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THE EXHIBIT FIGHT

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	SALT RIVER 1	SALT RIVER 2	SALT RIVER 7	SALT RIVER 8
TUESDAY, NOVEMBER 6				
8:00 AM-12:00 Noon	ASME	Next Treatment	Membranes	FGD
	Session	Level	for Mining	Blowdown
12:00 Noon-1:15 PM	Attendee Luncheon in the Exhibit Hall			
1:15-5:00 PM	ASME	Sustainable	Produced	Membranes
	Session	Desalination	Water	
5:00-7:00 PM	Attendee Reception in the Exhibit Hall			
WEDNESDAY, NOVEMBER 7				
8:00 AM-12: 00 Noon	Cooling	Power	Membrane	Optimized
	Water	Plants	Technologies	Wastewater
1:00-5:00 PM	Continuing Education Eorkshops (separate registration required)	ate registration required)		
THURSDAY, NOVEMBER 8				
8:00 AM-12:00 Noon	8:00 AM–12:00 Noon Continuing Education Workshops (separate registration required)	rate registration required)		
1:00-5:00 PM	Continuing Education Workshops (separate registration required)	rate registration required)		

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 79th Annual International Water Conference® (IWC) located for the first time in Scottsdale, Arizona. The IWC is a conference that for almost 80 years has been a leading provider of technical information and training for the water and wastewater business. Over the years, we have expanded to cover a wide array of industry sectors while continuing to provide informative technical information to the forefront of our industry.

Our technical program this year is exciting this year with lots of exciting topics such as mining, trace contaminants, zero liquid discharge, flue gas desulfurization, boiler water, cooling water, membranes, sustainability, recycle and reuse, produced water and power. As we also evolve with industry needs, this year we have added two exciting sessions on desalination and water project delivery. We hope that this year like all previous years you will enjoy the technical content of our sessions while providing enrichment in your career.

Again this year we are using an app for mobile use during the conference. Information on papers, workshops, authors, exhibitors, attendees and more can be found within the app. Please feel free to share feedback with the IWC so that next year's app can continue to evolve with the conference and attendee's needs.

The heart and soul of this conference is the peer reviewed format and prepared discussions that provide a well-rounded view of new technical information. This year's Technical Program Chairperson, Ken Dunn, has done an excellent job of assembling this year's technical program. Ken coordinated Session Chairs, Discussions Leaders, Authors and Discussers to provide a well-rounded technical program. Thanks to all folks who participated in developing this year's technical program and who shared their time and expertise to assemble this program.

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 over 20 different workshop opportunities for you to expand your knowledge base and earn continuing education credits. I'd like to thank Jim Summerfield and the instructors for putting together a great set of courses for us this year. The workshops are held Sunday afternoon, Wednesday afternoon and Thursday. 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.

Be sure to visit the Exhibit Hall with representatives from over a 100 different company exhibits to learn about the newest advancements in water and wastewater treatment. New this year, please take time to visit our outdoor exhibitors. Refreshments will be provided throughout the Hall during exhibit hours courtesy of our sponsors, so be sure to grab a bite to eat while you are networking.

Our keynote speaker this year is Mr. Joel Beauvais, a partner with the office of Latham & Watkins and previously served in a number of offices within the United States Environmental Protection Agency. He administered the Clear Water Act and Safe Drinking Water Act and was a key participant in development of a number

of regulations on water quality and solid waste management. We are excited to hear his thoughts on our industry. Please join us for the keynote address on Monday morning.

A conference of this size does not happen without the hard work of a lot of people. I want to thank the ESWP staff - Dave Teorsky, Taylor Bombalski, and Michael Gaetano, and Kristina Emmerson. The success and growth that the conference continues to experience each year is a direct result of all their hard work. 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 learn new information, engage in lively conversation with colleagues and enjoy the Arizona scenery. I and the rest of the IWC Executive Committee, welcome your feedback. Please do not hesitate to share your conference ideas with us. Enjoy the conference!

Sincerely,

Patricia Scroggin, P.E.
Burns & McDonnell
General Chair, 79th Annual IWC

,

About the IWC

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

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

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

Conference Proceedings

All registered attendees (except Exhibit Only) receive the Official Conference Proceedings of the 79th Annual International Water Conference®. The CD will be mailed to you approximately two months following the conference. Additionally you may now download this content via file transfer.

Call for Papers

To participate in the 2019 International Water Conference® as a presenter, please watch for the opening of the IWC Call for Papers. The Call for Papers is done exclusively on-line through the IWC home page at www.eswp.com/water.

Americans with Disabilities Act

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

Professional Development Hours

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

Attendee Receptions

To help you enjoy your stay in Scottsdale during the IWC, we have many special events and activities planned for you. Join your fellow conference attendees at the annual 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 afternoons in the Exhibit Hall. Luncheon buffets are also provided Monday and Tuesday afternoons in the Exhibit Hall. Schedule time to visit the exhibits and enjoy lunch on us!

Literature Table

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

Spouses' Welcome Breakfast

For spouses who are traveling with conference registrants, the IWC will host a Welcome Breakfast on Monday, November 5. 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 32nd 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 6 at 7:00 AM Sharp; meet in the hotel lobby at 6:45 AM. Distance: 3 miles – flat and easy course.

Merchandise

IWC shirts are available for sale! Pre-prints for (most) technical presentations are available at the Registration Desk. Pre-prints can be purchased for \$10.00 per copy, or \$40 per 2GB flash drive with all the available papers. Also, you can find copies of previous years' IWC Proceedings for \$55 per volume.

Name Badge Identification

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

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

Registration Lists

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

An electronic version of the Registration List will be available at the Registration Desk the morning of Wednesday, November 7. It provides the names of all registered attendees in both Excel and comma-delimited text formats. There is a \$25 fee, please provide a USB drive.

Info Share Suites

You're Invited! Join host Purolite in the Road Runner Room at Talking Stick Resport to enjoy light fare, refreshments and entertainment. Suite hours: Monday/Tuesday, November 5/6, 7:00 –9:30 PM.

ASME Co-Meetings - open to all attendees

Main Committee: Wednesday, Nov. 7, 2:00 - 3:00 PM,

Water Technology Subcommittee: Wednesday, Nov. 7, 3:00 – 5:00 PM and Thursday, Nov. 8, 8:00 AM –12:00 Noon

Properties Subcommittee: Thursday, Nov. 8, 8:00 AM -5:00 PM

Social Media

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

Future Conference Dates

See you next year on November 10 – 14, 2019; Hilton in the Walt Disney World Resort®, Orlando, FL, USA

Executive Committee

The International Water Conference® is sponsored by the Engineers' Society of Western Pennsylvania, a membership based, not-for-profit organization in Pittsburgh, PA. Members of ESWP create the IWC Executive Committee, who are top industry leaders. These ladies and gentlemen volunteer their time to help execute the conference year after year. ESWP extends a sincere thank you to the entire committee for their efforts. A special thanks goes to the General Chair, Patricia Scroggin.

Wayne Bernahl

W. Bernahl Enterprises Ltd., Elmhurst, IL

Debbie Bloom

Retired, Wheaton, IL

Ken Dunn

Solenis - Retired, Mashpee, MI

Michele Funk

Bechtel Corporation, Reston, VA

Michael Gottlieb

ResinTech, Inc., West Berlin, NJ

James (Jay) Harwood

SUEZ Water Technologies & Solutions, Oakville, ON, Canada

William Kennedy, P.E.

Duke Energy Corporation, Charlotte, NC

Jane Kucera

Nalco Water, an Ecolab Company, Naperville, IL

Tom Lawry

McKim & Creed, Inc., Sewickley, PA

Dennis McBride

Burns and McDonnell, Kansas City, MO

Paul Pigeon, P.E.

Golder Associates Inc., Lakewood, CO

Scott Quinlan

GAI Consultants, Inc., Cranberry Township, PA

Colleen Layman Scholl, P.E.

HDR, Inc.

Patricia Scroggin, P.E., Conference Chair

Burns & McDonnell, Chicago, IL

Jonathan Shimko

McKim & Creed, Sewickley, PA

Michael Soller, P.E., CPC

Bowen Engineering, Indianapolis, IN

Jim Summerfield

Dow Water and Process Solutions, Saginaw, MI

Bill Willersdorf

Veolia Water Technologies, Randolph, NJ

Bradley D. Wolf, P.E.

Berkeley Research Group, LLC, Pittsburgh, PA

Advisory Council

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

Air Liquide America

Brad Crocker; www.airliquide.com

AMBI-Design, Inc.

Shan Sundaram, P.E.

Aquatech International Corporation

Patrick Randall; www.aquatech.com

Athlon, A Halliburton Service

Lawrence (Larry) Broussard; www.athlonsolutions.com

Avista Technologies

Mike Graver; www.avistatech.com

Baker Hughes, a GE company

Bill Watson; www.bakerhughes.com

Bechtel Infrastructure and Power Corporation

HG Sanjay, P.E.; www.bechtel.com

Black & Veatch

Michael Preston; www.bv.com

Bowen Engineering Corporation

Michael Soller; www.bowenengineering.com

Burns and McDonnell

Andrew Erickson; www.burnsmcd.com

CGC, Inc./Purolite

Chris Graham; www.cgcinc.net

ChemTreat, Inc.

Raymond Post, P.E.; www.chemtreat.com

Civil & Environmental Consultants, Inc.

Ron Ruocco; www.cecinc.com

Culligan

Anne Arza; www.culligan.com

Duke Energy Corporation

Derek Henderson; www.duke-energy.com

Eco-Tec, Inc.

Mike Dejak; www.eco-tec.com

Eisenmann Corporation

Fabian Solberg; www.eisenmann.us.com

Epicor Incorporated

Phil D'Angelo; www.epicorinc.com

EPRI

Jeffery Preece; www.epri.com

Evergy

Heath Horyna; www.westarenergy.com

Evoqua Water Technologies

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

Fluor Enterprises, Inc.

Joseph Guida; www.fluor.com/pages/default.aspx

GAI Consultants, Inc.

David Weakley II; www.gaiconsultants.com

GHD

Kristen Jenkins; www.ghd.com

Golder Associates, Ltd.

Corne Pretorius; www.golder.com

Graver Water/Ecodyne

John Yen; www.graver.com

Hatch

Jerry Penland; www.hatch.com

HDR

Jim Beninati; www.hdrinc.com

Hydranautics

Wayne Bates; www.membranes.com

Integrated Sustainability, Inc.

Ivan Morales; www.integratedsustainability.ca

Jacobs

Tom Higgins; www.ch2m.com

Johnson March Systems

John Sands; www.johnsonmarch.com

Kalluri Group, Inc.

Ramesh Kalluri; www.kalluri.com

LANXESS Sybron Chemicals, Inc.

Ed Nace; www.lanxess.com/en/corporate/home

LG NanoH2O, Inc.

Tony Fuhrman; www.LGwatersolutions.com

McKim & Creed

John Van Gehuchten; www.mckimcreed.com

MICRODYN-NADIR US, Inc.

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

MPW Industrial Services

Brad Tolbert; www.mpwservices.com

Nalco Water, an Ecolab Company

Matthew Flannigan; www.ecolab.com/nalco-water

North America Dow Water and Process Solutions

Donna DeFlavis; www.dow.com/en-us/water-and-process-solutions

OLI Systems, Inc.

Mike Kochevar; www.olisystems.com

Pulsafeeder

Larry Pannell; www.pulsatron.com

Purolite Corporation

Donald Downey; www.purolite.com

ResinTech Inc.

Peter Meyers; www.resintech.com

RETEGO Labs

Les Merrill; www.retegolabs.com

Samco Technologies, Inc.

Richard Posa; www.samcotech.com

Sargent & Lundy, LLC

Matthew Heermann; www.sargentlundy.com/home

Solenis LLC

Michael Bluemle; www.solenis.com/en

Southern Research Institute

Young Chul Choi; www.southernresearch.org

SUEZ Water Technologies & Solutions

Lanny Weimer; www.suezwatertechnologies.com

SWAN Analytical USA

Randy Turner; www.swan-analytical-usa.com

Tetra Tech, Inc.

Jason Monnell; www.tetratech.com/en/water

Thermax, Inc.

Ajit Dighe; www.thermax-usa.com

Toyota

Max Brefeld; www.toyota.com

Turner Designs Hydrocarbon Instruments

Chip Westaby; www.oilinwatermonitors.com

U.S. Department of Energy, NETL

Briggs White; www.netl.doe.gov

U.S. Water Services

Michael Reniak; www.uswaterservices.com

Veolia Water Technologies

Brittany Hohman; www.veoliawaterst.com/en

WesTech Engineering, Inc.

Jeff Easton; www.westech-inc.com

Wigen Water Technologies

Steve McSherry; www.wigen.com

Wunderlich - Malec Engineering, Inc.

Brad Spindler; www.wmeng.com

Media Partners

Thank you to the media partners of the 2018 International Water Conference®, through their support and marketing efforts, we are able to introduce the IWC to more audiences! Thank you!

