Tisha Scroggin, Burns & McDonnell, Chicago, IL
Session Chair: Bill Kennedy, Duke Energy, Charlotte, NC
Discussion Leader: Jeffery Preece, EPRI, Charlotte, NC

8:00 AM

Session Introduction

This session will discuss a range of topics focusing on source and treatment of ELG targeted constituents. Novel technologies, system designs and process controls are presented with a focus on practical application for meeting the challenging regulatory compliance limits. You will have an opportunity to hear about ongoing work in this area from those involved in project execution and research.

8:10 AM

IWC 17-41: Investigation of Sources of Nitrate/Nitrite in Wet FGD Wastewater

Gary Blythe, P.E. and Mandi Richardson, AECOM, Austin, TX; Paul Chu, EPRI, Palo Alto, CA
This EPRI project was conducted to determine sources of nitrate/nitrite in FGD wastewater from coal-fired units. The 2015 ELGs established limits on nitrate/nitrite concentrations in FGD wastewater discharges. Little is known by the industry about the concentrations or the sources of these species in FGD waters. The project involved collecting and analyzing samples from wet FGD systems over several months, reviewing process operations over that period, and calculating water and nitrate/nitrite balances. The results indicate the contribution of NOX in flue gas to nitrate/nitrite concentrations, effects of oxidation-reduction potential on the conversion of nitrate to other non-regulated species, and show how FGD chloride purge rates impact nitrate/nitrite concentrations in the wastewater.

8:35 AM: Discusser: Jason Baker, American Electric Power, Columbus, OH
8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 17-42: Extreme Recovery Membrane System Results: Treating FGD Wastewater by Novel Salt Splitter Reverse Osmosis Technology

Malcolm Man, Ben Sparrow, Joshua Zoshi, and Megan Low, Saltworks Technologies Inc., Richmond, BC, Canada
Recent regulatory change and private investment in new treatment technologies is rapidly changing the flue gas desulfurization (FGD) wastewater treatment landscape. Operators are required to treat FGD wastewater to meet stringent discharge or reuse regulations and, often, eliminate wastewater discharge entirely and achieve zero-liquid-discharge (ZLD). Key economic considerations for designers and operators of FGD wastewater treatment and ZLD systems are reviewed while introducing an innovative treatment solution that lowers costs and amount of waste generated.

9:25 AM: Discusser: Dave Riedel, Arcadis, Washington, D.C.
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:20 AM

IWC 17-43: ELG Compliance through ZLD: UIC Wells – A Cost-effective Alternative for the Disposal of Reject Water

Jonathan Shimko and Dale Skoff, Tetra Tech, Inc., Pittsburgh, PA

The utility industry is searching for cost-effective solutions to meet the ELGs. ZLD is attractive, as it provides a longer compliance schedule, but with higher capital and O&M costs. This paper presents a cost-effective alternative to managing reject wastewater from ZLD systems through the direct disposal via Underground Injection Control (UIC) wells. The paper presents costs associated with a UIC well, regulatory and environmental concerns, and treatment consideration for FGD wastewater prior to injection.

10:45 AM: Discusser: Ralph Cutler, P.E., WesTech Engineering, Inc., Salt Lake City, UT

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

11:10 AM

IWC 17-44: Factors Affecting Arsenic Removal in FGD Wastewater Physical/Chemical Treatment

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

Power Generation Facilities were required under the EPA-promulgated ELGs (now being re-evaluated by EPA) to remove Arsenic to relatively low levels. However, there are differences in the operation of FGD systems that may have an impact on the removal of arsenic under some circumstances. This paper reviews the variables involved, and their potential impact, and presents bench scale data confirming that variations in arsenic solubility and speciation may result in the need for non-standard treatment approaches.

11:35 AM: Discusser: Diane Martini, Burns & McDonnell, Chicago, IL

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

12:00 Noon: Conclusion

SUSTAINABILITY – A DRIVER FOR INNOVATION

Tuesday, Nov. 14; 1:15–5:00 PM

Room: International Ballroom South

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

Session Chair: Michele Funk, Bechtel Infrastructure and Power Corp., Frederick, MD

Discussion Leader: Jason Monnell, Tetra Tech, Inc., Pittsburgh, PA

1:15 PM

Session Introduction

Water is scarce. Mother earth is beautiful. It is incumbent upon us to protect our most valuable resource – water. Our desire to reach the moon brought about some of the greatest engineering designs. For the water treatment industry alike, our quest for sustainability continues to drive innovative designs. This session's goal is to spotlight innovative designs in the name of sustainability. Specifically, the pioneering designs in this session include: creative recycle and reuse at a manufacturing facility, non-phosphate corrosion inhibitor performance on cooling water treatment, revolutionized UV technology for RO biofouling control, and an advanced biofilm monitoring and control technology for microbiological control allowing detection of sessile bacteria in real-time.

1:25 PM

IWC 17-45: Treatment of High Strength Industrial Wastewater using Ceramic Membranes and Reverse Osmosis-A Case Study

Gerard Van Gils, Kemco Systems Co., LLC, Clearwater, FL
This paper describes an innovative process using Ceramic Microfiltration Membranes plus Reverse Osmosis to treat a high strength waste stream coming from a dairy plant. The high strength waste contains high levels of milk fats, protein and cleaning chemicals. The installed treatment process allowed the dairy operators to reuse the treated water, thereby reducing the volumes of liquid waste that was being hauled off-site for disposal.

1:50 PM: Discusser: Neil Kern, P.E., Duke Energy, Charlotte, NC

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

2:15 PM

IWC 17-46: Hydro-Optic UV – A Sustainable Solution for Non-Chemical Biofouling Control

Dennis Bitter, Atlantium Technologies, Sarasota, FL; Ytzhak Rozenberg, Atlantium Technologies, Ltd., Har Tuv Industrial Park, Israel
A coal-fired electric generation facility (nameplate capacity 604 megawatts) eliminated the use of biocides and placed the Hydro-Optic (HOD) UV technology into service to reduce the operational impact of biofouling, improve RO feed water and reduce costs associated with disinfection treatment. This presentation will detail site background and operational results from full-scale commercial use of the HOD UV technology to provide non-chemical biofouling control as a sus-

tainable and environmentally friendly disinfection alternative in power applications.
2:40 PM: Discusser: HG Sanjay, Ph.D., P.E., Bechtel Corporation, Reston, VA
2:50 PM: Author's Closure & Floor Discussion
3:05 PM: Networking Break

3:20 PM

IWC 17-47: A Holistic Approach to Microbiological Control in Cooling Systems and the Environment

Raymond Post, P.E., Prasad Kalakodimi, Ph.D., and Doug McIlwaine, Ph.D., ChemTreat, Richmond, VA
Phosphorus is usually the limiting nutrient for algal photosynthesis and is also an essential nutrient for bacterial growth. Phosphorous compounds are widely used in cooling systems to control both corrosion and deposition. This increases the requirements for chlorine and antimicrobials, resulting in undesirable chlorinated byproducts and increasing costs. This paper presents a holistic approach to biological control, involving the use of totally non-phosphorus and non-zinc chemistries for controlling corrosion and deposition in cooling systems.
3:45 PM: Discusser: Caroline Sui, SUEZ Water and Process Technology, Trevose, PA
3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 17-48: Real-time Biofilm Monitoring in Industrial Water Applications

Shih-Hsiang Chien, Ph.D. and Michael Bluemle, Ph.D., Solenis LLC, Wilmington, DE; Jo Anna Ordonez, Solenis LLC, Kyle, TX; Patric Bierganns, Solenis LLC, Krefeld, Germany
An advanced biofilm monitoring and control technology has been developed to achieve successful microbiological control while optimizing chemical treatment. A real-time monitoring device that employs both an ultrasonic thickness and a thermal resistance sensor to detect biofilm growth is the core of the technology. The device was first evaluated on a pilot cooling tower using synthetic cooling water with cultured heterotrophic bacteria. Field validation was then conducted in industrial applications with a variety of water sources.
4:35 PM: Discusser: Frank Johns, Tetra Tech, Denver, CO
4:45 PM: Author's Closure & Floor Discussion
5:00 PM: Conclusion

ION EXCHANGE PAST, PRESENT, AND FUTURE: TESTING, PREDICTION, AND INNOVATION IN INDUSTRIAL AND POTABLE WATER

Tuesday, Nov. 14; 1:15–5:00 PM

Room: International Ballroom Center

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

Session Chair: Donna DeFlavis, Dow Water and Process Solutions, Collegeville, PA

Discussion Leader: Mike Bluemle, Solenis LLC, Wilmington, DE

1:15 PM

Session Introduction

The papers in this session cover innovating ion exchange applications on current hot topics such as PFAS (PFC) removal from water. PFAS (PFC) compounds have been getting much Public attention lately regarding drinking water and wastewater regulatory recommendations. The session also explores current improvements in ion exchange resin analysis as a tool for assessing issues such as organic fouling of anion resins and residual organic chlorides on resins used in high purity applications. We also take a historical look at the use of engineering data sheets in predicting ion exchange performance and how current software can reduce the time investment and expand the application areas not traditionally covered.

1:25 PM

IWC 17-49: Chlorides from Anion Resin in the Nuclear Power Industry 2015-2017

Gregory Bachman, Marty Wilkes, and Brian Blake-Collins, Evoqua Water Technologies, Rockford, IL; Michael Raymond, Entergy, Jackson, MS

Chloride levels in Nuclear Power Reactor Coolant systems at >1 ppb have initiated penalties beginning in 2008. The importance of removing chlorides is to avoid corrosion of system components through inter-granular stress corrosion cracking (IGSCC). In 2015, organic chloride compounds were slowly released and broken down in steam cycle temperature, pressure and radiation conditions. Subsequent analytical techniques were developed and continue to be deployed for evaluating refined resins prior to shipping. This ensures that chlorides will remain below action levels upon installation, loading, start-up and expected service run length. Evoqua determined the root cause as trace organic chlorides entrained in anion exchange resin. This paper will review the occurrences, actions taken, and resulting chemistry after the corrections were made and implemented.

1:50 PM: Discusser: Hans Juergen Wedemeyer, Lanxess, Cologne, NRW, Germany

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

2:15 PM

IWC 17-50: Modern Ion Exchange Resin Analysis

William Bornak and Harold Stansfield, RTI LLC, Warminster, PA

Two new tests are introduced to supplement conventional resin metrics. The first test measures the throughput of anion resin, both fouled and cleaned, under field regeneration conditions. The second test measures an unusual acid tailing effect seen in cation resins fouled with internal hardness. Both tests are helpful in addressing the question: clean or replace.

2:40 PM: Discusser: Matthew Roth, Dow Water & Process Solutions, Collegeville, PA
2:50 PM: Author's Closure & Floor Discussion
3:05 PM: Networking Break

3:20 PM

IWC 17-51: Removal of PFOA PFOS and other PFAS Substances Using Ion Exchange

Francis Boodoo, Jonathan Campos, and Sean Kennedy, Purolite Corporation, Bala Cynwyd, PA

Recent ten-fold reduction in US EPA health advisory levels for PFOA and PFOS to <70 ppt underscores the public's increasing concern for safe drinking water. Local cities have gone further asking for removal to non-detect levels. In this paper, newly developed selective ion exchange resins are demonstrated in commercial and pilot systems to effectively reduce both short and long chain poly- and perfluoroalkyl substances (PFASs) to non-detect levels ranging from 1 to 5 ppt. Cost comparisons to GAC and new system guidelines are given.