Cooling Technology Institute

www.cti.org

Pollution Equipment News

www.pollutionequipment.com

Process Cooling

http://www.process-cooling.com/

Sea Technology

www.sea-technology.com

Waesseri-PowerPlant Chemistry Journal

www.ppchem.net

Water Online

www.wateronline.com

WC and P

www.wcponline.com



Industrial Water & Process Treatment Technology







Cooling Water Chemistry Innovations Support Environmental Needs: New Green Chemicals, New Non-P Treatment, and Innovative Yellow Metal Treatment Technology in Contaminated Water Reuse

Monday, Nov. 5; 8:00-11:00 AM

Room: Salt River 1

IWC Rep: Michele Funk, Bechtel Corporation, Reston, VA Session Chair: Charles Kuhfeldt, CauseWay Water Consulting and Services, LLC, Taylor Lake Village, TX Discussion Leader: Chris Baron, ChemTreat, Newark, DE

8:00 AM

Session Introduction

Three presentations aid the sustainability of water use, water reuse and protection of natural resources through chemical innovation. Research continues toward the availability of naturally occurring antiscalant molecules. The first paper examines the newest developments in green (natural) antiscalants including plant extracts, biological molecules and modified natural industrial by-products. Strategies to discover these new green inhibitors, the methods to quantify their effectiveness and potential uses are discussed. In some cooling water chemistry applications interest in the removal of phosphate corrosion inhibitors is driven by discharge restrictions or concerns, as well as the potential of higher cycles and enhanced system protection through the elimination of calcium phosphate precipitation threats. The second paper introduces a new non-P corrosion inhibitor, comparing its performance in challenging applications, including sea water, to many inhibitors currently in use. The third presentation examines the problem of contaminated reuse water, microbiological control, and yellow metal corrosion control in a corrosive environment including the complication of mixed chlorine species and ammonia. Driven by a manufacturing facility cooling water application with a highly contaminated reuse water makeup source, laboratory potentiometry studies of yellow metal corrosion protection from azoles including combinations of azoles, contaminated reuse water, chlorine, monochloramine, and ammonia were used to determine the effective treatment choice.

8:10 AM

IWC 18-01: State of Art of Natural Inhibitors of Calcium Carbonate Scaling: Last Developments

Olivier Horner and Hélène Cheap-Charpentier, EPF, EPF – Graduate School of Engineering, Sceaux, France; Jean Ledion, AMVALOR, Paris, France; Hubert Perrot, LISE – CNRS/Sorbonne University, Paris, France

The formation of calcium carbonate in water is a major concern in some industrial processes. It can cause technical problems such as reduction of heat transfer efficiency in cooling systems and obstruction of pipes. The non-productive expenses related to scaling were estimated at 1.5 billion Euros per year in France,

0.8 billion \$US in Great Britain, 3 billion \$US in Japan and 9 billion \$ in the USA. A common method for controlling scale deposition is the use of chemicals which act as antiscalants. In this respect, phosphorous and nitrogen compounds have been fruitfully used against scale formation. However, these...

8:35 AM: Discusser: David Fulmer, Athlon, A Halliburton Service, Houston, TX

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

9:00 AM

IWC 18-02: New No P Scale Inhibitor for Inhibiting Scale under Highly Demanding Conditions Such as Sea Water cooling and Thermal Desalination

Jasbir Gill, Ph.D. and Matt Chudomel, Ph.D., Nalco Water, Naperville, IL; Santanu Banerjee, Ph.D., Nalco Water India Limited, Pune, Maharashtra, India; Sairam Sudhakaran, Nalco Champion MEA, Thuwal, Kingdom of Saudi Arabia

Demand for non-P scale and corrosion inhibitors has necessitated a move from phosphonates to polymers for scale inhibition. This in conjunction with the use of impaired water such as seawater for cooling has significantly raised the performance bar as compared to phosphonates, polyacrylic acid and polymaleic type of scale inhibitors. This paper presents unique new composition of the new inhibitor that out performs most of inhibitors currently available to the water treaters. The data presented in the paper compares its performance to the phosphonates and other polymers in the cooling water system where the seawater is used as make up water....

9:25 AM: Discusser: Michael Bluemle, Ph.D., Solenis LLC, Wilmington, DE

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

9:50 AM: Networking Break

10:10 AM

IWC 18-03: Corrosion Inhibition with Azoles in a Cooling Water System with Chloramine Contamination

Maria Nydia Lynch, Ph.D., Solenis, LLC, Wilmington, DE; Jo Anna Ordonez, Solenis, LLC, Kyle TX

A manufacturing facility opted to reuse contaminated water for their cooling systems, which presented challenges in maintaining effective yellow metal corrosion rates with conventional azole treatments. Laboratory potentiometry studies determined the corrosion rate of yellow metals via the evaluation of various azoles in the presence of free chlorine, monochloramine, and ammonia. Halogen resistant azole outperformed other azoles by maintaining the corrosion rate at less than 0.3 mpy at half-dose when compared to other azoles. Laboratory potentiometry studies were performed to determine the corrosion rate of yellow metal in the contaminated water and the effect of that contamination towards azole corrosion...

10:35 AM: Discusser: Prasad Kalakodimi, Ph.D., ChemTreat, Glen Allen, VA

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

11:00 AM: Conclusion

IWC 18-Reserve: Getting to the Source of Cooling Water

Treatment

Krystal Perez, P.E., Jacobs, Bellevue, WA; Thomas Higgins, Jacobs, Jacksonville, FL; Jim Lozier, Jacobs, Phoenix, AZ; Mary McCloud, Jacobs, Fort Lauderdale, FL; Ken Martins, Jacobs, Santa Ana, CA

Water scarcity, water quality degradation, tightening regulations, and competition for water supplies are leading power plants to evaluate their water supply strategies. The water quality of wells or surface water varies and can degrade seasonally and over time. Several plants are already reusing or are considering reusing their other process water streams or municipal wastewater effluent.

Water Projects: Delivering a Success

Monday, Nov. 5; 8:00-11:00 AM

Room: Salt River 2

IWC Rep: Bradley D. Wolf, Berkeley Research Group, LLC,

Pittsburgh, PA

Session Chair: Derek Henderson, Duke Energy, Raleigh, NC Discussion Leader: Mike Kochevar, OLI Systems, Inc., Cedar

Knolls, NJ

8:00 AM

Session Introduction

When implementing a water or wastewater treatment project, there are quite a few challenges that arise from design through construction. These challenges can pertain to design, schedule, cost, etc. In this session, we will review these project challenges and provide options and case studies on how to address them so that a successful project can occur.

8:10 AM

IWC 18-04: Project Considerations for Successful Execution of Water and Wastewater Treatment Facilities

Joseph Guida and Americus Mitchell, Fluor Corp, Sugar Land, TX

A myriad of important decisions and considerations are required before embarking on a water or wastewater treatment project. These decisions are different than those associated with structural or architectural projects due to the variable constituents in water, the regulations associated with discharge from plants, and the various technologies available. Understanding what decisions are required and being able to set the right direction early will ensure success, on time completion, and avoidance of costly changes down the road. This paper provides a framework to address the decisions and operational considerations that need to be established early to build a successful project...

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

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

9:00 AM

IWC 18-05: Utilizing Progressive Design-Build to Efficiently Complete Projects in the Upstream Oil & Gas Sector

Russell Huffmyer, McKim & Creed, Sewickley, PA

The upstream O&G sector utilizes a significant amount of water to drill and develop their wells and generates a significant amount of brine wastewater. In some industries infrastructure projects, such as water & wastewater pipelines and facilities, are developed utilizing the traditional design-bid-build project delivery model. The Design-Bid-Build concept, by its nature, results in extended delivery schedules and higher costs because of its linear progress and losing the opportunity for the constructors, and equipment suppliers to provide input into the design. In contrast, recent projects have shown that the design-build delivery method allows for the engineer to work closely with the...

9:25 AM: Discusser: Sam Fackrell, Bowen Engineering Corporation, Glen Burnie, MD

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

9:50 AM: Networking Break

10:10 AM

IWC 18-06: With the Chemistry Set, What's Next? A Case Study to Deliver a Fast-Tracked EPC Industrial Wastewater Project

Michael Soller, P.E., CPC, DBIA, Josh Thomas, P.E., and Ben Klick, E.I., Bowen Engineering Corporation, Indianapolis, IN

The key to complete a water or wastewater project is to understand the influent and effluent chemistry and agree on the treatment process flow sheet. Significant time is sometimes required to achieve stakeholder agreement on an optimized treatment scheme which can ultimately delay the start of detailed design and construction in the field. These delays can increase the design cost, and the construction complexity and cost due to overall schedule compression because the project end date does not change. For industrial wastewater projects it is common that the design time to confirm the treatment processes and finish the balance of plant design...

10:35 AM: Discusser: Ron Ruocco, P.E., Civil & Environmental Consultants, Inc., Charlotte, NC

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

11:00 AM: Conclusion

Reverse Osmosis: The Application of a Very Important Tool

Monday, Nov. 5; 8:00-11:00 AM

Room: Salt River 7

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

MO

Session Chair: Steve McSherry, Wigen Water Technologies,

Chaska, MN

Discussion Leader: David Weakley, GAI Consultants, Inc.,

Homestead, PA

8:00 AM

Session Introduction

Reverse osmosis technology is a versatile tool in the world of water treatment. It is a pre-treatment technology when used on high purity water treatment applications; a primary technology for general manufacturing applications and a post-treatment technology in waste water re-use applications. This session will examine the practical application of the technology with papers discussing membrane selection, predictive modeling software and a case study with 4 years of operating data on a waste water re-use and ZLD application.

8:10 AM

IWC 18-07: Reverse Osmosis vs Nanofiltration: Using Membrane Selectivity for Process Advantage

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

Membrane Technology has significantly improved our ability to handle significant water chemistry challenges. Often, reverse osmosis and nanofiltration are evaluated during lab screening and/or pilot testing to determine actual separation ability, pressure required and application robustness. As we apply these technologies to higher and higher salinities, organic concentrations and complex solution chemistries, conventional prediction tools are limited in their ability to direct our application of these membrane technologies. Often, these technologies are selected based on simple grouping of monovalent vs divalent or large vs small organics. As concentrations push higher and solutions contain complex solutes, simple rules of thumb no longer apply...

8:35 AM: Discusser: Holly Churman, P.E., GHD, Houston, TX

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

9:00 AM

IWC 18-08: The Practical Application of Ion Association-Speciation Models to Mineral Scale Formation and Control in High Ionic Strength Membrane Systems

Robert J. Ferguson, French Creek Software, Inc., Valley Forge, PA; Kaylie L. Young, Ph.D., and William Glover, Ph.D., Dow Oil, Gas & Mining R&D, Houston, TX

Traditional water chemistry simulation software is not up to the rigors of high ionic strength, high recovery, and water reuse membrane systems. They are not capable of adequately

modeling cascade systems. The simple indices used for predicting scale formation, and as driving forces for dosage optimization, do not simulate high ionic strength activity coefficients and near as well as far effects. The simple models fail to account for speciation and the ion association of even such standard (yet critical) pairs such as CaSO40 aqueous. Traditional scale inhibitor models do not account for inhibitor dissociation and the active form of the molecules...

9:25 AM: Discusser: Rasika Nimkar, OLI Systems, Inc., Cedar Knolls, NJ

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

9:50 AM: Networking Break

10:10 AM

IWC 18-09: A Case Study of Industrial Water Reuse and ZLD – 4 Years of Operation and Lessons Learned

Ed Greenwood, P.Eng., BCEE and Bill Malyk, P.Eng., BCEE, Wood plc, Cambridge, ON, Canada

One global food processor has risen to the challenge of water scarcity at one of its production facilities in India. Prior to 2013, the facility was able to draw all the water it needed from a well. However, droughts have reduced groundwater resources and the demand for the facility's products has grown. The food processor approached Wood (formally Amec Foster Wheeler) to help them with a major expansion that would triple production capacity. Since additional withdrawals from the aquifer were not permitted, a new Water Reclamation Plant was needed. Water reuse at a food processing facility was rare; however...

10:35 AM: Discusser: Kurt Blohm, Veolia Water Technologies, Moon Township, PA

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

11:00 AM: Conclusion

Nitty Gritty Details of FGD Wastewater Treatment

Monday, Nov. 5; 8:00-11:00 AM

Room: Salt River 8

IWC Rep: Patricia M. Scroggin, P.E., Burns & McDonnell,

Chicago, IL

Session Chair: Michael Preston, Black & Veatch, Overland

Park, KS

Discussion Leader: Thomas Higgins, P.E., Ph.D., Jacobs, St.

Augustine, FL

8:00 AM

Session Introduction

The ability to predict FGD wastewater quality based on coal power plant inputs has been a type of Holy Grail since the ELG rules have been considered. Our first paper will look at the results of modelling studies attempting to predict FGD wastewater quality and the fate of constituents as a function of fuel and other plant inputs. Our final two papers discuss

some unanticipated issues and challenges that have arisen with common FGD wastewater treatment processes as they attempt to deal with very concentrated wastewater and meet extremely low discharge requirements.

8:10 AM

IWC 18-10: Plant-Scale Mass Balance to Determine the Effect of Flue Gas Additives on Trace Metals in FGD Wastewater and Solids

Jonathan Allen and Christopher Ferens-Foulet, Allen Analytics LLC, Tucson, AZ; Chethan Acharya, Southern Company Services, Birmingham, AL

Coal-fired power plants burn coals of variable composition and commonly operate at a range of loads. These variable operations mean that the efficacy of treatment options cannot be unambiguously determined from changes in concentration; i.e. the effect of flue gas additives cannot be distinguished from changes in coal composition based on wastewater concentration, especially for trace metals. Evaluation of treatment efficacy is further complicated in the case of species like selenium (Se) and mercury (Hg) which partition among gas, particulate, and aqueous phases. Flue gas composition was measured at multiple locations. Samples of coal, ESP ash, and baghouse ash were collected throughout...

8:35 AM: Discusser: Nelson Fonseca, Suez Water Technologies & Solutions, Oakville, ON, Canada

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

9:00 AM

IWC 18-11: Investigation of Constituent Volatility in Thermal Treatment of Flue Gas Desulfurization Wastewater

Jeffery Preece and Trent Rogers, Electric Power Research Institute, Charlotte, NC; Anthony (A.J.) Gerbino, Ph.D., OLI Systems, Inc., Cedar Knolls, NJ

There is limited publicly available information that provides details on transfer mechanisms and volatility of certain species during evaporative treatment of flue gas desulfurization (FGD) wastewater. Understanding these mechanisms will assist in developing strategies that minimize or mitigate the need for constituent-specific treatment of distillate produced by thermal evaporation. This approach could lead to a reduction of overall cost in producing high purity distillate by avoiding post-treatment for certain constituents of interest. This study analyzes the chemical properties of various FGD wastewater sources as they undergo evaporative treatment simulations in OLI Systems software. Results from the software models are compared...

9:25 AM: Discusser: Krystal Perez, P.E., Jacobs, Bellevue, WA

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

9:50 AM: Networking Break

10:10 AM

IWC 18-12: Unforeseen Consequences of Cycling-Up Flue Gas Desulfurization (FGD) Scrubber Water

Frank Sassaman, Jr. and Kylie Henline, Evoqua Water Technologies, Warrendale, PA; Charles McCloskey, Evoqua Water Technologies, Schaumburg, IL

Some unintended consequences of cycling up FGD scrubber wastewater are highlighted in this paper including creating a waste stream that becomes more difficult to treat and more difficult to analyze. The paper presents data showing increasingly imprecise analysis of selenium and arsenic that is proportional to the TDS. It also shows how concentration of very difficult to treat organic arsenic compounds can result in non-compliance with 2015 Effluent Limitation Guidelines (ELG). In laboratory tests, a sample of FGD blowdown containing 20 g/L of TDS was gradually concentrated using reverse osmosis to TDS concentrations of 20, 30, 35, 50, and 70 g/L....

10:35 AM: Discusser: William Kennedy, P.E., Duke Energy, Charlotte, NC.

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

11:00 AM: Conclusion

Keynote Session

Monday, Nov. 5; 11:15-12:30 PM

Room: Salt River 7 & 8

Session Chair: Patricia M. Scroggin, P.E., Burns & McDonnell, Chicago, IL

The Keynote Session is the official start to the 2018 IWC! In addition to the presentation of the annual awards, we are pleased to have Joel Beauvais, (Partner, Latham & Watkins) and a member of the Environment, Land & Resources Department.

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 Peter Meyers. Mr. Meyers currently works for ResinTech, Inc. and is a frequent presenter at the IWC, and participates on the IWC Advisory Council.

Paul Cohen Award

As a memorial, o 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 78th Annual IWC. This year, we honor Akash Trivedi for his presentation of IWC 17-11: Case Study: On-Line Chloride and Sulfate Measurement by Microfluidic Capillary Electrophoresis.

First Time Presenter and Overall Best Paper Award
These awards are to be presented annually to an IWC presenting author (or authors) who best exemplifies the goal of clearly communicating new information, or a new understanding about a significant aspect of water use or water chemistry, or best enhances the knowledge that enables effective utilization of water in industry or another use that benefits humanity. To that end, the IWC is pleased to announce the winners of the 2017 awards. The First Time Presenter Award Winner is Chad Roby from Jacobs for the presentation of IWC 17-59: Closing the Bottom Ash Loop – Pilot Testing Treatment and Reuse for FGD Makeup. The Best Overall Paper Award Winner is Dan Sampson from HDR, Inc. for paper IWC 17-63: A Rock and a Hard Place – Managing use of Ammonia-laden Recycled Water.

IWC Travel Scholarship

The IWC, McKim & Creed, and Dewberry Engineers donated \$500 and a complimentary registration to four students. These students demonstrated interest and commitment to seek a career in the field of water technology. We are proud to present the following with the 2018 IWC Travel Scholarship:

- · Joshua Benjamin, University of South Florida
- · Nader Rezari, University of South Florida
- Stephen LaBonia, University of Florida

Keynote Presentation

Mr. Beauvais rejoined Latham in 2017 after serving for six years at the United States Environmental Protection Agency (EPA). Most recently, he served as Deputy Assistant Administrator for Water where he led the agency's National Water Program, which administers the Clean Water Act and Safe Drinking Water Act. In this role, Mr. Beauvais led the development and implementation of national regulations and policies, oversight of state water programs, and the implementation of national programs to support water infrastructure financing.

Mr. Beauvais previously served as Associate Manager for Policy at EPA, where he played a key role in the development of major regulations addressing climate, air quality, water quality, chemical safety, solid waste management, and other issues. In this position, he was a principal advisor to the EPA Administrator on regulatory policy, oversaw EPA's work on economic analysis, and led the agency's engagement with the White House Office of Management and Budget on regulatory issues. Prior to this, he served as Associate Assistant Administrator in the Office of Air and Radiation and as Special Counsel to the Office of the Administrator.

Before joining the EPA, Mr. Beauvais worked in the US House of Representatives as counsel for the Committee on Energy and Commerce and majority counsel for the Select Committee on Energy Independence and Global Warming where he helped develop legislation and advised on energy, climate, and air quality issues.

Boiler Water Contaminants and Their Effect on Boiler System Operations

Monday, Nov. 5; 1:15-5:00 PM

Room: Salt River 1

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

Elmhurst, IL

Session Chair: Dr. Claudia Pierce, Suez Water Technologies

& Solutions, Trevose, PA

Discussion Leader: Debbie Bloom, Retired, Wheaton, IL

1:15 PM

Session Introduction

Technical papers will be presented in the areas of water treatment, cases of corrosion related phenomena, and contaminants excursion requiring mitigating risks planting safety and reliability. The first paper will cover the differences between terminologies in the "water" composition of boiler systems. Terms like "Ultrapure Water" (UPW) and "Industrial water" (Power, Industrial boilers, refineries, cooling water, industrial process streams, mining, oil and gas) will be highlighted to help the audience come to a clearer understanding about these differences and their impact on water treatment decisions. Another paper included in this session is related to Flow Accelerated Corrosion (FAC), a phenomenon quite unique to steam generation systems. This paper will discuss the conditions which contribute to the two forms of FAC (single phase or two phase) as well as the means to reduce its effects, primarily focused in Heat Recovery Steam Generator (HRSG) systems. A paper is also included providing a case study for root cause analysis of pitting and evaluation of the process analytics in place to detect and monitor corrosive contaminants. It discusses the implementation of on-line chloride and sulfate measurements to complement current analytical measurements and provide actionable data to control power plant processes and reduce corrosion. The last paper will cover steam system silica excursion at an ammonia production site. This excursion led to a 17% reduction in continuous ammonia production rate over a 10-day period at two production sites (profit losses of \$ 600,000).

1:25 PM

IWC 18-13: How Do the Users of Ultrapure Water differ and What Drives Treatment Decisions?

Mike Henley, MD Henley & Associates, Denver, CO

In the water world, the terms "ultrapure water" (UPW), and "industrial water" have different meanings, depending on the application. Essentially, each water name acts as an umbrella term for several types of water. In UPW there are really three primary categories: semiconductor water, pharmaceutical water, and power water for sub- and super-critical boilers. Each kind requires specific types of treatment to ensure they meet the specifications for use in their respective end use. For example, in

the production of microelectronics water, the goal is a final water quality with a resistivity around 18.2 megohm-cm (at 25°C). To achieve this quality of water, a facility will use...

1:50 PM: Discusser: Eric Kangas, Nalco Water, Naperville, IL

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

2:15 PM

IWC 18-14: Flow-Accelerated Corrosion- What Is It and What to Do About It

Dennis McBride and Phil Walker, Burns & McDonnell, Kansas City, MO

A corrosion process, referred to as Flow Accelerated Corrosion (FAC), has been determined to be the cause of multiple catastrophic failures in power plants resulting in significant unplanned outages, expense, and even fatalities. Through the knowledge of where FAC can occur and the use of proper chemistry and metallurgical selections, these failures, as well as future fatalities, can be avoided.

2:40 PM: Discusser: James Robinson, Suez Water Technologies & Solutions, Trevose, PA

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

3:05 PM: Networking Break

3:20 PM

IWC 18-15: Case Study: Monitoring and Controlling Corrosion Using On-Line Chloride and Sulfate Measurement

Burt FitzHugh, Tennessee Valley Authority, Drakesboro, KY

Power plants constantly combat corrosion caused by chlorides and sulfates under high pressure water and steam conditions. Paradise Fossil Plant Unit3 is an 1150 MW supercritical generating unit, using a once-through boiler and implementing the associated tight controls over water/steam quality according to Oxygenated Treatment regimen. Even with continuous monitoring of cation conductivity and sodium to maintain them at acceptable levels, pitting was observed on the Low-Pressure Turbine blades during maintenance leading to expensive repairs and longer downtime. The root cause for this pitting was traced to excessive chloride and sulfate in the water/steam cycle. This paper provides a case study for root cause...

3:45 PM: Discusser: Randy Turner, Swan Analytical, Wheeling, IL

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

4:10 PM

IWC 18-16: Boiler Silica Excursion Results in Production Loss & Potential Plant Shutdowns at an Ammonia Production Site

Ray Titsing, BSc., BEd., Suez Water Technologies & Solutions, Oakville, ON, Canada

Silica is the most ubiquitous and plentiful component of the Earth's crust. The vast majority of minerals that contain silica have very low to extremely low solubility in water. Despite this

fact, the widespread presence and shear abundance of silica make it a pervasive contaminant in typical raw water sources utilized by industry. Due to its complex and dynamic chemical and physical-chemical properties, silica poses unique challenges when treating water for silica removal. Silica removal from water destined for use in industrial high-pressure steam turbine drives requires special attention. Silica in these systems can deposit on steam turbine blades, causing problems ranging...

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

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

5:00 PM: Conclusion

Sustainability in Water Treatment Design – Not Just a Differentiator, but the Future for Gaining a Competitive Edge

Monday, Nov. 5; 1:15-5:00 PM

Room: Salt River 2

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

Session Chair: Michele Funk, Bechtel Corporation, Reston,

VA

Discussion Leader: Kenneth Chen, Arcadis, Irvine, CA

1:15 PM

Session Introduction

It is commonly understood, yet not necessarily accurate, that sustainable designs increase the overall cost of the project. To the contrary, a single sustainable design change, such as fresh water reduction or use of a sustainable technology, can naturally lead to compounding benefits (lower power usage, reduced chemical usage or less environmental impact), and even result in an edge over competitors. This session will illustrate how sustainable designs have intrinsic relationships and can organically cultivate into a technical advantage, and even decrease overall cost. The designs in this session include: biological treatment realizing benefits of reduced chemical usage; an environmentally filming amine-type biocide that reduces truck delivery traffic and lowers dosing equipment capital cost and electrical use; a combined cycle power plant with no wastewater discharge permit that takes a holistic design approach with selection of air cooled condensing technology, while also reducing chemical use for regeneration of the condensate polisher; and a coal fired power plant reusing gypsum fines from wastewater dewatering for wallboard while optimizing greenspace footprint.

1:25 PM

IWC 18-17: Grey Water for Cooling Water Makeup: Mission Impossible

Brad Buecker and Ray Post, P.E., ChemTreat, Richmond, VA

By choice or mandate, owners and design engineers for many new power and industrial plants are selecting alternatives to

fresh water for plant makeup. An increasingly common choice is effluent from a publicly owned treatment works (POTW), commonly known as municipal wastewater treatment plant effluent or grey water. These waters typically contain elevated concentrations of ammonia, nitrite/nitrate, organics, phosphate, and suspended solids, all of which, if left untreated, can lead to a nightmare scenario of microbiological fouling in cooling towers and cooling systems. But with proper pre-treatment and cooling water chemical treatment, these makeup supplies can successfully be utilized. Methods to adapt grey water...

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

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

2:15 PM

IWC 18-18: Sustainable Alternatives to Power Plant Make-up Water: Using Treated Municipal Wastewater

Bridget Finnegan and Michael Pudvay, P.E., Veolia Water Technologies, Inc., Pittsburgh, PA; John He, P.E., Veolia Water Technologies, Inc., Cary, NC; Lucas Davis, P.E., Kiewit Engineering Group, Inc., Lenexa, KS

Using treated municipal effluent as make-up water for power plants presents obvious benefits, including cost reduction and sustainability. The methods and benefits of using treated municipal effluent are compared in this paper for three separate power plants in North America. Each power plant includes a nitrification stage and a solids removal process to treat the municipal effluent before it can be used. However, the stability of the source water and the environmental benefits outweigh the treatment costs.

2:40 PM: Discusser: Shih-Hsiang Chien, Solenis LLC, Wilmington, DE

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

3:05 PM: Networking Break

3:20 PM

IWC 18-19: Innovations in Water Treatments Employing Filming Amine Technology

Mary Wolter Glass, Mexel USA, LLC, Arlington, VA

Filming amines are receiving increased attention for use in cooling water applications from commercial and institutional cooling towers to large power plants with once-through cooling. Once considered only as a chemical to address corrosion, its unique chemistry is now being explored by manufacturers and water treatment professionals. The potential for reducing the environmental impacts of cooling water treatment programs along with energy savings are now being identified. The chemical mechanism of action for filming amines focuses on preventing fouling from a wide range of factors rather than remediating. These innovative uses of existing technology have now been demonstrated in a range...