3:45 PM: Discusser: Thomas Mallmann, Evoqua Water Technologies LLC, Rockford, IL
3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 17-52: Historical Review of Predicting Ion Exchange Resin Operating Capacity & Leakage Performance

Francis DeSilva, ResinTech, San Diego, CA; Michael Gottlieb, ResinTech, West Berlin, NJ

Since the early 1950's, equipment companies have relied on their resin suppliers to provide performance estimates of ion exchange resins used in demineralizers and softeners. This paper provides a history of how performance estimates for ion exchange resins were originally calculated, how the performance data was created, and the evolution to the technology of today. A feature of the paper is an analysis of the time investment required by the design engineer then versus now.

4:35 PM: Discusser: Joe Guida, P.E., Fluor, Sugar Land, TX
4:45 PM: Author's Closure & Floor Discussion
5:00 PM: Conclusion

MINE WATER TREATMENT: CHALLENGES AND SOLUTIONS

Tuesday, Nov. 14; 1:15–5:00 PM

Room: International Ballroom North

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

Session Chair: Jeff Easton, Westech Engineering, Inc., Salt Lake City, UT

Discussion Leader: Tom Sandy, P.E., Brown and Caldwell, Charlotte, NC

1:15 PM

Session Introduction

Today's mines have challenging issues with water treatment due to the wide variety of dissolved metals and other constituents found in their water. In this session we will explore two of the more difficult mine water constituents, Selenium and Sulfate. Both of these parameters are not only difficult to remove, but face mounting environmental regulation. This session presents two papers addressing Selenium treatment technologies. Two additional papers will look at treatment of Sulfate as well as reduction of Sulfate scaling.

1:25 PM

IWC 17-53: Review and Evaluation of Water Treatment Technologies for Removal of Selenium and Other Constituents of Concern in an Industrial Application

Shannon Brown, Jason Maughan, and John Pugh, Monsanto, Creve Cœur, MO; Karen Budgell, Golder Associates, Lakewood, CO

Increasingly stringent water quality regulations lead industry to seek cost effective, reliable, and robust water treatment technologies to achieve specific needs of each manufacturing site. A technology screening was conducted based on available technologies and water quality requirements for one industrial site. Bioreactor and reverse osmosis pilot testing is underway targeting removal of selenium and other constituents of concern. Characterization, technology screening, and pilot testing results from one industrial process water are discussed herein.

1:50 PM: Discusser: Kar Munirathinam, Tetra Tech, Pittsburgh, PA

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

2:15 PM

IWC 17-54: High Sulfate Mining Wastewater Treatment by Two-Stage Chemical Precipitation Process

Hillary Kronebusch and Srikanth Muddasani, Veolia Water Technologies, Pittsburgh, PA

A pilot study was conducted on gold mine wastewater to evaluate the performance of a process developed to treat high sulfate wastewaters for sulfate removal to less than 100 mg/l. The process precipitates sulfate as a highly insoluble calcium sulfoaluminate mineral known as Ettringite. Ettringite sludge is further processed to recover aluminum which is a critical reagent. Pilot study results along with preliminary costs will be presented and

2:40 PM: Discusser: Alberto Gonzalez, Teck Metals Ltd., Trail, BC, Canada
2:50 PM: Author's Closure & Floor Discussion
3:05 PM: Networking Break

3:20 PM

IWC 17-55: Paste and Thickened Tailings Water Benefits – Case Studies

Jerold Johnson and Wei Xie, WesTech Engineering, Salt Lake City, UT

Water losses in mining are to evaporation, seepage, and water trapped with the solids. The use of paste and thickened tailings technology and deposition methods can reduce the water loss in each of these categories. The water is recovered at the thickener while producing a non-Newtonian suspension underflow that achieves a higher final density of the tailings which also greatly lowers the risk of dam failures. This paper provides two case studies demonstrating this.

3:45 PM: Discusser: Corne Pretorius, Golder Associates Ltd., Mississauga, ON, Canada
3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 17-56: Considerations for Selenium Treatment of Mine-Impacted Waters

Joseph Tamburini, P.E. and Lauren Lundquist, Tetra Tech, Inc., Denver, CO

Mine-impacted water occurs as surface run-off and ground water seepage contacts waste rock from previous mining operations, and may contain selenium from waste rock and nitrate from residual blasting residue. These dissolved constituents are difficult to remove from mine-impacted water via conventional chemical treatment approaches. This paper will discuss important criteria to consider selecting the best technology for treatment, and strengths and weaknesses of different technologies.

4:35 PM: Discusser: Jonathan Witt, J.R. Simplot Co., Boise, ID
4:45 PM: Author's Closure & Floor Discussion
5:00 PM: Conclusion

CCR…NOT THE ROCK BAND YOU WERE THINKING OF

Tuesday, Nov. 14; 1:15–5:00 PM

Room: Crystal

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

Session Chair: Dave Riedel, Arcadis, Washington, D.C.

Discussion Leader: Derek Henderson, Duke Energy, Raleigh, NC

1:15 PM

Session Introduction

In the past few years, the power industry has developed a new appreciation for handling coal combustion residuals (CCR) due to increased regulatory focus. Plants are replacing conventional, water-intensive handling methods with dry and ZLD systems. These changes have significant impacts on the Plant water balance and require a holistic evaluation of all processes which utilize water, even those not related to CCR handling.

1:25 PM

IWC 17-57: ELG and CCR Rule Implementation: Treatment and Handling of General Plant Wastewater Flows

Chloe Grabowski, HDR, Missoula, MT

This paper will focus on a planning study conducted at a large coal fired power generating facility in North America for the purpose of developing design requirements for the treatment and handling of general plant wastewater (GPWW) flows through the use of settling basins. Following implementation of the CCR rule and revised ELGs it will be necessary to handle and treat GPWW flows separately.

1:50 PM: Discusser: Lars Ellingson, Burns & McDonnell, Centennial, CO

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

2:15 PM

IWC 17-58: Proven Water Treatment Installation for CCR Rule Ash Pond Closure

Thomas Lawry and John Van Gehuchten, McKim & Creed, Inc., Sewickley, PA; Rick Petrosino and Gayla Fecher, Envirogen Technologies, Inc., East Windsor, NJ

New regulations for disposal of coal combustion residuals from electric utilities require an innovative solution to treat a varying waste stream whose primary contaminants of concern are lead, copper, thallium, arsenic and selenium. This paper examines a proven mobile water treatment system that can be effectively adapted for both short and long term fluctuations in flow rate and contaminant concentrations using a combination of physical/chemical treatment, proprietary adsorbents and filtration.

2:40 PM: Discusser: Brett Housley, P.E., WesTech Engineering, Salt Lake City, UT

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

3:05 PM: Networking Break

3:20 PM

IWC 17-59: Closing the Bottom Ash Loop – Pilot Testing Treatment and Reuse for FGD Makeup

Chad Roby, P.E., BCEE, CH2M, Columbus, OH; Robert Muehlenkamp, P.E., We Energies, Milwaukee, WI; Thomas Higgins, Ph.D., P.E., CH2M, Reston, VA

The 2015 ELGs ban discharge of ash transport water. Many power stations will continue to use their wet-sluicing bottom ash systems in a closed-loop operation. A purge from the system will likely be necessary. The ELGs allow use of transport water for FGD make-up water. The industry has not yet defined what impact this would have. This study included conducting bench scale testing followed by pilot testing to determine what impact ash transport water would have on FGD operations.

3:45 PM: Discusser: Steve Winter, Wood, Pittsburgh, PA
3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 17-60: What Happens to My non-CCR Streams?

Jason Eichenberger and Samantha Tewell, Burns & McDonnell, Kansas City, MO

Many existing surface impoundments receive non-CCR streams; however, new process ponds or other treatment methods may be required at many power plants for future CCR compliance. After removal of CCR flows, the remaining flows will make a large impact on constituent levels, potentially causing them to exceed the anticipated future permit limits. This paper highlights several factors for process pond and tank-based treatment designs at confidential plant sites and presents lessons learned and sampling recommendations.

4:35 PM: Discusser: Joseph Potts, P.E., Duke Energy, Cincinnati, OH
4:45 PM: Author's Closure & Floor Discussion
5:00 PM: Conclusion

COOLING WATER TREATMENT: INNOVATION IN LEGIONELLA TESTING, RECYCLE WATER TREATMENT AND FILM FORMING AMINES

Wednesday, Nov. 15; 8:00 AM–12:00 PM
Room: International Ballroom South
IWC Rep: Ken Dunn, Solenis-Retired, Mashpee, MA
Session Chair: Charles Kuhfeldt, Athlon Solutions, Houston, TX
Discussion Leader: Christopher Baron, ChemTreat, Neward, DE

8:00 AM

Session Introduction

This session presents the issues of use of recycled water as well as innovation in Legionella testing and information about film forming amines in a closed loop treatment. The complexity of high ammonia content recycled water as cooling tower makeup and its subsequent discharge can lead to high operating cost, toxicity compliance issues, or TSS/BOD compliance issues. These problems are the subject of one paper with the history of treatment applications in two power plants. Multiple treatment approaches and technical and cost results will be discussed. The high mineral content of some reclaimed Grey waters creates difficulty with high exchanger scaling potential with the use of ortho phosphate. Our second presentation presents an alternative chemistry solution resulting in lowering the scaling potential while maintaining corrosion control. The third discussion focuses on recent Legionnaire's Disease outbreaks in 2015 and 2016, such as in New York City and Flint and the new ASHRAE Standard 188-2015. A more effective microbiological monitoring procedure and a "field friendly" bio-film monitoring procedure is discussed. New applications of film forming amines in closed cooling systems will be discussed in the final paper with data from multiple advanced surface analytical techniques (XPS, TOF-SIMS, TEM). The discussion includes review of the water and treatment chemical factors affecting the corrosion inhibition film formation.

8:10 AM

IWC 17-61: Inhibiting Corrosion in Cooling System Utilizing Reuse Makeup Water

Mary Jane Felipe, Khac Nguyen, Zhenning Gu, and Sidney Dunn, Baker Hughes, a GE company, Sugar Land, TX

In areas where there is water scarcity, the use of reclaimed water has become a viable option as a source of cooling tower makeup water. Oftentimes, reclaimed water contains high level of minerals increasing scaling tendency. This study details a corrosion treatment program solution for cooling towers utilizing reclaimed water wherein the calcium phosphate scaling potential is greatly reduced. Remarkably, this treatment program has shown excellent corrosion inhibition even at high temperatures.

8:35 AM: Discusser: Matt Wangerin, Solenis, Wilmington, DE
8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 17-62: Experience with Film Forming Amines in Closed Loop Cooling

Claudia Pierce and James Gleason, SUEZ Water Technologies & Solutions, Trevose, PA

The work presented in this paper showed that Film Forming Amines (FFA) are effective corrosion inhibitors capable of

forming hydrophobic films on metal water systems under closed loop cooling conditions. The presence of this films is demonstrated via X-Ray Photoelectron Spectroscopy. Time of Flight Secondary Mass Spectroscopy was also able to demonstrate that the FFA used was present on several treated metal surfaces after a 30 day exposure time.

9:25 AM: Discusser: Jeff O'Brien, Chemtreat, Waupaca, WI
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

10:20 AM

IWC 17-63: A Rock and a Hard Place – Managing use of Ammonia-laden Recycled Water

Daniel Sampson, HDR, Inc., Walnut Creek, CA
Two power plants in the Western United States receive recycled water from the same supplier with ammonia concentration of 30-80 mg/l as N. Both plants use recycled water primarily as cooling tower makeup. This paper examines historical microbial control at the two cooling towers, several oxidizing and non-oxidizing microbial control chemistries, and concludes with a technical and cost evaluation of the options. The narrative provides vendor-neutral information to assist others receiving water high in ammonia.

10:45 AM: Discusser: Jon Howarth, Enviro Tech Chemical Services, Modesto, CA
10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 17-64: A Field Friendly Bio-Film Monitoring Procedure for Cooling Tower Water-Offering the Potential to Minimize the Risk of Legionnaires Disease

Paul Puckorius, Puckorius & Associates, Inc. Water & Waste Water Consultants, Westminster, CO; Dr. John Dresty, Jr., Griswold Water Systems, Inc., Glastonbury, CT
Cooling tower water systems have been the cause of Legionnaires disease outbreaks which has prompted a study of the microbiological programs and the procedures commonly used to monitor both total bacteria as well as Legionella Bacteria. The results of this study suggests that the current practice of using water samples in testing for Legionella Bacteria should be changed to Bio-Film monitoring to reduce the risk for Legionnaires Disease. The Bio-Film monitoring procedure and several case histories are provided to illustrate the differences between water and Bio-Film monitoring results.

11:35 AM: Discusser: Brian Corbin, The Dow Chemical Company, Collegeville, PA
11:45 AM: Author's Closure & Floor Discussion
12:00 Noon: Conclusion

IWC 17-Reserve: Thallium Removal from Coal Power Cooling Tower Water

Julia Mercer and James Beninati, HDR, Pittsburgh, PA
This paper will focus on a specific case study of a coal fired power plant in Pennsylvania where the plant will be required to remove Thallium from cooling tower blowdown. This paper will discuss bench testing protocol which achieved Thallium removal to sub parts per billion levels and met new regulatory compliance limits.

DEVELOPMENTS IN DRINKING WATER – EXPANDING RESOURCES AND IMPROVING QUALITY

Wednesday, Nov. 15; 8:00 AM–12:00 PM

Room: Crystal

IWC Rep: Tisha Scroggin, Burns & McDonnell, Chicago, IL

Session Chair: Jonathan Shimko, Tetra Tech, Pittsburgh, PA

Discussion Leader: Abbey Antolovich, Denver Water, Denver, CO

8:00 AM

Session Introduction

As we continue to grow our footprint on the planet and our demand for clean, abundant and affordable drinking water, the need for innovative solutions intensifies. This session presents a variety of topics ranging from treatment technologies, reduction of trace contaminants and advances in our ability to source water previously considered undrinkable. Through modeling, bench testing and application of full scale systems, the papers presented in this session demonstrate compliance with emerging regulations and our ability to expand our utilization of water resources.

8:10 AM

IWC 17-65: Removal of Uranium from Contaminated Wells and Surface Waters on the Navajo Reservation

Edward Rosenberg and Ranalda Tsosie, University of Montana, Missoula, MT

Uranium contamination is a huge problem on the Navajo reservation. We have developed a silica-polyamine composite material containing an amino-phosphonic acid functional group1 that has been shown to selectively reduce ppm levels of uranyl to low ppb levels in the presence 12 gL-1sulfate. Solutions exactly profiling the contaminated water sources have been successfully tested and the novel material has compared with commercially available polystyrene resins. The uranyl can be efficiently recovered with carbonate solutions.

8:35 AM: Discusser: Beryn Adams, Lanxess Sybron, Birmingham, NJ

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

9:00 AM

IWC 17-66: Modeling Hazardous Metals in Municipal Water

Robert Ferguson, French Creek Software, Phoenixville, PA

Mandated and recommended Pb and Cu control techniques in municipal water distribution systems emphasize "anti-corrosive" treatment, and ignore the solubility, and dissolution of existing deposits. They fail to account for the impact of chemistry or water source changes on existing corrosion product solubility and transport through the system. This paper outlines a multifaceted approach to lead and copper contamination of municipal water systems that incorporates hazardous metal solubility, in addition to corrosion prediction and control.

9:25 AM: Discusser: Kelly McCurry, P.E., Ixom Watercare, Centennial, CO

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

9:50 AM: Networking Break

10:20 AM

IWC 17-67: Optimized Treatment Process Reduces Disinfection Byproducts for Potable Drinking Water Application

Phillip Locke, McKim & Creed, Inc., Clearwater, FL; Jim Hogan and Fred Greiner; City of Palm Coast, Palm Coast, FL

Palm Coast implemented a ZLD treatment process that treats NF concentrate, which is then blended into the WTP's finished water. TTHM levels have exceeded the regulatory limit of 80 ug/L. Several methods to reduce TTHMs were evaluated including: chemical processes, chlorine contact time management, pH adjustment, PAC, in tank and skid mounted TTHM removal systems and using chlorine dioxide as a disinfectant. This paper covers the results full-scale pilot testing to reduce levels for regulatory compliance.

10:45 AM: Discusser: Mel Butcher, Arcadis, Tampa, FL
10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 17-68: Introduction to Desalination and Review of Lessons Learned

Julia Horn, EI, Caroline Wilson, EI, and Brian Clarke, P.E., Kiewit Engineering Group Inc., Lenexa, KS

Desalination is gaining increased attention worldwide as a method to expand available drinking water resources. This paper will serve as an introduction to desalination by providing an overview of the process, including key process variables, intake and discharge options, and energy saving methods. Secondly, this paper will address lessons learned from the completion of the Carlsbad 50 MGD facility, the largest desalination plant in the United States.

11:35 AM: Discusser: Eric Dole, P.E., Hazen and Sawyer Consulting, Highlands Ranch, CO
11:45 AM: Author's Closure & Floor Discussion
12:00 Noon: Conclusion

PRODUCED WATER – TREATING RECYCLED WATER FROM SHALE OIL AND GAS FACILITIES

Wednesday, Nov. 15; 8:00 AM–9:50 AM
Room: International Ballroom Center
IWC Rep: Mike Ryder, Hatch Chester, Pittsburgh, PA
Session Chair: Don Downey, Purolite, Paris, ON, Canada
Discussion Leader: Chris Graham, Purolite Corporation, Calgary, AB, Canada

8:00 AM

Session Introduction

This mini session will feature two papers on equipment to treat recycled water from shale oil and gas facilities. The first paper deals with the problem of dissolved oxygen in stored produced water and evaluates six different aeration technologies. The second paper deals with many challenges associated with operating a centralized oil and gas wastewater treatment system. Topics covered include, crystallization, biological treatment, ion exchange, and reverse osmosis systems.

8:10 AM

IWC 17-69: Aeration and Mixing Technology Evaluation for Storage Impoundments used in Upstream Oil and Gas Operations

Matthew DeMarco, Arcadis, Wilmington, DE; Ketankumar Maroo, Daniel Olson, and Nibhana Suvarna, Arcadis, Houston, TX; Pranay Mane, Arcadis, Atlanta, GA

Reuse of water from hydraulic fracturing is an emerging trend among E&P companies because it can improve development logistics (reduced cost & environmental impact). The water is stored and reused after limited treatment; it still has high concentration of TDS and residual organic compounds. The reuse water must be maintained in conditions suitable for fracking. Here we will present the evaluation and selection process for technology to maintain the required water quality.

8:35 AM: Discusser: Ivan Morales, Devon, Calgary, AB, Canada
8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 17-70: Oil and Gas Wastewater Conversion Case Study-Beneficial Reuse using Membrane Bioreactor, Softening, and Reverse Osmosis Technologies at a Centralized Wastewater Treatment Facility in Pennsylvania

Jerel Bogdan and Dan Ertel, Eureka Resources, LLC, Williamsport, PA; Brian Arntsen, SUEZ Water Technologies & Solutions, Oakville, ON, Canada; Anthony Urciuoli, SUEZ Water Technologies & Solutions, Harwich, MA

Eureka Resources, LLC has been operating patent-pending, centralized oil and gas wastewater treatment facilities in Pennsylvania for over 8 years, with a model for sustainable treatment of unconventional oil and gas wastewater. The distillate generated by Eureka requires treatment prior to surface water discharge and/or use as de-wasted water, including full-scale membrane bioreactor, ion exchange softening, and reverse osmosis systems. This paper will present critical information regarding the design, installation, and of long-term operation of the distillate treatment component of Eureka facility.

9:25 AM: Discusser: Darrell Hartwick, Buckman North America, North Lancaster, ON, Canada
9:35 AM: Author's Closure & Floor Discussion
9:50 AM: Networking Break

SCALE AND SCALE PREDICTION IN GEOTHERMAL WATERS

Wednesday, Nov. 15; 10:20 AM–12:00 PM
Room: International Ballroom Center
IWC Rep: Mike Ryder, Hatch Chester, Pittsburgh, PA
Session Chair: Cathie Loudenslager, Calpine, Pasadena, TX
Discussion Leader: Jo Ordonez, Solenis, Kyle, TX

10:20 AM

Session Introduction

The papers presented in this session include two topics related to scale in geothermal water. A paper will be presented on the utilization of software specifically designed predicting mineral scale considering the challenges of the geothermal well's changing minerals and temperatures. A second paper will describe the ability to control the formation of silica scales within system utilizing silica precipitation.

10:30 AM

IWC 17-71: Silica Precipitation Chemistry, What works and how much does it cost?

Denney Eames and Jacob Aylesworth EIT, Watertectonics, Everett, WA; Lee O'Dell, CH2M Hill, Inc., Portland, OR
Silica precipitation chemistries will be presented with treatment pros and cons. Data for three (3) high silica water treatability case studies, where precipitation technologies were evaluated as the primary treatment method, will be shared along with estimated capital and operating costs. Water sources presented include:

- Drinking water
- Pretreatment of produced water reuse to steam production
- Pretreatment of mine wastewater to reverse osmosis

10:55 AM: Discusser: Claudia Pierce, SUEZ Water Technologies & Solutions, Trevose, PA
11:05 AM: Author's Closure & Floor Discussion

11:20 AM

IWC 17-72: A Tool to Predict Optimum Dose for Mitigating Scale in Geothermal Systems

Jasbir Gill, Nalco Water, An Ecolab Company, Naperville, IL; David Rodman, (AUS) Ecolab Pty Limited TA Nalco Australia, Darra, Queensland, Austria
This paper discusses software, designed to predict mineral scaling tendencies in geothermal power plants and to determine the best scale inhibitors and doses required for optimum plant protection. The scaling tendencies over typical temperature ranges are calculated for well profiling. Verification of the predicted dose from the software and the successful applications in the field are also discussed.

11:45 AM: Discusser: Robert Ferguson, French Creek Software, Phoenixville, PA
11:55 AM: Author's Closure & Floor Discussion
12:10 PM: Conclusion

FGD AND ASH POND WASTEWATER TREATMENT FROM CONCEPT TO REALITY

Wednesday, Nov. 15; 8:00 AM–12:00 PM

Room: International Ballroom North

IWC Rep: Bill Willersdorf, Veolia Water Technologies, Randolph, NJ

Session Chair: Kristen Jenkins, Southern Research, Cartersville, GA

Discussion Leader: Joe Potts, Duke Energy, Cincinnati, OH

8:00 AM

Session Introduction

Increasing regulations are driving coal fired power plants to move away from the use of ash ponds, requiring new technologies to treat wastewater. Flue Gas Desulfurization (FGD) scrubber blowdown and ash basin wastewater treatment will be reviewed. The papers in this session present approaches to FGD blowdown treatment from concept through full scale implementation and operation, and will touch on the perspectives of owners, engineers, and equipment suppliers.