3:45 PM: Discusser: Charles Kuhfeldt, CauseWay Water

Consulting, Taylor Lake Village, TX

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

4:10 PM

IWC 18-20: Process Changes to Coal Fired Power Plant Gypsum Dewatering in a Postage Stamp

Julia Mercer, EIT, HDR, Pittsburgh, PA

A confidential coal fired power plant client currently dewaters limestone forced oxidation gypsum solids on horizontal vacuum dewatering belts. The hydrocyclone overflow and dewatering belt filtrate allow a significant portion of the gypsum fines (approximately 10-15%) in the combined effluent water. Currently the effluent water containing the gypsum fines is sent to clarifiers, concentrated, and the sludge is pumped again to the horizontal dewatering belts and introduced on top of the gypsum which renders the entire dewatered gypsum stream unmarketable as wallboard grade gypsum, a high-end user. By segregating and dewatering the gypsum fines...

4:35 PM: Discusser: Venkata Sunil Kumar Sajja, Fluor, Sugar Land, TX

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

5:00 PM: Conclusion

Trace Contaminants: Detection, Removal and Recovery

Monday, Nov. 5; 1:15-5:00 PM

Room: Salt River 7

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

Session Chair: Donna DeFlavis, Dow Water & Process

Solutions, Collegeville, PA

Discussion Leader: Young Chul Choi, Southern Research,

Cartersville, GA

1:15 PM

Session Introduction

Removing trace contaminants from water sources is a challenging but necessary application in a time of limited water supplies and increasing regulatory concerns. This session will present papers on treatment systems used to selectively remove Radium, Uranium and Selenium as well as discuss the importance of accurate Selenium speciation for effective treatment. This session will also discuss recovery and reuse for Uranium.

1:25 PM

IWC 18-21: Radium Removal from Potable Water Supplies

Peter Meyers, ResinTech Inc., West Berlin, NJ and Frank DeSilva, ResinTech Inc., Gardena, CA

There has been intense interest in radium removal from potable water supplies in the last few years, driven by the radium MCL issued by the US EPA. Although the compliance cycle for large

systems ended a few years ago, the cycle for small community systems ended in Dec 2016. These small systems are now required to act if test samples exceed the MCL. Although radium can be reduced by membrane processes such as RO, this treatment method produces a waste stream of significant volume that contains the radium in more concentrated form. Radium is removed by water softening resins...

1:50 PM: Discusser: Douglas Kellogg, Evoqua Water Technologies, Rockford, IL

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

2:15 PM

IWC 18-22: Water Treatment Residuals Management for Uranium Removal Using Ion Exchange Media Re-certification and Reuse in Potable Water Systems

James Arnold, P.E. and Duane Bollig, Water Remediation Technology LLC, Arvada, CO

Uranium removal treatment for groundwater and municipal water systems incorporate recognized ion exchange water treatment technologies to great effectiveness. Once concentrated on ion exchange medias, uranium residuals become a challenging disposal problem involving state and federal regulations for handling, storage, transportation and final disposal. In addition, the long-term disposal implications of radioactive residual materials raise other concerns. Uranium water treatment residuals can be recovered by using the spent water treatment media as a direct source material substitute in uranium metal processing and production. The numerous state and federal licensing requirements in handling uranium containing materials complicate the simple substitution...

2:40 PM: Discusser: Frank Johns, Tetra Tech, Inc., Highlands Ranch, CO

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

3:05 PM: Networking Break

3:20 PM

IWC 18-23: Compliance with Selenium Aquatic Life Criterion and the Importance of Speciation for Treatment Selection and Monitoring

Ben Wozniak, Jamie Fox, and Russ Gerads, Brooks Applied Labs, LLC, Bothell, WA

It is well-known that for many elements, static water quality guidelines can be over- or under-protective for aquatic life. A variety of site-specific factors may either inhibit or enhance the uptake and bioaccumulation of an element into aquatic organisms like algae, invertebrates, and fish. Regulators have recognized this issue for decades, promulgating guidance for the generation of site-specific contaminant limits and, especially in the case of selenium, tissue-based criteria that may be adopted by states or provinces. The Aquatic Life Criterion for Selenium released by the USEPA in 2016 recommends adoption of a multi-component standard...

3:45 PM: Discusser: Brandon Kern, Dow DuPont, Midland, MI

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

4:10 PM

IWC 18-24: Real-time, Continuous & Accurate Selenium Data Ensures a Reliable Selenium Removal Treatment

Vladimir Dozortsev, P.E., Aqua Metrology Systems, Sunnyvale, CA

Maintaining the integrity of a biological remediation process and providing cost-effective treatment of selenium is dependent on obtaining timely and accurate data on selenium speciation at critical remediation process stages. However, traditional methods have struggled to accurately measure concentrations of trace selenium species due to multiple selenium species present in process waters and their highly dynamic equilibrium in the sample solution. A novel online selenium monitor has been developed to determine the levels of dissolved different selenium species and total selenium species in real time. Maintaining the integrity of a biological process and providing cost-effective treatment is dependent on obtaining...

4:35 PM: Discusser: Chaoyang Huang, Southern Research, Cartersville, GA

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

5:00 PM: Conclusion

Recycle and Reuse – Emerging Tools and Case Studies from Industry to Public-Private Partnerships

Monday, Nov. 5; 1:15-5:00 PM

Room: Salt River 8

IWC Rep: Bill Willersdorf, Veolia Water Technologies,

Randolph, NJ

Session Chair: HG Sanjay, Ph.D., P.E., Bechtel, Reston, VA Discussion Leader: Jo Anna Ordonez, Solenis LLC, Kyle, TX

1:15 PM

Session Introduction

Recycle, Reuse and Resource Recovery is generally associated with metals, plastic and paper products. However, water is a resource and must be viewed as such. Water Environment Federation (WEF) made a conscious choice a few years back to try and focus on resource recovery by referring to wastewater treatment facilities as Water Resource and Recovery Facilities (WRRF). The term WRRF is still in infancy, but water recycle, and reuse is gaining momentum in various sectors including industry, agriculture and landscaping. This session includes papers showcasing emerging tools to evaluate the true cost of water and case studies from energy sector, manufacturing and public-private partnership to facilitate recycle and reuse of water.

1:25 PM

IWC 18-25: Upcoming Tools to Help Industry with Making the Business Case for Water Conservation Projects

Brian Moore, Arcadis, Clifton Park, NY

A key barrier that often thwarts many water conservation ideas, exacerbating the above challenges, is the common misconception that water is "cheap", and the cost for water conservation projects lack the necessary return-on-investment (ROI) to justify implementation. This myth is disbanded by a true cost of water analysis. Influencing cost factors can include:

- · The cost of energy used to move or purify water
- · Costs of labor to manage water systems
- Regulatory costs
- · Costs for heating or cooling water
- The costs of chemicals for pretreatment or other industrial processes
- The cost of wastewater treatment (capital equipment and operating costs) prior to discharge...

1:50 PM: Discusser: Heath Horyna, Evergy, Topeka, KS

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

2:15 PM

IWC 18-26: Municipal Recycle Water Use for High Purity Manufacturing Processes, Lessons Learned

Max Brefeld, Toyota Motor North America, Georgetown, KY; Donald Castete, Toyota Motor Manufacturing Texas, Inc., San Antonio, TX

Hundreds of gallons of water are required to manufacture an automobile. Auto makers continually strive to reduce this volume to control the increasing use and disposal costs of this natural resource. In 2003, Toyota Motor Corporation decided to build a manufacturing facility in the water-stressed area of San Antonio, Texas. Recycled water from the San Antonio Water System (SAWS) was used to meet the needs of all utility and process applications and thus reduced the new facility's impact on the environment and regional aquifer. There have been many challenges to using recycled water for high purity manufacturing processes, but since...

2:40 PM: Discusser: Julia Horn, El, Kiewit, Lenexa, KS

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

3:05 PM: Networking Break

3:20 PM

IWC 18-27: The Devil is in the Details – A Recycled Water Treatment Plant Case Study

Daniel Sampson, HDR, Walnut Creek, CA

The operating permit of a power plant located in the Western United States requires that the plant produce and use disinfected tertiary recycled water as the primary source of cooling tower

makeup and process water. The power plant receives secondary effluent from a nearby wastewater treatment plant and must treat this water such that it meets the standards listed in the plant's operating permit. Commissioning of the Recycled Water Treatment Plant (RWTP) revealed that the initial design could not produce water meeting the plant's permit requirements. The RWTP as originally designed and installed could not achieve the required effluent turbidity...

3:45 PM: Discusser: Jamie Doran, Solenis LLC, Rancho Cordova, CA 3:55 PM: Author's Closure & Floor Discussion

4:10 PM

IWC 18-28: Pharmaceutical Wastewater Reuse – Testing and Validating a Combination of Physicochemical, Biological and Membrane Processes

Nabin Chowdhury, Sergiy Popov, Cory Robertson, Denise Horner, John Williamson, and Adriano Vieira, SUEZ Innovation, Development & Advanced Services (IDEAS) Center, Ashland, VA; Rudy Labban, Suez Water Technologies & Solutions (WTS), Richmond, VA

A lab-scale treatability study was conducted to validate a treatment line comprised of physicochemical, biological and membrane filtration for pharmaceutical wastewater treatment and to assess feasibility of non-potable water reuse. Major objectives of this study were (i) determine optimum treatment condition for phosphorus removal, (ii) remove/degrade influent formaldehyde and reach an effluent formaldehyde < $10~\mu g/L$, (iii) investigate impact of influent formaldehyde on the biological nitrification, and (iv) remove/degrade influent Triton TM X-100. All tests were conducted using water/wastewater received from a North American vaccine production plant. Test results indicate that the selected treatment line efficiently removed phosphorus, formaldehyde, attained biological nitrification, and complete Triton TM X-100 removal is expected in the UF-RO filtration.

4:35 PM: Discusser: Americus Mitchell, Sundt Construction, Inc., Tempe, AZ

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

5:00 PM: Conclusion

ASME Session: Water Treatment for Combined Cycle Plants

Tuesday, Nov. 6; 8:00 AM - 12:00 Noon

Room: Salt River 1

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

Session Chair: Robert D. Bartholomew, P.E., Sheppard T.

Powell Associates, LLC, Baltimore, MD

Discussion Leader: Vickie Olson, Honeywell Process

Solutions, Sandy Springs, GA

8:00 AM

Session Introduction

This session highlights water treatment aspects of evaporative coolers, wastewater recycle systems, and steam/water cycle systems. Flow accelerated corrosion (FAC), iron monitoring methods, use of ammonia, organic amines and film forming products to control FAC and iron transport in air cooled condensers (ACC) and other components are discussed. The increase in cycling service impacts all these systems and requires greater consideration during unit design, operation and treatment.

8:10 AM

IWC 18-29: Living in Perpetual Drought – Operational Impact of Power Plant Design Features to Minimize Water

Daniel Sampson, HDR, Walnut Creek, CA

Two combined cycle power plants in the Western United States employ various design features to minimize water usage to the maximum extent possible. Both plants employ air-cooled condensers and evaporative coolers. Evaporative cooler blowdown, HRSG blowdown, and other plant waste streams are recovered and reused to the maximum extent possible. One plant includes wastewater recovery using a combination of membrane and thermal concentration. Inspections at both plants revealed flow-accelerated corrosion (FAC) in both the air-cooled condensers and in the drums of the LP HRSGs. Recycling of plant waste streams creates significant challenges for steam cycle chemistry. Contamination in recovered water, complicated...

8:35 AM: Discusser: James Bellows, James C. Bellows & Associates, Maitland, FL

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

9:00 AM

IWC 18-30: Evaporative Cooler Water Requirements – The Letter and the Intent of the Law

Brian Clarke, P.E., Caroline Wilson, E.I., Charles Statler, E.I., and Steve Russell, P.E., Kiewit Engineering Group, Inc., Lenexa, KS

Evaporative cooler water recommendations vary by manufacturer and are inconsistent related to constituents and achievable cycles of concentration. Following a brief overview of how evaporative coolers work, the limits of three manufacturers (GE, Siemens, MHI) will be evaluated and the intent of the limits will be discussed. Previous experience has shown some

flexibility related to the standard limits and that once systems are operating the facility often treats the evaporative cooler more simply than the design engineer intended. This paper explores the goal of the evaporative cooler water guidelines and provides recommendations to design engineers and operators to optimize and...

9:25 AM: Discusser: Kenneth Chen, Arcadis, Irvine, CA

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

9:50 AM: Networking Break

10:20 AM

IWC 18-31: Experience Using a Film-Forming Corrosion Inhibitor at RWE Generation UK's Staythorpe Power Station

Daniel Cicero and Lionel Barre, Nalco Water, an Ecolab Company, Naperville, IL

Over the past few years, discussions of the impact of cyclical operation have filled the agendas of technical conferences and the pages of trade publications. Even those predisposed to minimizing the impact of cyclical operation — like the National Renewable Energy Laboratory — have conceded that these practices do stress power plant systems. To address these stresses, many power plants have applied filming corrosion inhibitors to minimize the impact of cyclical operation on their steam systems. Several water treatment companies have developed and applied filming corrosion inhibitors. This paper discusses the application of such an inhibitor at the RWE Generation UK's Staythorpe...

10:45 AM: Discusser: James Robinson and Tony Rossi, Suez Water Technologies & Solutions, Trevose, PA

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

11:10 AM

IWC 18-32: Decreasing Filterable Iron Levels in an Aircooled Condenser at a Combined Cycle Power Plant

Kevin Brown and Pat Mongoven, U.S. Water, St. Michael, MN

The issue of FAC (Flow Accelerated Corrosion) continues to be a leading concern in combined cycle power plants (CCP). The FAC has historically been found on the lower temperature circuits of the Heat Recovery Steam Generator (HRSG), Surface condensers, and inlet area of Air Cooled Condensers (ACC). It has been well documented that there are various factors that affect FAC including velocity, chrome content of steel, temperature, geometry, pH and oxygen content. We will present new information that indicates that pH adjustment with just ammonia is not sufficient to prevent FAC in air cooled condenser (ACC) plants. We wanted to evaluate...