8:10 AM

IWC 17-73: FGD Technology Evaluation for Two Similar Power Plants Leads to Different Solutions

Krystal Perez, P.E., CH2M, Bellevue, WA; Robert Muehlenkamp, P.E., We Energies, Milwaukee, WI; Thomas Higgins, Ph.D., P.E., CH2M, Reston, VA; Chad Roby, P.E., BCEE, CH2M, Columbus, OH; Christina Joiner, P.E., CH2M, Atlanta, GA

We Energies operates the Pleasant Prairie Power Plant, Elm Road Generating Station, and Oak Creek Power Plant. The plants are seemingly very similar, but the resulting wastewater characteristics are very different in terms of flow and water quality. This paper will present how development of the basis of design for the three FGD wastewaters was used in evaluating technologies, associated costs and risks. Despite being similar plants, the optimum technology for each plant was different.

8:35 AM: Discusser: Gary Blythe, P.E., AECOM, Austin, TX

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

9:00 AM

IWC 17-74: Case Studies & Analysis of Reverse Osmosis to Treat Flue Gas Desulfurization Wastewater

Derek Stevens, Ph.D., Dow Water and Process Solutions, Edina, MN; Cheng Yang, Ph.D., Dow Water and Process Solutions, Shanghai, China; Brandon Kern, Dow Water and Process Solutions, Midland, MI

Membranes can pre-concentrate wastewater to reduce ZLD costs, but, for FGD waste, high COD, hardness and dissolved solutes give rise to operational challenges in fouling, scaling, and osmotic pressure. Here we present design options using proper pretreatment and selection of ion exchange, reverse osmosis and nanofiltration to concentrate FGD WW ahead of ZLD, including an economic analysis and

information on several case studies of power plants in China which are employing such technologies.

9:25 AM: Discusser: John Wentz, Power Engineers, Cincinnati, OH

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

9:50 AM: Networking Break

10:20 AM

IWC 17-75: The Impacts of Chloride Concentration Variations on Biological Selenium Removal in FGD Blowdown

Joel Citulski, Carsten Owerdieck, Wajahat Syed, and Jeff Cumin, SUEZ Water Technologies & Solutions, Oakville, ON, Canada

Biological treatment technologies are an important component to achieving selenium and nitrate removal in wet flue gas desulfurization (FGD) purge streams. Variable and/or elevated chloride concentrations are a common feature of FGD wastewater, and their impacts on the efficacy and stability of biological treatment remain poorly defined. This paper demonstrates the resilience of a fixed-film anoxic/anaerobic treatment process to chloride variations through both performance data and DNA profiling of the microbial community within the bioreactors.

10:45 AM: Discusser: Kirk Ellison, EPRI, Charlotte, NC

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

11:10 AM

IWC 17-76: Design, Installation and Start-up of First Commercial Hybrid ZVI Wastewater Treatment System

Charles McCloskey, Evoqua Water Technologies, Schaumburg, IL; Derek Henderson, Duke Energy, Raleigh, NC; Michael Riffe, Evoqua Water Technologies, Warrendale, PA; Steven Lindvall, Evoqua Water Technologies, Rockford, IL

The use of hybrid ZVI for the removal of constituents from power plant wastewaters has been well documented. This paper describes the basis of design, engineering, installation and start-up of the first full scale commercial application of the technology in the power industry. A controlled performance demonstration was accomplished in March pending full scale start-up and operation. Pretreatment requirements, system sizing criteria and operational results will be presented along with guidance for future applications.

11:35 AM: Discusser: Tyler Cromey, Southern Company, Birmingham, AL

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

12:00 Noon: Conclusion

WORKSHOPS

The IWC Continuing Education Workshop program 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 the field and are loaded with technical content, *not* sales information. Each workshop will provide an opportunity for a technical exchange between the students, the instructor and other workshop participants. The workshop will 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. All workshops are scheduled based on minimum reservations; please inquire with conference staff about the current status of any of the workshops.

W1: WATER TREATMENT 101

Sunday, Nov. 12; 1:00–5:00 PM

This workshop is a great introductory course covering the basic concepts of water treatment for industry. 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 was include treatment of makeup water for 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 be considered with chemical conditioning as required.

Dennis McBride, Burns & McDonnell, Kansas City, MO

W2: ION EXCHANGE TECHNOLOGY AND PRACTICAL OPERATING PRACTICES

Sunday, Nov. 12; 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

W3: THE WONDERFUL WORLD OF REVERSE OSMOSIS

Sunday, Nov. 12; 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. We'll cover 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. 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 Company, an Ecolab Company, Naperville, IL

W4: WET FGD CHEMISTRY AND OPERATIONAL IMPACTS ON WASTEWATER QUALITY DISCHARGE

Sunday, Nov. 12; 1:00–5:00 PM

This workshop will provide an overview of wet FGD chemistry and operating factors that will affect the wastewater quality. The various subsystems of the wet FGD system will be discussed including reagent handling, reagent preparation, absorber internals, recycle slurry, slurry spray headers, mist eliminators, primary dewatering, secondary dewatering, and wastewater treatment. The workshop will discuss the operational chemistry involved in removal of SO2 from the flue gas and highlight how operating parameters like pH, conductivity, ORP, and other issues affect the overall process. The workshop will also address how operation of the wet FGD system can affect the quality of the wastewater being discharged.

Bryan D. Hansen, P.E., Burns & McDonnell, Centennial, CO

W1A: WATER TREATMENT 101

Wednesday, Nov. 15; 1:00–5:00 PM

This workshop is a great introductory course covering the basic concepts of water treatment for industry. 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 was include treatment of makeup water for 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 be considered with chemical conditioning as required.

Dennis McBride, Burns & McDonnell, Kansas City, MO

W3A: THE WONDERFUL WORLD OF REVERSE OSMOSIS

Wednesday, Nov. 15; 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 Company, an Ecolab Company, Naperville, IL

W4A: WET FGD CHEMISTRY AND OPERATIONAL IMPACTS ON WASTEWATER QUALITY DISCHARGE

Wednesday, Nov. 15; 1:00–5:00 PM

This workshop will provide an overview of wet FGD chemistry and operating factors that will affect the wastewater quality. The various subsystems of the wet FGD system will be discussed including reagent handling, reagent preparation, absorber internals, recycle slurry, slurry spray headers, mist eliminators, primary dewatering, secondary dewatering, and wastewater treatment. The workshop will discuss the operational chemistry involved in removal of SO2 from the flue gas and highlight how operating parameters like pH, conductivity, ORP, and other issues affect the overall process. The workshop will also address how operation of the wet FGD system can affect the quality of the wastewater being discharged.

Bryan D. Hansen, P.E., Burns & McDonnell, Centennial, CO

W5: TROUBLE SHOOTING AN ION EXCHANGE MIXED BED UNIT

Wednesday, Nov. 15; 1:00–5:00 PM

In the water treatment plant the Ion exchange mixed units can be your best friend or worst enemy. Mixed bed can provide very high quality water, for days, weeks or even months without regeneration, this means less hand on by operations. Compared to normal demin trains that could regenerate up to twice/day, operators do not retain the day to day routine of regenerating a mixed bed which can lead to being unfamiliar with how to trouble shoot problem. When a mixed bed unit does not work properly – it could take months or even years to get it back into proper operation. This workshop will cover problems with improper backwashing or air mixing, mechanical failure inside the vessels and changes in feed water quality. In will also cover resin parameters, choosing the best resins for the application, the importance of chemical dosages, and what to look for in the resin reports. This workshop will include some of the author's +40 years of experience with trouble shooting and repairing various mixed bed system in North America.

Presenter: Don Downey, Purolite, Paris, ON, Canada

W6: INDUSTRIAL BOILER WATER TREATMENT

Wednesday, Nov. 15; 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.

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

W7: COOLING TOWER WATER SYSTEMS 101- HOW TO DEVELOP A COOLING WATER TREATMENT PROGRAM AND HOW TO DETERMINE IF YOUR PROGRAM IS THE MOST COST EFFECTIVE

Wednesday, Nov. 15; 1:00–5:00 PM

This workshop discusses the problems commonly found in Cooling Tower Water systems and the various water treatments that can be used to control or prevent those problems. Specific water treatment chemicals are discussed and their advantages and disadvantages are presented. These specific chemicals are for corrosion, scale, fouling, and microbiological control. They are identified generically and include the most recent developments. The preparation of the complete water treatment program is provided in easy to apply steps. This workshop is excellent for operators, utility mangers, and water treatment suppliers both new on the job and great as a refresher for others. Bring your cooling tower water treatment program information.

Presenter: Paul Puckorius, Puckorius & Associates, Inc, Arvada, CO

W8: WASTEWATER TREATMENT 101

Wednesday, Nov. 15; 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, secondary clarifiers, controlled returned activated sludge (RAS) and controlled waste activated sludge (WAS) and sludge dewatering etc. will be discussed. Design example of a typical refinery wastewater plant and video tutorials will be used to enhance understanding wastewater treatment process.

Approximate Subject matter outline:

- Identification of typical refinery wastewater streams
- Selective segregation & pretreatment of wastewater

streams
- Microbiology and identification of Microbes for optimum design
- Primary, Secondary & Tertiary Operating units
- Solids production and Disposal management
- Tutorial videos on selected topics
- Typical refinery wastewater design example

Presenter: Rafique Janjua, PE, Fluor, Sugarland, TX

W9: WATER TREATMENT 201

Thursday, Nov. 16; 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.

Presenter: Rafique Janjua, Fluor, Sugarland, TX

W10: CONTAMINANTS A TO Z, BEST AVAILABLE REMOVAL TECHNOLOGIES

Thursday, Nov. 16; 8:00 AM–12:00 NOON

A fast moving presentation on the more common contaminants found in water, their general behavior, how they get into water, and the best available technologies for their removal. Chapters include naturally occurring and man-made trace contaminants, radioactive contaminants, plating residuals, oxidation byproducts, organic contaminants, dissolved gasses, and a special bonus section about bulk ions. Approximately 100 of the more common contaminants found in water are covered, however due to time constraints, not every contaminant is covered orally. Students are encouraged to suggest the contaminants of greatest interest so they can be given extra attention.

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

W11: ELECTRODEIONIZATION (EDI)

Thursday, Nov. 16; 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 require-

ments. 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.

Presenter: Jon Wood, Evoqua Water Technologies LLC, Lowell, MA

W12: EVAPORATIVE WATER TREATMENT FUNDAMENTALS FOR STEAM GENERATING EOR PROCESSES

Thursday, Nov. 16; 8:00 AM–12:00 NOON

Evaporative water treatment may seem complex at surface level, but once the underlying principles are understood, evaporation system design and operation become very straightforward. This course is designed to explore everything from evaporator design to its integration into various EOR processes: including steam-flood, SAGD and CSS. Students will come away from this course with a practical understanding of how evaporators work, why they work and how they are used in the oil & gas industry to solve real problems. Course matter will cover evaporative boiler feed water production (either OTSG's or drum boilers) and brine discharge reduction strategies. A particular emphasis will be placed on produced water chemistry variation and design implications. Unit operations such as falling-film evaporation and crystallization will be covered in-depth. Several real-world case studies will be examined to reinforce theoretical principles and students will work through several design optimization problems.