11:35 AM: Discusser: Edward Beardwood, Solenis LLC, Wilmington, DE

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

12:00 Noon: Conclusion

Next Treatment Level - Innovative Water

Tuesday, Nov. 6; 8:00 AM - 12:00 Noon

Room: Salt River 2

IWC Rep: Michael Soller, P.E., CDC, Bowen Engineering,

Indianapolis, IN

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

Inc., Sewickley, PA

Discussion Leader: Peter Meyers, ResinTech, Inc., West

Berlin, NJ

MA 00:8

Session Introduction

Our industry continues to innovate new processes, technology, and overcome obstacles in treating water. Nothing better illustrates this than this wide industry cross section of new approaches to existing challenges. This session includes speakers that will demonstrate the cutting-edge work being completed at the Water Technology Development Center for SAGD industry, treated superfund contaminated groundwater, essential improvement to ZLD processes, and using fiber ion exchange material to treat FGD wastewater.

8:10 AM

IWC 18-33: Technology Advances and Economic Optimization of Advanced Membrane Brine Concentration and Zero Liquid Discharge

Ellie Albadvi, Ben Sparrow, Megan Low, Anisa Maruschak, Zhongyuan Zhou, and Xin Xiao, Saltworks Technologies Inc., Richmond, BC, Canada

Brine management is becoming increasingly important in industrial and inland desalination. This work presents state-of-the-art options, performance data, and economics. First, we review reducing brine volumes through targeted "process pollutant" removal and internal recycling via monovalent electrodialysis. Second, recent innovations in advanced chemical softening and test data from ultra-high-pressure reverse osmosis (RO) membranes are shared. The work outlines a pathway and cost analysis to achieve 130,000 mg/L TDS brine concentration, leveraging desalination's primary engine – RO. Finally, advancements in lowering the cost of thermal-based brine treatment are disclosed, focusing on a new breed of evaporator crystallizers that lower costs as much as three times over the authors' previous work.

8:35 AM: Discusser: HG Sanjay, Bechtel Corporation, Reston, VA 8:45 AM: Author's Closure & Floor Discussion

9:00 AM

IWC 18-34: Development of a Fiber-Based Ion Exchange Material for Treatment of FGD and Other Wastewaters

Philip Brandhuber, Ph.D., HDR Engineering, Denver, CO; Tadashi Kamada, Osaka, Japan

The treatment of arsenic and selenium along with other metals

concentrated in wastewater from flue gas desulfurization (FGD) is a vexing problem for the electrical power industry. Current treatment approach consists of trains combining chemical, physical and biological processes. Selenium, often in the form of selenate, is particularly difficult to treat, requiring the use of biological process. In addition, the high background levels of sulfates and high total dissolved solids (TDS) of FGD wastewater degrade treatment performance in comparison to less challenging water quality matrices. In summary, while the technology exists to treat FGD wastewater, the technology...

9:25 AM: Discusser: Brett Housley, WesTech Engineering, Salt Lake City, UT

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

9:50 AM: Networking Break

10:20 AM

IWC 18-35: Canadian Thermal Oil Industry Water Technology Development Center – Purpose, Design and Vision

Brad Sobey, P.Eng. and Basil Perdicakis, Suncor Energy Inc., Calgary, AB, Canada; Rodger Bernar, Husky Energy, Calgary, AB, Canada

The \$165MM Water Technology Development Centre located near Fort McMurray, Alberta, Canada will be completed construction by late 2018 and represents a unique opportunity for oil field produced water technology stakeholders to demonstrate or vet their technology at a demonstration scale. Live production fluids at temperature and pressure will be available for delivery to technology skids in a low-cost plug and play fashion, without the risk of affecting production operations that can cut trials short or obtaining fluids that are aged and give false results. While the center is designed to be equipped with a steam generator, emulsion separator, and...

10:45 AM: Discussers: Donald Downey, Purolite Corporation, Paris, ON, Canada and Steve Portelance, P.Tech., Innovative Water Treatment Solutions, Calgary, AB, Canada

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

11:10 AM

IWC 18-36: Groundwater Remediation System Pilot and Operating Data

Edward Koch, 3M, Charlotte, NC

This paper presents pilot and operating data for a groundwater remediation system installed at an EPA Super Fund site in Southern California. Primary goal of the project was to control dissolved oxygen level in polluted groundwater. Towards that goal, water from the underground aquifer was pumped out and run through a mobile membrane degasification (MDG) skidded system before reinjecting the water back to the underground reservoir. To prevent scaling and fouling in the MDG system, an Ultrafiltration (UF) membrane skid was installed prior to the MDG system. Multiple companies with unique competencies were involved in overall system design, fabrication, installation...

11:35 AM: Discusser: Julia Horn, P.E., Kiewit, Lenexa, KS

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

12:00 Noon: Conclusion

Membranes for Mining

Tuesday, Nov. 6; 8:00 AM - 12:00 Noon

Room: Salt River 7

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

Lakewood, CO

Session Chair: John Schubert, P.E., HDR, Sarasota, Florida Discussion Leader: Kashi Banerjee Ph.D., P.E., BCEE, Veolia

Water Technologies, Moon Township, PA

8:00 AM

Session Introduction

The mining industry is experiencing greater attention related to wastewater effluent quality. The increased focus is not just on metals. It is no longer unusual to be regulated for sulfate, total dissolved solids and other soluble constituents, which have in the past not been as much of a concern. New approaches are being developed to meet these challenging situations. The use of membranes in the treatment of mining wastewaters is one area in which new information is rapidly being generated. The papers in this session feature treatment processes in which membranes are a key component. Three of the papers describe the treatment of wastewater from a rare earth mining facility, an acid mine drainage wastewater, and a gold mining wastewater. All utilize reverse osmosis systems as the key process step for separation of soluble constituents. A fourth paper describes a different type of membrane, a permeable reactive barrier that functions in place to treat contaminated water.

8:10 AM

IWC 18-37: A New Membrane Based System for Mine Water Discharge Treatment

Rahul Patil and Arun Mittal, Aquatech International LLC, Canonsburg, PA

The mining industry in Latin America is faced with new regulatory requirements that limit the discharge of chlorides, arsenic, cadmium and other constituents of concern into receiving streams such as rivers. To meet these new regulatory standards for a gold mine water discharge, Aquatech have developed a new membrane-based treatment approach which maximizes the recovery over 97% of treated water good for disposal. The process comprises media filtration followed by pre-concentration RO followed by softening in ceramic membrane microfiltration followed by two additional stages of RO to achieve an overall recovery of over 97%. The concentrated brine from the last...

8:35 AM: Discusser: Bernie Mack, Veolia Water Technologies, Natick, MA

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

9:00 AM

IWC 18-38: Three Years of Full Scale Water Treatment Plant Operational Experience from Rare Earth Mining

Mohan Badami, Keith Benson, Kashi Banerjee, and Charles Blumenschein, Veolia Water Technologies, Moon Township, PA

A centralized water treatment plant was built in 2012 in a rare earth mining facility in the Southwestern part of the United States to treat well water and water recycled from various systems. The objective of the treatment plant was to produce demineralized water with conductivity $<10~\mu s/cm$ for boiler feed and other plant areas. This paper will describe and discuss various treatment steps and will present three years of operational data.

9:25 AM: Discusser: Joseph Tamburini, Tetra Tech, Inc., Denver, CO

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

9:50 AM: Networking Break

10:20 AM

IWC 18-39: MaxH2O DESALTER Technology Treats Calcium Sulfate Saturated Wastewater, a Perfect Solution for Treating Acid Mine Drainage Wastewater

Alex Drak, Roi Zaken Porat, and Tomer Efrat, IDE Technologies, Kadima, Israel; Marco Kerstholt, Royal HaskoningDHV, Umhlanga, South Africa; Gerard Van Houwelingen, Royal HaskoningDHV, Amersfoort, the Netherlands

Acid rock drainage mechanisms involve oxidation of sulfide minerals, leading to highly acidic, metal-rich waters with high sulfate content and high scaling potential. Sulfate is considered a more significant long-term water quality issue for mining operations, and its control levels are based primarily on secondary drinking water recommendations of approximately 500 mg/L. Two methodologies are mainly used to remove sulfate from acid mine water: separation, for example membrane separation; or salt precipitation, for example formation of gypsum. Conventional membrane separation systems, as a solution for sulfate removal from acid mine wastewater, have several drawbacks that limit the maximum possible system...

10:45 AM: Discusser: Srikanth Reddy Muddas, P.E., Veolia Water Technologies, Moon Township, PA

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

11:10 AM

IWC 18-40: Learnings from Phased Installation of a Permeable Reactive Barrier for Mine Water Treatment

Shannon Brown and John Pugh, Bayer U.S.-Crop Science, Creve Coeur, MO; Molly Prickett, Bayer U.S.-Crop Science, Soda Springs, ID; Matthew Wright, NewFields, Missoula, MT

Weathering oxidation can enable release of oxidized selenium compounds from pyrite and sphalerite laden overburden into surface runoff water and groundwater. The remote nature inherent to mining operations can preclude access to utilities and infrastructure necessary for many water treatment systems.

Therefore, passive biotreatment utilizing naturally occurring endemic microbes supported by emplacement of organic matter within an engineered interception and treatment system was selected. Phased installation of this permeable reactive barrier afforded opportunities for optimization.

11:35 AM: Discusser: Michelle Van Rooyen, P.Eng, PMP, Mintek, Johannesburg, Gauteng, South Africa

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

12:00 Noon: Conclusion

FGD Blowdown – Treatment, Concentration, and Solidification – Oh My!

Tuesday, Nov. 6; 8:00 AM - 12:00 Noon

Room: Salt River 8

IWC Rep: William Kennedy, P.E., Duke Energy Corporation,

Charlotte, NC

Session Chair: Kristen Jenkins, P.E., GHD, Duluth, GA Discussion Leader: Corne Pretorius, Golder Associates,

Mississauga, ON, Canada

8:00 AM

Session Introduction

This session on Flue Gas Desulfurization scrubber wastewater will cover a range of management technologies to comply with current and future discharge regulations. The technologies covered include scrubber optimization to reduce selenate formation, polishing treatment at both pilot scale and full scale to remove particulate selenium, membrane concentration, and the latest in solidification/stabilization research on FGD brines.

8:10 AM

IWC 18-41: Brine Encapsulation as an Integral Step in Power Plant Wastewater Treatment

Ben Clegg and Clark Harrison, Purestream Services, Salt Lake City, UT

Brine encapsulation is becoming an essential element of effluent discharge compliance plans for coal-fired steam generation power plants looking to future CCR pond closures, state water quality regulations, and the EPA's Effluent Limitation Guidelines (ELG). Plants considering thermal evaporation brine concentrators for reducing wastewater volume, like Purestream's AVARA vapor recompression system or FLASH clean steam brine concentrator, want to use their CCR byproducts to encapsulate the brine and sequester its constituents. Wastewater volume can have reduced in many cases up to 93% leaving behind high TDS brine that can be encapsulated to provide an affordable solution for waste volume reduction, discharge...

8:35 AM: Discusser: Joseph Potts, P.E., Brookside Engineerings PLLC, Walton, KY

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

9:00 AM

IWC 18-42: Application of Ultrafiltration for FGD Waste and Water Polishing, Comparisons Pilot to Full Scale

Russ Swerdfeger, Evoqua Water Technologies, Colorado Springs, CO; Chuck McCloskey, Evoqua Water Technologies, Schaumburg, IL; Frank Sassaman, Evoqua Water Technologies, Warrendale, PA; Derek Henderson, P.E., Duke Energy, Raleigh, NC

Advanced wastewater process technologies offer power companies a feasible approach to compliance with national and state regulations. This paper presents two similar installations where an ultrafiltration process is being applied after a biological treatment process to remove heavy metals such as mercury, along with TSS for final discharge. We present how the UF process enables the power company to meet and exceed the ELG regulations. Additionally, we present how this technology enables the opportunity to reuse the water in a future scenario. From April 2017 through July 2017 a pilot scale UF was installed at a facility where a biological...

9:25 AM: Discusser: Diane Martini, Burns & McDonnell, Chicago, IL

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

9:50 AM: Networking Break

10:20 AM

IWC 18-43: A Scale-Resistant, Membrane-Based Solution for the Treatment of FGD Wastewater to Meet EPA Guidelines

Jon Liberzon, Jonathan Chen, and Tzu Lung Lin, Tomorrow Water (BKT), Anaheim, CA; Arnab Hanra, Jaeho Ho, and Chunwoo Lee, SafBon Water Technology, Tampa, FL

Flue gas desulphurization (FGD) wastewater is a byproduct of pollution control processes at coal-fired power plants. The EPA's 2015 effluent limitation guidelines (2015 ELG) mandate treatment of this wastewater to meet selenium (Se), arsenic (As), mercury (Hg) and nitrate/nitrite (NOx) limits prior to discharge. Other compounds or total dissolved solids (TDS) may also be regulated by state-issued permits. FGD wastewater contains concentrated scale-forming compounds, which cause membrane fouling and make conventional membrane treatment unattractive. To solve this problem, a new antifouling membrane system (AFMS) was deployed to treat FGD wastewater at a >2,000 MW power plant. Trade-named FMX, the system...

10:45 AM: Discusser: Holly Churman, P.E., GHD, Houston, TX 10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 18-44: Wastewater and Brine Management using Encapsulation: Laboratory and Pilot Testing Results, New Findings, and Testing Recommendations

Kirk Ellison, EPRI, Charlotte, NC

As investigations continue into volume reduction approaches for wastewater management, environmentally responsible solutions are needed to address the final disposal of the resulting concentrated wastewater or brine. Encapsulation, as defined in this paper, involves accurately combining wastewaters with coal combustion byproducts, including fly ash, bottom ash, and gypsum, and additives (e.g. quicklime, cement, aluminates). The overall goal of encapsulation is to create a low permeability material upon landfill deposition that sequesters and inhibits long term re-release of constituents of concern to the environment. This paper discusses the key focus areas of brine encapsulation research and presents results from ongoing studies....

11:35 AM: Discusser: David Pernitsky, Stantec, Calgary, AB, Canada

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

12:00 Noon: Conclusion

ASME Session: Controlling Corrosion and Impurities in Steam and Process Condensate Industrial Cogeneration Plants

Tuesday, Nov. 6; 1:15 - 5:00 PM

Room: Salt River 1

IWC Rep: Debbie Bloom, Retired, Wheaton, IL

Session Chair: David Daniels, M&M Engineering, Leander,

TX

Discussion Leader: George Patrick III, Suez Water

Technologies & Solutions, Drums, PA

1:15 PM

Session Introduction

This session will focus on the recovery, treatment, and monitoring of process condensate. It will include papers on evaluating process condensate to ensure that it is suitable as boiler feedwater, treatment options such as polishing, and key monitoring parameters.

1:25 PM

IWC 18-45: Measuring pH in Utility and Industrial Boiler Steam and Water Cycles

Randy Turner, SWAN Analytical USA, Wheeling, IL

Steam and water cycle pH is one of the most important parameters to monitor and control to mitigate corrosion, however, it is one of the most challenging parameters to accurately measure. Measuring pH in high purity water is very challenging because the sample has very low conductance.

This paper will detail the historical challenges faced in the measurement of pH in high purity samples, discuss the technological advances, and discuss calculated pH by differential conductivity.

1:50 PM: Discusser: Vickie Olson, Honeywell Process Solutions, Sandy Springs, GA

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

2:15 PM

IWC 18-46: Evaluating Condensate Recovery and Treatment in Industrial Facilities

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

The collection and reuse of condensate from industrial process or facility heating users is commonly recognized as a highly effective means of improving the efficiency of the steam generating plant as well as an important part of enabling a facility to reach its sustainability goals. While recovering and reusing condensate saves energy, reduces fuel costs, reduces water consumption and wastewater production, and often reduces chemical costs, there is often a hesitation in many industrial facilities to do so due to risks of contamination and the anticipated costs associated with mitigating this risk, physically collecting and returning this condensate to the...

2:40 PM: Discusser: Bob Bartholomew, Sheppard T. Powell Associates LLC, Baltimore, MD

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

3:05 PM: Networking Break

3:20 PM

IWC 18-47: Key Production Plant Steam and Condensate System Factors that Impact HRSG Feedwater Quality

Charles Kuhfeldt, CauseWay Water Consulting and Services, LLC, Taylor Lake Village, TX

The integration of combined cycle cogeneration plants with production plants, particularly petrochemical plants and oil refineries, can be problematic in operation when feedwater contamination exceeds the established guidelines for the Heat Recovery Steam Generator (HRSG) operating pressure. These problems can originate in the operating production facility and affect the HRSG when condensate from the production plant is returned to the HRSG feedwater system. While the contaminant concentrations acceptable or recommended for HRSG operation are now well defined the impacts of the surrounding production facility system design, the system's subsequent evolution through site growth, and the operational variability of the...

3:45 PM: Discusser: Edward Beardwood, Solenis LLC, Wilmington, DE

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

4:10 PM

IWC 18-48: A Reality Check on Condensate Polishing: A Discussion on Misconceptions

John Yen and Max Johnson, Graver Water Systems, LLC, New Providence, NJ

Condensate polishing technologies and applications have been around for decades. Over the years, there have been successes and failures both from a product design and improper application. As a result, misconceptions on the technology perpetuate throughout the industry. This paper will attempt to address several of these misconceptions as well as provide an economic comparison of the various types of solutions from a capital cost and operating cost point of view. Today, plant designs vary from not including any condensate treatment while others incorporate filtration, deep bed ion demineralizers, or precoat filter / demineralizers. First, we will discuss the impact...

4:35 PM: Discusser: Wayne Bernahl, W. Bernahl Enterprises, Flmhurst. II

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

5:00 PM: Conclusion

Fundamentals of Sustainable Desalination

Tuesday, Nov. 6; 1:15 – 5:00 PM

Room: Salt River 2

IWC Rep: Jim Summerfield, Dow Water & Process Solutions,

Saginaw, MI

Session Chair: Jane Kucera, Nalco Water, an Ecolab

Company, Naperville, IL

Discussion Leader: Denise Haukkala, The Dow Chemical

Company, Fairfield, CA

1:15 PM

Session Introduction

Desalination has been a part of water treatment for centuries; in fact, distillation has been practiced for nearly 200 years and reverse osmosis (RO) for over 50. In the era of reduce, reuse, and recycle, desalination is being called upon to treat all types of make-up sources for a variety of end uses in both the industrial and municipal arenas, and to do so in a sustainable manner, i.e., with minimal pretreatment, high recovery, and reliability. But, how do we get there? In this session, we provide some insights as to how to achieve sustainable desalination. As an introduction, the first paper covers the history and application of RO, one of the most popular desalination technologies. The following papers cover best practices for RO, to sustain the operation of the desalination technology; challenges with recycling FGD wastewater-contaminated well water for reuse within a power plant, using RO desalination; and brine reduction strategies, to minimize the waste regenerated by desalination technologies.

1:25 PM

IWC 18-49: Reverse Osmosis: A History and Explanation of the Technology and How It Became So Important for Desalination

Lyndsey Wiles and Elke Peirtsegaele, MICRODYN-NADIR, Goleta, CA

From cellulose acetate (CA) hollow fiber membranes to advanced thin-film composite membranes in a spiral-wound configuration, developments in reverse osmosis (RO) membrane technology have allowed the desalination industry to tackle an even broader range of applications than ever before. This paper focuses on the advancements in membrane chemistry that have allowed RO membranes to offer extremely high salt rejection, operate at lower pressures, and handle a wide range of operating conditions. In addition, this paper discusses the history of RO element design, including an explanation of the industry-standard spiral-wound element design and why this design allows for RO to be...

1:50 PM: Floor Discussion

2:15 PM

IWC 18-50: Fundamentals of Sustainable Desalination: Managing Operating Risks in Industrial Reverse Osmosis Systems Loraine Huchler, CMC, FIMC, P.E., MarTech Systems, Inc., Trenton, NJ

Conceptually, the use of reverse osmosis (RO) units in industrial facilities seems like a straight-forward solution; in reality the operation and maintenance of an RO unit in industrial facilities is complex, with a significant number of hidden liabilities that result in more frequent cleaning events, poor effluent quality and shorter membrane life. Owners of RO units can avoid these problems by adhering to a set of best practices for design and operation. Attendees will learn how to conduct a Basic Best Practices assessment of an RO to identify the most common design and operating mistakes. Through a series of short...

2:40 PM: Discusser: Kelle Zeiher, Ph.D., Garratt-Callahan, Burlingame, CA

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

3:05 PM: Networking Break

3:20 PM

IWC 18-51: Reverse Osmosis Treatment of Well Water Commingled with Flue Gas Desulfurization Wastewater at a Power Plant

John Korpiel, P.E., Michael Pudvay, P.E., and Mark Hess, Veolia Water Technologies, Moon Township, PA

A pilot study was conducted to evaluate the performance of reverse osmosis (RO) technology for the treatment of well water that has been commingled with flue gas desulfurization wastewater at a power plant site. The commingled well water presents treatment challenges due to its high calcium sulfate and manganese concentrations. The power plant plans to reuse

the treated well water. The paper discusses the results of the successful pilot study to validate RO technology.

3:45 PM: Discusser: Anne Bridgman, P. Eng., Associated Engineering, Calgary, AB, Canada

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

4:10 PM

IWC 18-52: Survey of Brine Reduction Treatment Options and Techniques

Michael Preston, Black & Veatch, Overland Park, KS

As the need for fresh water increases, impaired sources of water are more frequently being considered, especially in areas of water restriction. This along with drive for more efficient water processes creates issues with wastewater disposal, particularly for inland facilities. Technologies and process approaches are being developed and have been deployed to attempt to minimize or eliminate issues associated with brine disposal associated with water treatment processes. This paper will survey brine minimization and treatment processes and techniques in industry and consider their benefits and challenges for implementation.

4:35 PM: Discusser: Michael Pacholski, P.Eng., Canadian Water Technologies Ltd., Calgary, AB, Canada

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

5:00 PM: Conclusion

Produced Water Management: Overcoming Unique Challenges in a Demanding Industry

Tuesday, Nov. 6; 1:15 - 5:00 PM

Room: Salt River 7

IWC Rep: Jonathan Shimko, McKim and Creed, Sewickley,

PΑ

Session Chair: Les Merrill, RETEGO Labs, Bountiful, UT Discussion Leader: Russell Huffmyer, McKim & Creed, Inc.,

Sewickley, PA

1:15 PM Session Introduction

The economical treatment and management of Produced Water from Oil and Gas exploration, extraction and processing has experienced exponential growth over the last 15 years. This session includes presentations of projects ranging from existing facility expansion to new construction in a remote location. The audience will gain insight into the challenges of designing and constructing facilities that must operate in extreme weather and the obstacles of getting specialized equipment to a distant region in China. The treatment of produced water to facilitate reuse to reduce the costs of procuring new water and eliminating costs of water disposal will be also be presented....

1:25 PM

IWC 18-53: Case Study: Horizontal Falling-Film Evaporator for Produced Water Treatment at Shengli Oil, China

Roi Zaken Porat, Hadar Goshen, and Tomer Efrat, IDE Technologies, Kadima, Israel

Water scarcity in the Xinjiang region in China, together with the growing demand for water for the oil & gas industry and new regulations for water disposal and reuse, have led China authorities to establish a program for advanced water treatment in the oil fields. One of the leading solutions for the treatment of oil field produced water is based on pretreatment to remove residual oil, colloidal silica and suspended particles (TSS), followed by a desalination process using an evaporator. This case study presents the design challenges, and construction and operation challenges of the produced water treatment project at Shengli Oil, in which...

1:50 PM: Discusser: Alan Daza, P. Eng., Aquatech International LLC, Canonsburg, PA

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

2:15 PM

IWC 18-54: Threshold Inhibition of Magnesium Silicate and Prevention of Organic Fouling in Produced Water Evaporator Preheaters

Martin R. Godfrey, Nalco Champion, an Ecolab Company, Eagan, MN; Nathan Marshall, Nalco Champion an Ecolab Company, Calgary, AB, Canada; Antony Kao and Graeme Finley, Nalco Champion an Ecolab Company, Bonnyville, AB, Canada

Field development of an antifoulant program for produced water evaporator preheaters is discussed. The most effective phosphonate inhibitor was identified. The threshold concentration for scale inhibition was determined at various produced/well water blend ratios and the data was used to develop a simple and robust operating directive for product dosage. Effective cleanings were critical for probing deposit chemistry and removing crystal nucleation sites from the exchanger. A small concentration of organic dispersant prevented organic fouling. Without treatment the heat exchangers required cleaning in as little as 2 days. After implementation of the combined program heat exchanger run time is more than 2 months.

2:40 PM: Discusser: Christopher Lloyd, RETEGO, Bountiful, UT

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

3:05 PM: Networking Break

3:20 PM

IWC 18-55: The Retrofit of a Remote 160,000 Barrel Per Day Oil Field Produced Water Train

Americus Mitchell, Sundt Construction, Tempe, AZ; Paul Dunne, and Po Lai, Fluor, Sugar Land, TX

Retrofit projects present the unique challenge of designing a system under existing conditions with minimum impact to

the operation of the current system. The impact to the current operations needs to be considered in both the design and execution of the project. Adding to these challenges, the issues associated with installation at remote sites, limited construction/shipping windows, harsh site conditions and limited onsite construction personnel requires more foresight be placed in both the design and construction of the system. This was the challenge faced on a project on a remote island in a northern climate. The end goal...

3:45 PM: Discusser: Chip Westaby, Turner Designs Hydrocarbon Instruments, St. Louis, MO

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

4:10 PM

IWC 18-56: Closing the Cycle: Optimizing Produced Water Management Through Efficient Reuse Treatment

Jean Louis Kindler and Ayush Tripathi, OriginClear Inc., Technologies Division, Los Angeles, CA

An advanced wastewater treatment technology, Electro Water Separation with Advanced Oxidation (EWS:AOx), was tested as both a pretreatment system and standalone system for treatment of produced water. Four different pilot studies were performed at four dispersed locations. Variable parameters were tested at each of these locations based on the local disposal and reuse requirements. Greater than 90 percent reduction was obtained for most contaminants. Cost to treat these waters ranged from 0.024USD/bbl to 0.10 USD/bbl.

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

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

5:00 PM: Conclusion

IWC 18-Reserve/Produced Water: Chemical Softening Using Lime and Magnesium Hydroxide

William Sanz, Ecodyne Limited, Burlington, ON, Canada

Some older processes are just too good to go away.

Lime precipitation chemistry is currently being applied for longstanding and newer applications as a resurgent technology. In Western Canada, for SAGD and other steam EOR processes. a critical aspect in the recovery of heavy oil is the facility design related to steam production. Large volumes of steam are injected downhole to lower oil viscosity and to recover the oil. This steam production is done with minimal fresh water usage by reusing de-oiled produced water for steam makeup.

Conventional steam plant design has been to incorporate a Lime Softener followed by...