Presenter: Greg Mandigo, Aquatech International Corp., Hartland, WI

W13: HRSG AND HIGH PRESSURE (>900 PSIG/60 BAR) BOILER WATER TREATMENT AND OPERATION

Thursday, Nov. 16; 8:00 AM–12:00 NOON

This workshop will cover the water quality required for high pressure (>900 psig/60 bar) steam boilers including the various treatments being used and new developments relative to protection from scale and corrosion. The course will also cover treatment issues related to pre□boiler systems and the condensate systems and a discussion of controls and troubleshooting techniques. Operators, utility plant supervisors, managers, and engineers can all benefit greatly from the practical information provided in this course.

Presenter: David Daniels, Mechanical & Materials Engineering, Austin, TX

W14: COOLING TOWER WATER SYSTEMS - HOW TO SUCCESSFULLY GO FROM FRESH MAKEUP WATER TO RECYCLED WATERS

Thursday, Nov. 16; 8:00 AM–12:00 NOON

This workshop will cover guidelines to be used in developing a cooling water treatment technology going from fresh to recycle waters as makeup. These guidelines will identify possible concerns and potential benefits with recycle water. A step by step approach is provided not only for existing cooling tower water systems but also new systems that can handle almost any recycled waters. A number of case histories are provided. Attendees are encouraged to bring not only any questions but also details on their cooling tower water systems and the recycle water quality being considered. A must workshop for operators, utility managers, and for water treatment suppliers.

Presenter: Paul Puckorius, Puckorius & Associates, Inc, Arvada, CO

W15: ARSENIC AND SELENIUM IN WASTEWATER TREATMENT

Thursday, Nov. 16; 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.

Presenter: John Schubert, P.E., HDR Engineering, Sarasota, FL

W2A: ION EXCHANGE TECHNOLOGY AND PRACTICAL OPERATING PRACTICES

Thursday, Nov. 16; 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.

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

W16: THERMAL AND HYBRID ZERO LIQUID DISCHARGE PROCESSES

Thursday, Nov. 16; 1:00–5:00 PM

This course is designed to give a basic understanding of the information required for the selection and design of a Zero Liquid Discharge (ZLD) system in a wastewater application. ZLD represents the ultimate in water utilization efficiency. ZLD systems can recover nearly every drop of water entering the site, "future proofing" owner concerns from variable and increasingly stringent discharge requirements. ZLD selection and configuration depend on numerous factors including fuel source, water chemistry, climate, environmental requirements, CapEx, and OpEx. Hybrid ZLD systems utilizing membranes and thermal components with appropriate physical, chemical, and/or biological pre-treatment processes to mitigate scaling and fouling are becoming the norm. Further alternative ZLD options include utilizing a Spray Dryer Evaporator (SDE), which evaporates this wastewater in a hot flue gas stream, or the long-term sequestration of residual constituents by creation of encapsulated materials or solidification of residual brines. The design basis will cover various treatment applications such as Flue Gas Desulfurization (FGD) wastewater, cooling tower blowdown, Produced Water, and others.

Presenters: Joe Tinto and Craig Van Dyke, SUEZ Water Technologies & Solutions, Bellvue, WA; Lanny Weimer, SUEZ Water Technologies & Solutions, Ormond Beach, FL

W17: WATER DISTRIBUTION SYSTEM MONITORING AND OPTIMIZATION UTILIZING ANALYTICAL TESTING

Thursday, Nov. 16; 1:00–5:00 PM

The objective of the workshop is to communicate the significance of maintaining the drinking water distribution system through analytical testing and improved optimization practices. Participants will increase awareness of the regulatory monitoring requirements and gain knowledge of problems often encountered in distribution grids and storage. Additional workshop topics offer a review of potable water chemistry testing methods and how interpreting sample results can facilitate sustaining water quality within the distribution system. Workshop attendees will acquire current updates on emerging analytical water testing methods and products intended for potable water. And how those products could be applied to better maintain water quality and prevent distribution system issues. Workshop attendees will have an opportunity to interact with presenters who are industry leading regulators, expert water utility managers, drinking water scientist and a Certified Water Utility Operator. Additional benefits include hands-on demonstrations of analytical testing kits and in-depth discussions among participants and presenters in a receptive learning forum.

Presenter: L. Keith McLeroy, RETEGO Labs, College Station, TX

W18: UF, RO AND EDI MAINTENANCE AND CLEANING

Thursday, Nov. 16; 1:00–5:00 PM

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.

Presenter: Robert Cohen, Evoqua Water Technologies LLC, Rochester, NY

W20: LEGIONELLA RISK MANAGEMENT

Thursday, Nov. 16; 1:00–5:00 PM

Recent regulations, updated guidelines and the first published U.S. standard have placed the spotlight on managing risks associated with Legionellosis and other waterborne pathogens. New guidelines and proposed standards are near completion, that will add much more information available to the public. A comprehensive understanding of these issues and how to manage the associated risks is now an essential tool for water treatment professionals, building owners and facility managers. This short course will provide the basic tools to understand Legionella, current methodologies for microbial control and especially Legionella, an overview of ASHRAE/ANSI 188-2015, and current guidelines with a focus on cooling water systems. Information on how to prepare for water management plans and Legionella response will be provided. Other new and upcoming standards and guidelines will be discussed, with a comparison against previously released documents.

Presenter: Jon Cohen, ChemTreat, Inc., Richmond, VA

W21: ALGAE BASED TREATMENT OR BIOREMEDIATION OF WASTEWATER: POSSIBILITY, NEW TRENDS AND TECHNOLOGY

Thursday, Nov. 16; 1:00–5:00 PM

1. To establish with details the potential of algae based treatment (or bioremediation) in wastewater treatment and reuse possibilities
2. To compare the strengths and weaknesses of algae based treatment to conventional wastewater treatment processes: costs , energy demand and sustainability
3. To describe the algae mode of operation in removing pollutants from wastewater, the operating conditions and list algae species that can remove effectively pollutants from wastewater
4. To elaborate on possibilities of using algae biomass after wastewater treatment for green energy production purpose.
5. To describe problems with current wastewater treatment practices.
6. To show where do algae fit or play a role when used for wastewater treatment.
7. To describe some issues related to Costs and economy regarding algae based treatment
8. To discuss some aspects of design and construction
9. To present some case studies, on-going research and development in the field.

Presenter: Joseph Kapuku Bwapwa, Mangosuthu University of Technology, South Africa

EXHIBITORS

The IWC Exhibit Hall features countless different opportunities 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 of the Hilton Hotel. The Exhibit Hall hours of operation are:

- Sunday, November 12, from 5:00–7:00 PM
- Monday November 13, from 11:30 AM–1:30 PM and 5:00–7:00 PM
- Tuesday November 14, from 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 Sunday, Monday, and Tuesday. Luncheons and receptions are open to all registered attendees.

A listing by booth number of all 2017 IWC Exhibitors is provided below. On the following pages, you will find a detailed description of these Exhibitors, including contact information and company description.

100	Johnson March Systems, Inc.
101	Honeywell UOP
102	American Water Chemicals, Inc.
103	Honeywell
104/106	3M Separation and Purification Sciences Division
105	IDE Technologies
107	Sumitomo Electric Industries, Ltd.
109	RETEGO Labs
111	Itochu Chemicals America Inc.
113	Pall Water
200	ProMinent Fluid Controls, Inc.
201	Aquatech International Corp.
202	Fluidra USA
203	Swan Analytical USA
204	Oasys Water
205	Agape Water Solutions, Inc.
206	Grundfos North America
207	Justeq, LLC
208	BlueInGreen, LLC
209	Brown and Caldwell
210	Ionomr Innovations Inc.
211	WaterTectonics
212	i2m LLC
213	Ellis Wastewater
215	Global Treat, Inc.
217	Univar
300	Turner Designs Hydrocarbon Instruments, Inc.
301	LANXESS Sybron Chemicals
302	Sentry Equipment Corporation
303	U.S. Water
304	Bowen Engineering Corporation
305	Advanced Sensors Ltd
306	Microdyn-Nadir US, Inc.
307	Burns & McDonnell Engineering Company, Inc.
308	Chemtrac, Inc.
309	USP Technologies
310/312	DOW Water and Process Solutions
311	Neptune Chemical Pump Co. / Fluid Dynamics

EXHIBITORS

313 Buckman North America
314 Illinois Water Technologies
316 Atlantium Technologies
317 ProChem, Inc.
400 Golder Associates Inc.
401 ResinTech, Inc.
402 Graver Water Systems/Ecodyne Water
403 SAMCO Technologies Inc.
404 AVANTech, Inc.
405 Southern Research Institute
406 Hach Company
407/409 SUEZ Water Technologies & Solutions
408 Survey Equipment Services/Teledyne Oceanscience
410 Centrisys Corporation
411 Parkson Corporation
412 Plastocor Inc.
413 Brenntag North America
416 QUA Group, LLC
417 OLI Systems, Inc.
500 Veolia Water Technologies
501 WesTech Engineering, Inc.
502 Schreiber LLC
503 Avista Technologies, Inc.
504 Thermax, Inc.
505 METTLER TOLEDO
506 COCHRANE® by newterra
507 Athlon Solutions
508 Solenis LLC
509 Deep Trekker
510 Cooling Technology Institute
511 Jacobi Carbons, Inc.
512/516 Wigen Water Technologies
513 Filtra-Systems Company LLC
515 Protec-Arisawa America
517 Howden Roots
600/602 Purolite Corporation
601 ChemTreat
603 PWT/Piedmont
604 WaterColor Management
605 Federal Screen Products, Inc.
606/608 Technoform Kunststoffprofile GmbH
607/609 Marubeni Specialty Chemicals, Inc.
610 CDG Environmental, LLC
611 Stenner Pump Company
612 GWI Ultrapure
614 Heartland Water Technology, Inc
616 LANXESS Corporation
700 Global Chem-Feed Solutions, LLC
701 French Creek Software, Inc.
702 MPW Industrial Services
703 Taylor Technologies
704 PulsaFeeder
706 FreeWave Technologies
707 Baker Hughes, a GE company
708 Eisenmann Corporation
709 Frontier Water Systems, LLC
710 Feel Good, Inc.

3M Separation and Purification Sciences Division

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3M brings over 30 years of industrial membrane expertise in ultrafiltration and dissolved gas control applications. 3M™ Liqui-Flux™ Ultrafiltration modules take advantage of a pressure-driven out flow design with optimized backwash performance. 3M™ Liqui-Cel™ Membrane Contactors are compact and modular devices that control dissolved gases in liquids.

Advanced Sensors Ltd

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Advanced Sensors is the leading global supplier of Oil in Water analyzers to the Oil and Gas Industries. We provide innovative solutions that guarantee our analyzers are self-cleaning, reliable and durable. We combine technologies such as ultrasonics, fluorescence and video microscopy to ensure analyzers stay clean and provide precise readings.

Agape Water Solutions, Inc.

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Agape Water Solutions is the Ionpure Master Service Provider for North America. The company provides EDI, CEDI and EDR modules and control panels to OEMs and private label systems.