If I Only Had a Membrane! (A Potpourri of Industrial Wastewater Topics All Connected by Membranes)

Tuesday, Nov. 6; 1:15 - 5:00 PM

Room: Salt River 8

IWC Rep: Jay Harwood, Suez Water Technologies &

Solutions, Oakville, ON, Canada

Session Chair: David Riedel, P.E., Arcadis, Washington, D.C. Discussion Leader: Josh Prusakiewicz, HDR, Ann Arbor, MI

1:15 PM

Session Introduction

Industrial wastewater comes in many different forms requiring clients, engineers and equipment manufacturers to develop unique solutions. Increasingly membranes play a part in the overall solution because of their ability to physically remove many constituents to levels well below permit limits and to open the door for water reuse opportunities. The papers in this session touch on chemical manufacturing, various food production, FGD wastewater, metal finishing, and dewatering, but they all are tied together using membranes as part of the treatment solution.

1:25 PM

IWC 18-57: Membrane Processes for Wastewater Treatment in the Food Industry

Gerard Van Gils, Ph.D., Kemco Systems Co., LLC, Clearwater, FL

The food industry presents a variety of water and wastewater challenges due to its high volume of water usage and due to the types of waste constituents present in the waste streams. Membranes can be used to good advantage in the treatment of wastewater, addressing high strength wastes and producing high quality purified water which may be suitable for reuse.

1:50 PM: Discusser: Eugene Rozenbaoum, LG Water Solutions, Torrance, CA

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

2:15 PM

IWC 18-58: Ceramic Hollow Fiber Membrane Technology for Industrial Wastewater Treatment in Recycle/Reuse Applications

Greg Wood, i2m LLC, Raleigh, NC; Sreenath Kariveti, Mann+Hummel USA Inc., Raleigh, NC

Crossflow membrane technology has gained more interest recently with an important focus in treating high total suspended solids (TSS) concentration and oily wastewater applications to recover the valuable products and reduce total waste volume. Ceramic Hollow Fiber Membranes (CHFM) show the advantage of a high volumetric filtration area and high flux rates compared to other ceramic membranes with different geometric membrane designs. CHFM's performance parameters resulting from pilot tests are given with respect to the effect of membrane pore size, crossflow velocity, transmembrane pressure, the separation

characteristics and the cleaning efficiency while achieving highest solids concentrations (> 10%) and stable operational...

2:40 PM: Discusser: Lucas Davis, P.E., Kiewit, Lenexa, KS

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

3:05 PM: Networking Break

3:20 PM

IWC 18-59: Overcoming Challenges in Biological Treatment of Selenium Containing Wastewaters by Advancements in Bioreactor Design

Rebeccah Chapman, Frontier Water Systems , Salt Lake City, Utah; Luke Halverson and Logan Terheggen, Frontier Water Systems, Atlanta, GA

This paper covers engineering advancements that have been made in bioreactor design for selenium treatment which overcome the challenges associated with conventional bioreactor design. Specifically, a two-stage approach has been developed to allow for a smaller footprint, prefabricated and modular bioreactor design suitable for a wide variety of water treatment applications. Several case studies support motivations behind the reactor design, exemplify treatment capabilities, and show versatility in treatment applications.

3:45 PM: Discusser: Jamie Felicetti, WesTech Engineering, Salt Lake City, UT

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

4:10 PM

IWC 18-60: MBR Technology Utilized to Resolve an Increase in Flows and New Discharge Requirements When Upgrading a CPI Wastewater Treatment Plant at Eastman Chemical facility in Chestertown, Maryland

John Sisson, Eastman Specialties Corporation, Chestertown, MD; Brian Arntsen and Carsten Owerdieck, Suez Water Technologies & Solutions, Oakville, ON, Canada; Eric Kozmic, Suez Water Technologies & Solutions, Trevose, PA

Eastman Chemical Company is a global advanced materials and specialty additives company producing a broad range of products found in items people use every day. With a portfolio of specialty businesses, Eastman works with customers to deliver innovative products and solutions while maintaining a commitment to safety and sustainability. As a globally diverse company, Eastman serves customers in more than 100 countries. Eastman acquired the Chestertown, Maryland site in 2010, which produces non-phthalate plasticizers and coalescents used in building and construction, medical and consumer goods. The Chestertown facility had an existing wastewater treatment plant (WWTP) consisting of both physical and...

4:35 PM: Discusser: Christopher Huth, HDR, Pittsburgh, PA

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

5:00 PM: Conclusion

Cooling Water – Recent Advances in Monitoring, Chemistry, and Modeling

Wednesday, Nov. 7; 8:00 AM - 12:00 Noon

Room: Salt River 1

IWC Rep: Ken Dunn, Solenis-Retired, Mashpee, MA
Session Chair: Ray Post, ChemTreat, Langhorne, PA
Discussion Leader: David Fulmer, Athlon, A Halliburton

Discussion Leader: David Fulmer, Athlon, A Halliburio

Service, Houston, TX

8:00 AM

Session Introduction

Owners and operators of cooling systems are facing increasing challenges related to water utilization efficiency and environmental sustainability. The drive for higher cycles of concentration and zero liquid discharge amplify both scaling tendency and corrosivity. Environmental restrictions are driving the development of chemistries with better environmental profiles. The four papers in this session describe prominent advancements in meeting current cooling water challenges including real-time scale detection, copper alloy corrosion inhibition, silica deposit control, and thermodynamic and kinetic modeling of scaling tendencies.

8:10 AM

IWC 18-61: Monitoring and Prevention of Mineral Scale Formation in Open Cooling Systems with an Inline Fouling Monitor

Shih-Hsiang Chien and Michael Bluemle, Solenis LLC., Wilmington, DE; Donald Holt, Solenis LLC., Whitby, ON, Canada; Jacob Young, Solenis LLC., Grimes, IA

Prevention of mineral scale formation is critically important to the treatment of industrial cooling systems. Inorganic scale greatly reduces heat exchanger efficiency, may lead to under deposit corrosion, and increases operational costs. Scale formation can be mitigated by many types of additives, which have varying efficiency on different scaling species. The effectiveness of the inhibitors depends on temperature, pH, and additive concentration. Constant monitoring of water composition provides an indirect indication for scale forming potential but does not directly measure scale formation. Additionally, the potential for mineral scale deposition can be affected, often abruptly, by changes in makeup water...

8:35 AM: Discusser: Walker Garrison, Ph.D., Valero Energy, San Antonio, TX

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

9:00 AM

IWC 18-62: A Novel, Better Performing Yellow Metal Corrosion Inhibitor with Lower Toxicity and its Use for Copper Alloy Condenser at a Power Plant

Yanjiao (Andrew) Xie, Jothibasu Seetharaman, Daniel Meier, Xuejun Wang, Donald Johnson, Anand Harbindu, Deepak Rane, and Pradeep Cheruku, Nalco Water, an Ecolab Company, Naperville, IL

Copper and its alloys have been widely used in heat exchangers due to its high thermal conductivity and natural corrosion resistance. However, in acidic-to-neutral and highly halogenated environments that are common in cooling water systems these metals suffer from corrosion. This may result in failure of heat exchangers and consequently loss of production and costly replacement. In the last few decades, different triazole chemistries were used as a protective filming inhibitor for yellow metal. These chemistries have their limitations, including poor stability in halogenated environment, high consumption rate, and high aquatic toxicity. To overcome these challenges, Nalco Water has developed an...

9:25 AM: Discusser: Dr. Claudia Pierce, Suez Water Technologies & Solutions, Trevose, PA

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

9:50 AM: Networking Break

10:20 AM

IWC 18-63: Cooling Water High Cycle Silica Treatment Program Implemented at a Southwest ZLD Power Plant

Caroline Sui, Ph.D. and Jeffrey Melzer, Suez Water Technologies & Solutions, Trevose, PA; Timothy Eggert, Suez Water Technologies & Solutions, Seal Beach, CA; Joseph Grenier, Suez Water Technologies & Solutions, Fort Collins, CO

A Southwestern United State (US), zero-liquid discharge (ZLD) power plant faces challenges with managing its water balance during seasonal, full load operation. Extended full-load operation overloads the brine concentrator operation causing the evaporation ponds to fill to maximum capacity. This high evaporation pond level can potentially lead to power production rate reductions to prevent overflowing the evaporation ponds. The plant determined that increasing cooling water cycles of concentration would be the most cost-effective and feasible approach to reduce blowdown volume that reduces the load on the brine concentrators, therefore reducing the flow of brine concentrate to the evaporation ponds. The...

10:45 AM: Discusser: Richard Breckenridge, EPRI, Palo Alto, CA 10:55 AM: Author's Closure & Floor Discussion

11:10 AM

IWC 18-64: Scale Formation in Cooling Tower: Theoretical Approach to the Thermodynamics and Kinetics of the Water Chemistry in the Makeup and Cycled Water

Kenneth Chen, Arcadis, Irvine, CA; Americus Mitchell and Joe Guida, Fluor Enterprises, Inc., Houston, TX

As fresh water becomes scarcer due to population growth, it is imperative to reduce fresh water consumption through water chemistry adjustment, utilization of alternative source of water (i.e. seawater, gray water, etc.), revamp of existing designs, and water reuse. For power plants, in particular combined cycle plants, cooling towers represent the largest continuous water

demand due to the evaporation and blowdown of the circulating water. The water chemistry dictates the blowdown rate, and as a result, it is a variable that may be controlled to reduce the amount of water consumption. To prevent the formation of scale, fouling, and corrosion issues...

11:35 AM: Discusser: Kaylie Young, The DOW Chemical Company, Lake Jackson, TX

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

12:00 Noon: Conclusion

Water Management in Power Plants

Wednesday, Nov. 7; 8:00 AM - 12:00 Noon

Room: Salt River 2

IWC Rep: Scott Quinlan, GAI Consultants, Cranberry

Township, PA

Session Chair: Jeffery Preece, Electric Power Research

Institute, Charlotte, NC

Discussion Leader: Jeff Easton, P.E., WesTech, Salt Lake City, UT

8:00 AM

Session Introduction

There are many applications of water management in power plants. Process and regulatory changes are major drivers leading to the reconsideration of existing approaches and evaluation of new techniques. The papers in this session present examples where power plants, impacted by changes in disposal of coal combustion residuals, are addressing management of bottom ash water, outage wash water, and treatment of water from impoundments.

8:10 AM

IWC 18-65: Arsenic Treatability and Pilot Testing at Little Blue Run CCR Impoundment

Ronald Ruocco, P.E. and Michael Keen, Civil & Environmental Consultants, Inc., Charlotte, NC; Robert Golightley, First Energy Generation, LLC, Akron, OH; Mark Orzechowski, Civil & Environmental Consultants, Inc., Pittsburgh, PA

The Little Blue Run Disposal Facility (LBR) is an unlined surface impoundment that received Coal Combustion Residuals (CCR) from the Bruce Mansfield Generating Station. With approximately 135,000,000 yd3 of capacity and covering an area of more than 950 acres, it is one of the world's largest CCR disposal facilities. Water monitoring at two locations at LBR identified arsenic concentrations that exceeded the groundwater abatement standard under Pennsylvania's residual waste disposal impoundment regulations. This bench and pilot study identifies treatment technologies and verifies arsenic removal from onsite water, in the event that arsenic removal would be needed to treat spring discharge prior...

8:35 AM: Discusser: Karen Budgell, Golder Associates, Lakewood, CO

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

9:00 AM

IWC 18-66: Closing the Loop in Bottom Ash Systems – Not as Easy as They Thought

Diane Martini, Kyle Vester, and Corey Kipp, Burns & McDonnell, Chicago, IL; Jared Troyer, P.E., Duke Energy, Charlotte, NC

With the movement around the Coal Combustion Residuals rule (CCR) and the Steam Electric Power Effluent Guidelines (ELG) many power plants are installing closed loop bottom ash systems. As true closed-loop bottom ash systems had not been extensively installed and operated prior to the advent of these rules, the industry has encountered many challenges related to water management. The large ash ponds previously used for ash management provided more extensive water treatment than was previously recognized. Long hydraulic detention times (sometimes on the order of months) not only allowed particles to settle, but also allowed water quality to stabilize and...

9:25 AM: Discusser: Larry DeBirk, ClearStream Environmental, Inc., Sandy, UT

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

9:50 AM: Networking Break

10:20 AM

IWC 18-67: Water Management in Closed-Loop Bottom Ash Systems

Laura Reid, P.E., Jacobs Engineering, Charlotte, NC; Thomas Higgins, P.E., Jacobs Engineering, Jacksonville, FL; Dennis Fink, P.E., Jacobs Engineering, Oakland, CA; Paul Chu, EPRI, Palo Alto, CA

Recent regulations are leading many power plants to install recirculating, closed-loop systems for bottom ash transport water. Issues observed in managing a closed-loop system include water quality ones, such as carryover of fine solids, scaling, and corrosion, as well as having more water entering the system than exiting. This paper discusses management options for these issues through a study of six plants with recirculated water bottom ash systems and bench test studies. This paper will discuss managing closed-loop bottom ash systems, including drivers that necessitate purges, and treating the purge for discharge or for reuse in the power plant. Information...

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

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

11:10 AM

IWC 18-68: Outage Wash Wastewater Treatment Alternatives at Coal Fired Power Plants

Julie Horan, P.E., HDR, Inc., St. Louis, MO; Josh Prusakiewicz, P.E., HDR, Ann Arbor, MI

In compliance with the Coal Combustion Residuals (CCR) rule, many power plants are faced with closing their ash ponds and finding other alternatives to treat and dispose of the many other non-CCR plant wastewater streams that once were simply pumped to the ash pond. Non-chemical cleaning outage wash wastewaters, such as boiler fireside wash, economizer wash, air preheater wash, or precipitator wash; which have typically been discharged to the ash ponds in the past, create a special challenge for many facilities. Not only are these wastewater streams large in volume and highly intermittent, they also usually contain significant suspended solids...