American Water Chemicals, Inc. (AWC)

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AWC manufactures specialty chemicals for pretreatment and cleaning of reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) membrane systems. AWC has pioneered advanced membrane autopsy techniques and investigative services such as ROSSEP® ('Reverse Osmosis Scaling Synthetically Emulated by Precipitation') which allows our technicians to replicate field operation in a laboratory setting in a fraction of the time of traditional field pilot trials. AWC maintains a complete water and membrane laboratory with all the required equipment allowing for a more thorough analysis of membrane condition and foulant composition. AWC supports both public and private business sectors using our services and products. This total offering has proven to help identify complex operational problems by improving membrane system performance and reducing cost through scientifically engineered solutions.

Aquatech International Corp.

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Aquatech is a global leader in water and wastewater treatment for industrial and infrastructure markets, and is internationally respected for its technology leadership and commitment to performance excellence. Aquatech has grown to more than 600 employees, with operations around the globe, including North America, Europe, the Middle East, India and China. Aquatech has completed more than 1600 projects in 60 countries, and in the process, applied this experience to build a portfolio of patented innovations.

Athlon Solutions

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Athlon Solutions provides specialty water and process treatment chemicals, customized engineering solutions, and services to the industrial sector, including the refining, petrochemical, chemical, ammonia/fertilizer, and power industries. We are committed to helping our customers achieve production reliability and preserve capital equipment. Athlon Solutions has a long history of serving America’s largest refineries and ammonia plants with specialty chemicals and engineered solutions.

Atlantium Technologies

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Atlantium’s revolutionary and patented HOD™ technology will deliver a “real” dose, 100% of the time, with less energy and equipment. All other UV sciences delivers an “average” dose with significantly more equipment. HOD™ UV minimizes the inefficiencies of dose delivery and increases the UV effectiveness. Through this advanced science, HOD™ UV has validations and acceptance’s not seen by any other UV technology. HOD UV has over 60 patents.

AVANTech, Inc.

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AVANTech provides engineered systems fabricated to treat and clean water to specific criteria. Technologies include wastewater recycling, filtration, reverse osmosis, and chemical treatment. Our systems deliver the lowest life cycle system cost and integrate

client's input and business goals to deliver high quality solutions. AVANTech utilizes specialized engineering skills to deliver, install, and operate cost effective, environmentally friendly modular systems with a quality assurance program that builds quality into every project deliverable.

Avista Technologies, Inc.

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Avista® Technologies is an industry leader in specialty chemical formulations and process support for reverse osmosis, microfiltration/ultrafiltration and multimedia filtration systems in over 90 countries. Our extensive line of membrane specific formulations includes NSF certified antiscalants, cleaners, coagulants, chlorine scavengers, and membrane storage chemicals and EPA certified biocides.

Baker Hughes, a GE company

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Baker Hughes, a GE company (NYSE:BHGE) is the world's first and only full-stream provider of integrated products, services and digital solutions. We deploy minds and machines to enhance customer productivity, safety and environmental stewardship, while minimizing costs and risks at every step of the energy value chain. With operations in over 120 countries, we infuse over a century of experience with the spirit of a startup – inventing smarter ways to bring energy to the world.

BlueInGreen, LLC

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BlueInGreen provides dissolved gas solutions for dozens of industrial applications both in-plant process water and discharge water treatment. Oxygen, carbon dioxide, and ozone delivery systems with several unique features and capabilities over traditional methods. We provide engineered solutions to solve oxygenation, disinfection and pH issues.

Bowen Engineering Corporation

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Bowen is a national self-performing general contractor delivering our clients EPC construction services. With a history in both the Water/Wastewater and Energy/Industrial Markets, Bowen is your nationwide Industrial Water construction expert. Our experience includes building 1,000+ treatment facilities using phys-chem, biological, evaporator processes with multiple technology partners. We serve, Private and Municipal Water/Wastewater clients and Energy/Industrial clients by striving to be the most Resourceful, and Responsive construction company bringing you the best project results.

Brenntag North America

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Brenntag Water Additives your partner in Solutions for Industrial, Commercial and Municipal Water Treatment. Experienced and dedicated team members apply knowledge from Brenntag's global network to meet local needs. Brenntag is a full line chemical distributor with over 160 stocking locations in the US and Canada. Our broad product line includes coagulants, flocculants, biocides, scale inhibitors, corrosion inhibitors, defoamers, permanganates, filtration media, NSF certified products and facilities, as well as products for heavy metal removal and odor control. Source from the experts! Contact Brenntag today to learn how we can be your trusted partner in delivering quality chemicals safely, and on time.

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

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Buckman offers an optimal solution for water treatment – an extensive portfolio of specialty chemicals, unmatched technical expertise and service, and a global network of experienced associates to help your operation become more efficient, effective and sustainable.

Burns & McDonnell Engineering Company, Inc.

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Burns & McDonnell is a full-service engineering, architecture, construction, environmental and consulting solutions firm. Our multi-disciplined staff of more than 5,700+ employee-owners includes engineers, architects, construction experts, 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.

CDG Environmental, LLC

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CDG Solution 3000, storage-stable, ready-to-use chlorine dioxide aqueous solution delivers chlorine dioxide to the application without the need for any on-site generation or “activation.” The CDG Gas:Solid system, produces high-purity chlorine dioxide gas in the safest, simplest means available for on-site production of high-purity chlorine dioxide. Chlorine dioxide is a powerful, selective, environmentally-friendly biocide which can be used in cooling towers and cooling loops, healthcare facilities, human and animal potable water, and food processing applications.

Centrisys Corporation

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Centrisys Corporation is a U.S.A. manufacturer of dewatering and thickening centrifuges, as well as complete dewatering systems for municipal and industrial wastewater. Centrisys provides global service, repair and parts for all brands of centrifuges. CNP – Technology Water and Biosolids Corporation designs and supplies nutrient recovery and biosolids treatment optimization systems. CNP's key technologies are AirPrex® and CalPrex™, phosphorus recovery technologies recovery technology, and PONDUS, a Thermo-Chemical Hydrolysis Process (TCHP). CNP - a division of Centrisys.

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 system optimization. Chemtrac is a global leader in providing streaming current charge measurement technology for coagulant feed control, and offers online analyzers for chlorine, ozone, pH, ORP, and organics monitoring.

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

COCHRANE® by newterra

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With 150+ years pioneering clean water technology, newterra's heritage dates back to the pioneering work of Joseph Harrison in 1863. That spirit of innovation continues to drive our development of advanced treatment technologies that return water to nature's high standard – and allow efficient recycling and reuse.

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
- Technical information exchange

Deep Trekker

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Deep Trekker Inc. is a Canadian company that builds underwater remotely operated vehicles (ROVs) and submersible pipe and utility crawlers. Their products are being used in-field around the world by thousands of municipalities and contracting teams to inspect and clean submerged infrastructure and water towers. Deep Trekker offers extremely robust systems while keeping them at an accessible price point.

DOW Water and Process Solutions

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The global leader in sustainable separation and purification technology, Dow Water & Process Solutions is helping to make water safer and more accessible, food taste better and industries more efficient. Dow offers a broad portfolio of ion exchange resins, reverse osmosis membranes and ultrafiltration membranes for industrial and municipal water, industrial processes, power, oil and gas, residential water and waste and water reuse.

Eisenmann Corporation

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Eisenmann offers environmental technologies that enable processes of the future. Besides air abatement and waste management, the portfolio encompasses recycling, decontamination and treatment of industrial waste water. Special attention is paid to the customer's individual process and desired outcome to develop and implement the ideal solution.

Ellis Corporation

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Ellis Wastewater manufactures complete wastewater treatment solutions. From pH conditioning to dissolved air flotation (DAF) systems, Ellis has the solution for any treatment application. All systems are custom fabricated for each customer. This allows ease of integration into existing plants.

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.

Feel Good, Inc.

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Feel Good, Inc. provides portable TENS (transcutaneous electrical nerve stimulation) units offering wide variety of benefits, including alleviating back, nerve and diabetic pain and migraines. Our units can also improve circulation, sleep patterns and have been shown to decrease the use of pain relievers that can cause negative side effects.

Filtra-Systems Company LLC

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Filtra-Systems is the global leader in providing custom-engineered industrial filtration & separation products, systems, and technology for the water & wastewater, chemical, and steel industries. Filtra-Systems was founded in 1979, and has installed over 16,000 filtration systems worldwide. We provide technology for removing suspended solids and oil from industrial wastewater, process water, and contaminated ground water, which allows the water to be recycled or to meet environmental disposal guidelines.

Fluidra USA

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With more than 20 years of experience, FLUIDRA designs and manufactures pressure vessels in fiberglass reinforced polyester (FRP) for swimming pools, aquariums, water parks, zoos, aquaculture, industry, water treatment, and desalination. Our products are suitable for sand filtration, multimedia filtration, ion exchange, activated carbon, biological filtration, denitrification and remineralisation. We customize our vessels to meet specific needs. The connections, working pressure, dimensions, internal and external finishes can be adapted according to each project's specifications.

FreeWave Technologies

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With nearly 25 years of RF innovation under its belt, FreeWave is the undisputed leader in industrial wireless. Millions of our best-in-class, outdoor, ruggedized radios have seen action in some of the harshest places in the world. Our ZumIQ App Server Software platform combines industrial App development with RF technology to make Edge Intelligence and Process Automation a reality. If it's mission-critical intelligent wireless, it's FreeWave.

EXHIBITORS

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French Creek develops and markets software for the water treatment industries including the industry standard WaterCycle® for cooling water, DownHole SAT® for oil field brines and frac'ing, hydROdose® for membrane systems, WatSIM™ for potable water and Pb and Cu modelling, and MineSAT for process waters. Predict scale and corrosion, optimize treatments, develop your own models for corrosion and minimum effective dosage rates. Generate 3D profiles. Windows® DLL's and UNIX libraries available for license to incoroporate our calculates into you applications, Web Apps, or controllers.

Frontier Water Systems, LLC

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Frontier Water is the pioneer and leading supplier of premium engineered equipment packages for high rate treatment of selenium, nitrate, and metals from heavy industry. Building from a track record of applied performance, our equipment solutions are saving our customers millions of dollars, while providing best in class water to our lakes and rivers.

Global Chem-Feed Solutions, LLC

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Global Chem-feed Solutions (GCS) is a manufacturer of custom skid mounted chemical feed systems for Electric Generating, Hydrocarbon Petrochemical and other Heavy Industrial Manufacturing facilities. These custom systems are engineered for the injection of chemicals into boiler water, cooling water, and waste water systems, as well as a wide variety of process applications. GCS also manufactures Ammonia Storage / feed systems, Chlorination Systems, as well as fugitive wet dust suppression systems - designed and fabricated for material handling and storage pile applications.

Global Treat, Inc.

Booth #: 215
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For more than 20 years, Global Treat, Inc. has been a supplier of Water and Wastewater treatment equipment for Industrial and Municipal Applications. Some of the products we provide include Fiberglass Shelters; Acid Dilution Troughs; Chem-feed Equipment (for Gas, Liquid, and Solids); High-capacity Chlorine, Sulfur Dioxide, and Ammonia Feed Systems (including Evaporators); Chemical Scales; Chemical Diffusers. Please stop by the Global Treat, Inc. booth for more information on all of the products we have to offer.

Golder Associates Inc.

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Established in 1960, Golder is a global, employee-owned company providing independent consulting, design, and construction services in earth, environment, and energy. We help clients overcome challenges related to manufacturing, the extraction of finite resources, energy production, water supply and management, waste management, urban development, and climate change. Golder's reputation has been gained by delivering high-quality services to our clients and meeting the goal of Engineering earth's development, while preserving earth's integrity. For more information, visit golder.com.

Graver Water Systems/Ecodyne Water

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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 65 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 North America

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Grundfos is committed to delivering innovative products that ensure the efficient management of water. Pumps currently account for 10 percent of global electricity consumption – Grundfos works to reduce that number that by manufacturing the most efficient and technologically advanced products on the market. High on the company's corporate agenda is an active commitment to improving the environment. Grundfos contributes to global sustainability by pioneering technologies that improve quality of life for people and care for the planet.

GWI Ultrapure

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Ultrapurewater.com is an online controlled circulation publication that focuses on technologies, trends and troubleshooting for users of high purity and industrial water and wastewater treatment systems. Formerly published as the bi-monthly title's Ultrapure Water Journal and Industrial Water Treatment Magazine, the new Ultrapurewater.com unites the two publications, with a continued focus on high quality, high value technical articles covering utility; process; domestic and wastewater applications, Concentrating on Cooling Water; Boiler Feedwater; Wastewater; Microelectronics and Pharmaceuticals. Coverage also includes industry news; patents; technology developments; water market information and interviews with industry professionals.

Hach Company

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For more than 70 years, Hach has been committed to providing solutions for better management and testing of water quality by offering high-quality products that are simple to use and accurate. Our analytical instruments and reagents are used to test the quality of water in a variety of industries and markets around the globe.

Heartland Water Technology, Inc.

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Heartland Water Technology, Inc. develops and markets proprietary wastewater treatment technologies. Heartland has developed an innovative direct-contact heat exchange concentrator that is a simple, robust and reliable treatment solution for challenging wastewaters. Our concentrator effectively handles wide-ranging water chemistries with demonstrated success in Power Generation, Oil and Gas, and Municipal Solid Waste applications.

Honeywell

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Unparalleled industry experience and proven results – that's why industrial manufacturers rely on Honeywell to improve performance and business outcomes. Since introducing the first distributed control system 50 years ago, Honeywell continues to innovate technologies that provide data visibility across the entire enterprise, from field to boardroom. We ensure water quality, plant safety, security, and productivity through a portfolio of process and safety systems, including analytical and field instrumentation. Analytical instrumentation shown at this conference includes process pH, conductivity/resistivity, ORP and dissolved oxygen for boiler, cooling, produced and waste water applications.

Honeywell UOP

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With more than 40 years of experience in the wastewater treatment industry, Honeywell UOP provides total solutions that meet customers' industrial wastewater treatment needs and successfully removes impurities such as radionuclides, heavy metals and organics from a wide range of waste and groundwater streams. UOP's XCeed™ bioreactor system efficiently removes up to 90 percent of organic and inorganic contaminants to help industrial, manufacturing and groundwater remediation facilities meet contaminant removal specifications for wastewater discharge or reuse.

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Howden Roots LLC is proud to offer the most complete product line for Mechanical Vapor Compression (MVR) and water treatment blowers and compressors in the world. With decades of experience and thousands of MVR installations across the world and in many industries, Howden Roots is the world leader in MVR application expertise and product quality and reliability. Howden Roots is the originator of world-renowned Roots® Rotary Positive Displacement Blowers, and is the North American source for the unique ExVel® turbo fan product line.

i2m LLC

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Our ceramic hollow fiber ultrafiltration/microfiltration membrane modules, CERA~DUR, are used to filter large volumes of industrial water and wastewater utilizing minimal space and energy. Along with the typical benefits of higher temperatures and chemical resistance that ceramic offer, CERA~DUR can handle up to 100,000 ppm TSS, 20,000 ppm COD and 5,000 ppm oil. CERA~DUR delivers stable flux and high-quality permeate water for disposal/reuse with <1 ppm TSS, <500 ppm COD and <5 ppm oil.

IDE Technologies

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IDE is a world leader in water treatment solutions, specializing in the development, engineering, construction and operation of some of the most advanced industrial water treatment plants, desalination and water reuse plants. IDE specializes in oil & gas, mining and power industries, delivering reliable, sustainable and economical solutions including eco-friendly solutions, cooling tower blowdown and ZLD.

Illinois Water Technologies

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Illinois Water Technologies is a privately owned company that brings over 35 years' experience in providing commercial, industrial water treatment equipment and field service work. We understand the frustration with suppliers who attempt to fit your needs into their design. our projects include custom engineered drawings specific to your project. All equipment is fully shop assembled to ensure proper fit in the field. Our focus is to serve your needs and meet your special requirements.

Ionomr Innovations Inc.

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Ionomr Innovations is a focused, innovative membrane solution and R&D partner located in Vancouver, Canada. We design, adapt, and manufacture ion exchange membranes, coatings, and resins for membrane based water treatment applications. This includes dry membranes and coated electrodes for electrochemical devices and robust thin-film coatings for pressure based membrane separation. Our core technology, Aemion, is the most durable and alkaline stable, high-performance anion-exchange membrane on the market, backed by outstanding quality assurance & consistency.

Itochu Chemicals America Inc.

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Exclusive distributor of ION EXCHANGE RESINS, manufactured by Mitsubishi Chemicals, for use in separation and purification processes in the food, beverage, water & biochemical and pharmaceutical industries. Exclusive distributor for Quantum DMI-65 Iron and Manganese filtration media.

Jacobi Carbons, Inc.

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Jacobi Carbons, one of the leading global activated carbon manufacturers, has expanded into the ion exchange resin marketplace. Resinex is the division of Jacobi Carbons that offers a complete portfolio of high quality ion exchange resins. This division includes many different ion exchange, adsorbent, and catalyst type products for a variety of applications. Jacobi and Resinex stay on the leading edge of carbon and resin technology by adding more products to solve unique applications daily.

Johnson March Systems, Inc.

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A worldwide leader in the design and fabrication of custom Chemical Dosing Systems for Boiler, Cooling Tower and Waste Water Treatment, Process Additive Systems, Steam and Water Sampling Panels (SWAS), Ammonia Feed Systems, ASME Code Pressure Vessels, Electrolytic and Gaseous Chlorination Systems, Equipment Shelters, Chemistry Laboratory Shelters, Sample Coolers and Dust Suppression Systems. We are ISO 9001-2008 Certified by Underwriters Laboratories. All JMSI Welders are ASME and CWB (Canadian Weld Bureau) Certified. Johnson March was founded in 1935. We have completed projects in over 66 countries worldwide.

Justeq, LLC

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Justeq07 is cheaper, more effective, and easier to use than any other oxidizing biocide. It is a unique, revolutionary new biocide that penetrates slime masses that bleach and other oxidizers leave behind. It then forms bromine from within to kill slime. Because of its formula, it is cheaper to use than any other oxidizing biocide. Plus, Justeq07 has a year-long shelf life, does not decompose corrosion inhibitors, and is much less corrosive than other oxidizers.

LANXESS Corporation

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LANXESS Material Protection Products is a worldwide leading manufacturer of biocidal active ingredients and formulations. We offer a wide range of products useful in many different applications such as paint and varnish preservation, wood protection, disinfection, and many other industrial applications. With the use of LANXESS water treatment products, damage and operational breakdowns caused by microorganisms can be minimized. To fully satisfy our customers' needs, we continually invest in the research and development of innovative products. LANXESS Material Protection Products is a worldwide leading manufacturer of biocidal active ingredients and formulations. We offer a wide range of products useful in many different applications such as paint and varnish preservation, wood protection, disinfection, and many other industrial applications. With the use of LANXESS water treatment products, damage and operational breakdowns caused by microorganisms can be minimized. To fully satisfy our customers' needs, we continually invest in the research and development of innovative products.

LANXESS Sybron Chemicals

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LANXESS with over 80 years of experience in water treatment and purification applications is one of the most important suppliers for liquid separation procedures worldwide. We hold a leading position in the development and production of ion exchange resins and are strongly committed to the development of reverse osmosis membrane elements.

Marubeni Specialty Chemicals, Inc.

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Marubeni Specialty Chemicals, Inc. is one of the largest distributors of chemicals in North America. Marubeni is proud to be the distributor for the DIAFLOC and DIACATCH brands of polymer flocculants and coagulants from Mitsubishi Chemical Corporation. Mitsubishi, the largest chemical company in Japan, is also the technology leader in the production of water treatment polymers and is proud to introduce the highest performing dewatering polymer available in the world today – “DIAFLOC KP-7000.”

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 US, Inc.

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MICRODYN-NADIR is a membrane manufacturer that delivers the membrane products to meet your water and wastewater needs. We offer the widest range of membrane products, including MF, UF, NF, and RO in flat sheet, spiral-wound, and hollow-fiber configurations. From our technologically advanced BIO-CEL® MBR to spiral RO elements and customized membrane solutions, we have the membrane products to meet your needs.

MPW Industrial Services

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MPW is an industry leader, offering services that can be implemented quickly for emergency response or customized water solutions that are designed to meet your long-term water purification needs. Our fleet of mobile filtration, clarification and reverse osmosis systems serve advanced processes, where water supply conditions are challenging and produced water purity levels more demanding. For more permanent industrial solutions, we build, install and service turnkey water purification treatment systems designed to meet specific plant requirements.

Neptune Chemical Pump Co./Fluid Dynamics

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Neptune is a manufacturer of chemical metering pumps, portable mixers and chemical feed systems. Neptune offers a full line of water treatment products including bypass feeders, filter feeders, sample coolers, injection quills and corporation stops. Neptune designs and builds semi-custom and custom chemical feed systems for boiler and cooling tower water treatment.

Oasys Water

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Oasys Water is the world leader in development of advanced membrane-based solutions to transform industrial effluents into valuable freshwater resources. Award winning technologies such as the award winning, forward osmosis (FO) driven, membrane brine concentrator (MBC), are at the core of systems that provide lower operating and capital cost for treating challenging waters. Established in 2008, Oasys Water is headquartered in Cambridge, MA, with offices, projects and partnerships around the world.

OLI Systems, Inc.

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OLI provides simulation software for electrolyte flowsheet simulation using OLI Flowsheet: ESP and for rigorous water chemistry analysis using the OLI Studio. Using first-principles, OLI models water reclamation and water re-use along with waste water processing in a variety of industrial applications, such as oil and gas production, chemical process, electricity generation, nuclear energy and hydrometallurgy. Software licenses and expert simulation studies are available, with expertise built on 46 years of study of electrolyte thermodynamics.

Pall Water

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Pall Water, a member of the Danaher portfolio of water companies, is the filtration partner of choice for companies who need smart water solutions. With more than two billion gallons of installed capacity spanning six continents, Pall Water is a leader in membrane-based water treatment solutions. Pall Water's broad portfolio of intelligent, reliable water systems and modules are used by leading industrial and municipal customers to ensure the continual supply of safe and reliable water.

Parkson Corporation

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Parkson is a supplier of equipment and solutions for potable water, process water, and industrial and municipal wastewater applications. Parkson designs, engineers and assembles products that provide customers with advanced screening, biological, filtration and biosolids management solutions. Parkson also has a highly trained field service team 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. EXTENDED LABOR AND MATERIAL WARRANTIES INCLUDED

ProChem, Inc.

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ProChem provides custom-tailored solutions to industrial water problems. We've partnered with KLeeNwater to provide the power generation industry with ELG compliance, GTCC treatment, concentrate management, and zero liquid discharge options, offering a total water solution that combines expert chemical pretreatment with multiple equipment options to provide optimized treatment solutions.

ProMinent Fluid Controls, Inc.

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ProMinent Fluid Controls, Inc is a global manufacturer of chemical metering pumps and systems, process instrumentation, dry and liquid polymer systems, disinfection equipment, and custom packaged feed systems. We have proudly served the Municipal, Industrial and OEM markets in the United States for over 35 years.

Protec-Arisawa America

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Protec-Arisawa is the leading RO pressure vessel manufacture in the USA. We have produced pressure vessels for the municipal, industrial, commercial and residential market since 1999 in our 65,000 square foot manufacturing facility in Vista, California. We have design engineering, process engineering and manufacturing all in our facility. As part of the ARISAWA group, we also manufacture RO vessels in our facility in Mungia, Spain and in Japan. All PROTEC ARISAWA vessels are designed to the exacting ASME Boiler and Pressure Vessel Code section X for filament wound vessels. ASME code stamp and documentation are available at a nominal additional charge.

PulsaFeeder

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Pulsafeeder, recognized as a leader in fluid handling technologies, manufacturing water treatment controllers, chemical metering pumps, pre-engineered systems, and accessories. MicroVision EX controller with conductivity, pH and ORP, with PULSAlink Communications you can safely communicate with your MicroVision EX controller from anywhere on your laptop, or mobile device. From our controllers and our metering pumps including trusted brands such as PULSAtron, Chem-Tech, BLACKLINE, and MecOMatic we are here to meet your needs with world-class products and customer service.

Purolite Corporation

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Purolite is more than a resin company— we're your solutions company. With innovations in ion exchange, catalyst, adsorbent and high-performance resin technologies, our sales team brings the experience, knowledge and service you need to solve your most complex water challenges. Continual R&D innovation, strict manufacturing practices and global warehouses ensure that trouble-free Purolite resins are available whenever and wherever they are needed.

PWT & Piedmont

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PWT - Chemical manufacturing and supply for the membrane industry, with a product line developed around a unique dendrimer-based antiscalant chemistry for scale and fouling control. PWT have also developed solutions and services to support their customers who are addressing varied and difficult applications like seawater desalination and wastewater re-use.

Piedmont (http://www.piedmontpacific.com/) - Piedmont Pacific is a global leader in corrosion resistant equipment for desalination plants and meets critical customer demand for a wide range of applications in the industrial and municipal markets.

QUA Group, LLC

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QUA is an innovator of advanced membrane technologies that address the most demanding water purification requirements. Headquartered in the USA, QUA provides its global OEM partners with best practices in R&D, innovation, quality, and customer service. QUA's diverse product portfolio includes fractional electrodeionization technology (FEDI®), polymeric (Q-SEP®) and ceramic (CeraQTM) ultrafiltration membranes, and submerged membrane bioreactor modules (EnviQ®). These products are specifically designed for high purity water treatment, wastewater recycle/reuse, seawater desalination, potable water purification applications.

ResinTech, Inc.

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ResinTech Inc., an acknowledged leader in ion exchange, manufactures a broad range of ion exchange resins for water and wastewater treatment, including deionization, softening, metals removal, product purification, resource recovery, and pollution control. In addition to its ion exchange resins, ResinTech supplies activated carbon and inorganic selective exchangers. ResinTech has developed an application technology resource group that includes state-of-the-art laboratories with full resin testing and analysis capabilities.

EXHIBITORS

RETEGO

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RETEGO Labs was established in October of 2014 to develop and establish a quick and robust method of determining contamination levels in complex industrial waste waters. The RETEGO method for measuring water contaminants is based on more than 20 years of scientific experience in the treatment and monitoring of oilfield source and waste waters. Our tests are conducted on-site and deliver fast and reliable water monitoring within 1-3 minutes without specialized training or liquid reagent handling. And the results are digital, making electronic distribution to anyone, anywhere a snap.

SAMCO Technologies Inc.

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Separation from the Ordinary - Manufacturer of innovative minimum waste/high yield water management solutions for produced water, boiler feed, condensate polishing, brine concentration/crystallization. Waste systems for selenium/boron removal. Dow Advanced-Amberpack Deionization (ADI) technology. Sour gas separation, Degasification.

Schreiber LLC

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Serving Industrial & Municipal markets since 1979, Schreiber LLC solves wastewater treatment problems through the application of energy-efficient, innovative, and proprietary equipment/process technology. Schreiber offers a complete system from head works to tertiary filtration. Our patented treatment processes such as the Continuous Sequencing Reactor® and compressible media filter "Fuzzy Filter®" combine effectiveness and efficiency to produce the industry's highest quality products. The "Fuzzy Filter®" is an adjustable pore size filter to 4 microns that operates at 5 times the rate and uses1/4 the wash water of granular media filters.

Sentry Equipment Corporation

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With proven sampling expertise since 1924, Sentry products and services provide power generators the critical insights to optimize processes and control corrosion. We deliver true representative sample conditioning and analysis techniques to customers around the globe, empowering them to accurately monitor and measure their water chemistry for improved production efficiency, output and safety.

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 37 manufacturing facilities strategically located around the globe and employs a team of 3,700 professionals in 118 countries across five continents.

Southern Research Institute

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Southern Research is a leading non-profit research organization of scientists and engineers working to solve energy and environmental challenges. We partner with private sector clients and government agencies to assess and develop new-to-the-world technologies for clean energy, clean air, and clean water.

Stenner Pump Company

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Established 1957, Stenner manufactures reliable peristaltic metering pumps. Featuring the S Series, designed for efficient interface with process control systems. Multiple operational modes such as scalable, invertible 4-20mA, Hall Effect and PPM Feed. Programmable communication such as tube leak detect, tube change timer and transfer operation to a backup pump. All Stenner pumps are self-priming up to 25 ft., can run dry without damage and offer toolless tube replacement. Visit the booth for hands-on demonstrations.

SUEZ Water Technologies & Solutions

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

Sumitomo Electric Industries, Ltd.

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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.

Survey Equipment Services/Teledyne Oceanscience

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Survey Equipment Services Inc (SES), based in Katy TX, specialize in supply of Marine Survey & Navigation Equipment for hire, sale (new & ex-rental) and lease purchase – stocking various types of equipment such as:

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- 2D and 3D Acoustic Sonar's, ADCP's & DVL's, Hydrographic Survey Software
- Inertial Navigation Systems, Motion Compensators, DGPS / RTK Receivers,
- GPS / Heading Receivers, Gyrocompasses, Marine Magnetometers / Gradiometers
- Side Scan Sonar Systems, Side Scan Sonar / Bathymetry Systems
- Sub Bottom Profiler Systems, Scanning Sonar Systems
- SSS Acquisition Software / Systems, SBP Acquisition Software / Systems
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SES also offer true 24/7 technical & engineering support and stock all rental pool in their new state of the art 10,0000 Square foot facility.

Swan Analytical USA

Booth #: 203
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Fax: 847-229-1320
E-mail: info@swan-analytical-usa.com
Website: www.swan-analytical-usa.com/

Swan Analytical 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, phosphate, nitrate, ammonium, hydrazine, TOC, chlorine, bromine, fluoride and turbidity. Swan's analyzers deliver high precision with ease of operation.

Taylor Technologies

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Website: www.taylortechnologies.com

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Technoform Kunststoffprofile GmbH

Booth #: 606/608
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E-mail: nscherer@tkp.biz
Website: www.tkp.biz

Technoform Kunststoffprofile (TKP) is a subsidiary of the Technoform Group, which is market leader in the extrusion of technical thermoplastics. Processing of materials with high amounts of fillers enables TKP to introduce plastic tubes to industries, where plastic products have not been widely used before. The extrusion specialist designed heat exchanger tubes for wastewater applications, which combine a good corrosion resistance with a high heat transfer coefficient. They can fully compete against metal tubes.

Thermax, Inc.

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Thermax Inc is part of Thermax Group, a Company providing a range of engineering solution to the Energy and Environmental sectors of our global market. We operate globally through 19 International offices, 12 Sales & Service offices, and 12 manufacturing facilities, 8 of which are in India & 4 overseas. Our Ion Exchange Resin Division falls under our Chemicals portfolio. Thermax Chemicals is one of the leading manufacturers of a gamut of TULSION brand Ion Exchange Resins for more than 35 years. TULSION is a premium brand and enjoys a global reputation in the field of water treatment and process application technologies.

Turner Designs Hydrocarbon Instruments, Inc.

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Website: www.oilinwatermonitors.com

Turner Designs Hydrocarbon Instruments, Inc. is the worldwide leader in the application of field portable, laboratory, and online continuous process monitors for measuring and monitoring hydrocarbons in water. Our monitors are exclusively based in UV and visible fluorescence technology.

U.S. Water

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U.S. Water gets to the root cause of problems to eliminate them at their source by utilizing an integrated water management approach that combines engineering, equipment, chemicals and services. We help industries find cost-effective and environmentally friendly solutions for their most challenging water, energy and compliance problems. Our customer focused approach enables our staff to work as an extension of your team making your goals our goals so you can focus on what's important – running your facility.

Univar

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Univar (NYSE: UNVR) is a global chemical and ingredients distributor and provider of value-added services, working with leading suppliers worldwide. Supported by a comprehensive team of sales and technical professionals with deep specialty and market expertise, Univar operates hundreds of distribution facilities throughout North America, Western Europe, Asia-Pacific and Latin America.

USP Technologies

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For more than 20 years USP Technologies, formerly US Peroxide, has been providing cost-effective, peroxygen-based technologies and full-service chemical treatment programs for municipal and industrial water and wastewater applications. Our programs provide low-risk, value-added solutions to customers. We successfully integrate storage equipment, customized dosing control, chemical supply, inventory and logistics management, and ongoing equipment and applications support.

Veolia Water Technologies

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

WaterColor Management

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WaterColor Management is the original insurance organization that has provided risk management support to companies andprofessionals in the water treatment industry since the AWT was founded in 1986. We now offer, in partnership with an A++ XVrated company, the broadest-available insurance coverages for water treaters, manufacturers, suppliers and consultants in the industry. Our coverages are specifically tailored to meet the needs of our insureds.

WaterTectonics

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WaterTectonics designs and manufactures water treatment solutions for clients in oil & gas, mining, industrial, and construction applications. We specialize in innovative electrocoagulation and electrochemical technologies and integration within larger solutions. A comprehensive suite of services includes treatability research, industrial design, and project delivery field services. From the mountains of Colorado to the the Australian outback to the deserts of Oman, we have treated water in some of the most challenging places in the world.

WesTech Engineering, Inc.

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WesTech provides proven solutions for cooling water, hydrofracturing, water reuse, raw water pretreatment, and industrial wastewater treatment. Reliable industrial and municipal process treatment installed on site, or mobile fleet. Design build, retrofits, intake screens to nanofiltration, reliable process, manufacturing and project management experience. Celebrating forty-five years of excellence in liquid-solids separation technology, WesTech is your Independent Source for experience and reliability in process solution design, manufacture, and operation. Employee-owned since 1973 and ISO 9001 certified.

Wigen Water Technologies

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Since its inception in 1965, Wigen Water Technologies has become a leading manufacturer of custom water treatment systems. We specialize in application-specific, cost-effective and reliable solutions for industrial, municipal and ultrapure clients. WWT purifies water for manufacturers making cutting edge medicines, brand name food and beverage producers feeding the world, power districts providing electricity, hospital and university laboratories requiring re-agent grade water and semi-conductor/nanoscience fab floors at the cutting edge of technology.

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