11:35 AM: Discusser: Dallas Torgersen, P.E., WesTech Engineering, Salt Lake City, UT

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

12:00 Noon: Conclusion

IWC 18-Reserve/Power: Ash Transport Water Quality

Corey Kipp, EIT and Diane Martini, Burns & McDonnell, Kansas City, MO

In the Steam Electric Power Effluent Guidelines, USEPA has stated that bottom ash transport and fly ash transport water quality are essentially the same and no discharge of pollutants from ash transport water can be allowed. However, there is a lack of industry data in this area. This paper will characterize ash transport water, compare pollutants found in bottom ash transport water to those associated with fly ash transport water, and discuss implications of these assumptions.

Evolving Membrane Technologies and Applications

Wednesday, Nov. 7; 8:00 AM - 12:00 Noon

Room: Salt River 7

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

Naperville, Il

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

Discussion Leader: Adhiraj Joshi, Aquatech International,

LLC, Cannonsburg, PA

8:00 AM

Session Introduction

From humble beginnings within the last century, modern membrane technologies have developed to include a wide variety of chemistries and formats that offer solutions for an ever-increasing range of applications. Modern membrane technologies include reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) chemistries in a multitude of formats, such as spiral-wound elements, tubular

and capillary modules, hollow-fiber modules, plate and frame designs, and more. This session focuses on these evolving membrane technologies and the expanse of applications that they are being used for. In terms of RO, the session will discuss both a new type of RO format and a new system design that will allow the membrane industry to handle new applications. The session will also discuss a new option for dechlorination ahead of membranes and how a UF hollow fiber membrane brings a plant a new water source. All in all, the variety of papers in this session truly represents modern membrane technologies and the expanding array of applications that they provide solutions for.

8:10 AM

IWC 18-69: Counterflow Reverse Osmosis – New Membrane Technology for Ultra-High Salinity Desalination

Richard Stover, Ph.D. and Simon Choong, Ph.D., Gradiant Osmotics, Woburn, MA; Aaron U and Prakash Govindan, Ph. D., Gradiant Corporation, Woburn, MA

Water scarcity is driving the development of alternative water resources such as desalination and water reuse. Reverse osmosis (RO), the most widely-applied treatment method, generates a substantial stream of brine concentrate. Typically, additional concentration of this brine is not possible with RO equipment due to the required pressures which exceed equipment limitations. Existing brine concentration technologies use heat, require high capital costs and consume significant amounts of energy. The CounterFlow Reverse Osmosis (CFRO) process is a non-evaporative, membrane-based method for desalination of brines with total dissolved solids (TDS) concentrations of up to 250,000 mg/l. The CFRO process uses hydraulic pressure...

8:35 AM: Discusser: Wayne Bates, Hydranautics, Rockton, IL

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

9:00 AM

IWC 18-70: Using Membranes to Produce River Water Cooling System for Large Chemical Plant

Jake Moen and Sundeep Ramachandran, The Dow Chemical Company, Minneapolis, MN; Caitlin Burns, The Dow Chemical Company, Freeport, TX; Michael Bourke, Wigen Water Technologies, Chaska, MN

The Clarified River Water (CRW) system is part of The Dow Chemical Company's Freeport Site located in Texas, United States. The Freeport Site is the largest integrated chemical manufacturing complex in the Western Hemisphere. With physical space limited and the seasonal fluctuations of the Brazos River, the design of the plant focused on the benefits membranes can provide over traditional technology. Additional details of UF skid design and operation will be focused in this paper along with detailed operating data since startup in 2017. This paper will examine the water quality, system design, and reliability essential to produce...

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

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

9:50 AM: Networking Break

10:20 AM

IWC 18-71: The New Standard for Industrial Desalination Michael Boyd, Desalitech, Newton, MA

Reverse osmosis (RO) is the primary technology utilized in the desalination of industrial water and wastewater. Although the technology is very effective at removing salts, it has many limitations and pain points associated with its operation. These include low recovery rates, fouling and scaling of membranes, high CIP frequencies, short membrane life, difficulty in managing variations in feed water quality, compromised permeate quality, high operating costs, and the list goes on. The key to solving all these issues, ultimately came down to thinking outside of the box and reinventing the basic filtration process starting from scratch. In traditional multi-stage RO systems, recovery, flux and crossflow are coupled, so managing efficiency...

10:45 AM: Discusser: Tony Fuhrman, LG Water Solutions, Torrance, CA

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

11-10 AM

IWC 18-72: Evaluation of Long-Term Membrane Performance with Continuous Use of Hydro-Optic UV Dechlorination at Plant Bowen

Dennis Bitter, Atlantium Technologies, Inc., Sarasota, FL; Ytzhak Rozenberg, Atlantium Technologies, Israel

In 2014 Plant Bowen, a 3,160-megawatt coal-fired power station, in Cartersville, Georgia evaluated and installed a non-chemical dechlorination process, the Hydro-Optic™ (HOD) UV water treatment technology, to improve the overall quality of reverse osmosis (RO) feed water. New membrane elements were installed in March 2014. As a non-chemical approach to decompose the free chlorine oxidant and protect the RO membranes, the technology provided the facility with the opportunity to reduce or eliminate the use of sodium metabisulfite (SMBS) and reduce maintenance and associated costs. Data for the membrane system's differential pressure, normalized salt passage and rejection, permeate flow, and normalized...

11:35 AM: Discusser: Emily Meyers, Duke Energy, Edwardsport, IN

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

12:00 Noon: Conclusion

IWC 18-Reserve/Membranes: Real Time Continuous Membrane Integrity Monitoring in Wastewater Reuse for Potable Purposes

Seong Hoon Yoon, Ph.D., P.E., Ritika Singh, Jason Fuse, Nalco, An Ecolab Company, Naperville, IL

In wastewater reuse for potable purposes, microbial contamination is the primary concern from the perspective of public health. Therefore, pathogen removal efficiency of the treatment process is tightly regulated by imposing minimum log removal values (LRV). Virus, parasites, E. coli, etc. are subject to be regulated depending on State, but virus is considered the most challenging species due to its small size. Currently, most of the hybrid processes designed for potable reuse includes RO as a mean to remove all the residual fine particulates and dissolved organics carried over by the pre-filtered water. Due to the non-porous nature, RO is...

From the Bench to Full-scale – Optimization of Wastewater Treatment Systems

Wednesday, Nov. 7; 8:00 AM - 12:00 Noon

Room: Salt River 8

IWC Rep: Tom Lawry, McKim and Creed, Sewickley, PA Session Chair: Mike Bluemle, Solenis LLC, Wilmington, DE Discussion Leader: Andrew Erikson, Burns & McDonnell,

Kansas City, MO

8:00 AM

Session Introduction

Due to the often-complex nature of industrial wastewater, development of effective treatment strategies typically requires bench-scale testing to augment design calculations and confirm innovative treatment approaches. Additionally, varying process conditions and water quality drive the necessity for continued monitoring and refinement to maximize the efficiency of plant operations. Papers in this session discuss the implementation of bench-scale testing to improve full-scale applications and theoretical and practical enhancements to dissolved air flotation (DAF) unit operations.

8:10 AM

IWC 18-73: The "Ins & Outs" and "Dos & Don'ts" of Bench Scale Treatment Studies

Chloe Grabowski, HDR, Inc., Missoula, MT

This paper will focus on the planning, execution, and data evaluation phases of bench scale treatment studies. It will discuss potential pitfalls to avoid in the planning and execution processes, through review of lessons learned during several real-world studies conducted at industrial facilities. The paper will provide tips for optimizing bench scale treatment studies as well as an understanding of the benefits and limitations of these types of studies.

8:35 AM: Discusser: Paul Pigeon, P.E., Golder Associates, Lakewood, Co

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

9:00 AM

IWC 18-74: Zeta Potential for Optimizing Coagulation at Industrial Water Treatment Plants

David Pernitsky, Ph.D., P.Eng., Stantec, Calgary, AB, Canada; Gabe Maul, Stantec, West Palm Beach, FL; Keri Seeley, Babcock and Wilcox, West Palm Beach, FL; Basil Perdicakis, Adrian Revington, and Anita Selinger, Suncor, Calgary, AB, Canada

Sedimentation, flotation, and granular media filtration processes are at the heart of many industrial water and wastewater treatment plants, including pretreatment for boiler feed water systems and sedimentation in ash-management facilities.

Determining the appropriate coagulant dose is essential to making these processes work effectively. Although the theory of these processes is well known to researchers, practical application of this theory in operating water treatment plants is not common. Rather, coagulant doses are determined using jar tests, visual observations, and trial and error. This paper summarizes the author's twenty-five years of experience to illustrate the use of bench-scale zeta potential measurements...

9:25 AM: Discusser: John Schubert, P.E., HDR, Sarasota, FL

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

9:50 AM: Networking Break

10:20 AM

IWC 18-75: Tiny Bubbles Float Floc — Optimizing Dissolved Air Flotation Operations

Mikel Goldblatt, P.E., Solenis, LLC, Wilmington, DE

Factors determining efficacy of dissolved air flotation (DAF) unit operations include i) solids loading, oil & grease loading and float sludge removal; ii) hydraulic loading, dwell time and rise rate; iii) air injection in the air dissolution tank, and evolution in the flotation tank. This paper focuses on optimization of air injection and evolution as embodied in the air-to-solids (A:S) ratio calculations. Examples of improvements in industrial wastewater DAFs based on enhancing A:S ratios are given. A generic dissolved air flotation (DAF) unit consists of a flotation tank with a skimmer for float sludge removal, baffling to segregate and capture...

10:45 AM: Discusser: Martin Grygar, MBA, P. Eng., B.Sc., Houston, TX

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

11:10 AM

IWC 18-76: Hydrogen Peroxide for Supplemental Dissolved Oxygen for Petrochemical Wastewater Treatment

Rick Fuller, USP Technologies, Atlanta, GA

The use of hydrogen peroxide as a source of supplemental dissolved oxygen (DO) in activated sludge treatment systems is well documented and has been practiced for decades. The focus of this paper is on the use of hydrogen peroxide (H2O2) to increase the DO in the aeration basin of a petrochemical

plant's wastewater treatment system. The petrochemical plant is a $\approx\!100,\!000$ barrel per day U.S. facility that produces gasoline, kerosene, and jet fuel. In 2017 USP Technologies was called upon to provide supplemental DO to the activated sludge system through the addition of H2O2. The H2O2 was fed directly into...

11:35 AM: Discusser: Venkata Sunil Kumar Sajja, Fluor, Sugar Land, TX

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

12:00 Noon: Conclusion

NEW THIS YEAR! H20 Theatre

A new addition to the IWC is the H20 Theatre! These informal presentations are presented by experts in their respective fields, and done in an informal setting, open to all attendees! There is no additional fee to attend, and advance registration is not required. All presentations are conducted in the Salt River Foyer. (Schedule subject to change.) Just pull up a chair and hear from the following.

MONDAY, NOVEMBER 5, 2018

- 1:30 PM Eisenmann Corporation
- 2:00 PM Justeq, LLC
- 3:30 PM OLI Systems, Inc.
- 4:30 PM Aqua-Aerobic Systems, Inc.

Tuesday, November 6, 2018

- 9:00 AM Pulsafeeder
- 9:30 AM Sentry Equipment
- 10:30 AM ChemTreat
- 11:00 AM SUEZ Water Technologies & Solutions
- 1:30 PM Avista
- 2:00 PM E2Metix, Inc.

VISIT BOOTH 504

TO SEE THE LATEST INNOVATIONS FROM

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Ecolab.com/nalco-water

The IWC Workshop program (denoted with "W") is designed to provide practical information that includes a basic understanding of the topic as well as detailed case studies. They are presented by experts in their field and are loaded with technical content, not sales information. Each workshop will provide an opportunity for a technical exchange between the registrant, the instructor and other workshop participants. IWC workshops provide attendees four professional development hours (PDHs) and a certificate of completion. A separate fee of \$250.00 per workshop is required. Discounts are given for multiple registrations. Workshops 1, 2, 3, and 4 are offered on Sunday, and repeated later in the week. Workshops 1, 2, and 3 combined are offered as the "basics package" for \$600.00. All workshops are scheduled based on minimum reservations. Register at https://eswp.com/water/registration/ Workshops currently scheduled (subject to change):

W1: Water Treatment 101

Sunday, November 4; 1:00 - 5:00 PM

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

Dennis McBride, Burns & McDonnell, Kansas City, MO

W2: Ion Exchange Technology and Practical Operating Practices

Sunday, November 4; 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, November 4; 1:00 - 5:00 PM

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

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

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

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

Sunday, November 4; 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, November 7; 1:00 - 5:00 PM

Repeated from Sunday. See full description in previous listing.

W3A: The Wonderful World of Reverse Osmosis

Wednesday, November 7; 1:00 – 5:00 PM

Repeated from Sunday. See full description in previous listing.

W5: Troubleshooting an Ion Exchange Mixed Bed

Wednesday, November 7; 1:00 - 5:00 PM

In the water treatment plant, the ion exchange mixed bed units can be your best friend or worst enemy. Mixed beds 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 and can become 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. Part 1 of the training session will discuss some of the author's +40 years of experience with trouble shooting and repairing various mixed bed system in North America. It will cover cases involving resin problems, mechanical failure inside the vessels and changes in feed water quality. Part 2, will cover resin parameters, choosing the best resins for the application, the importance of chemical dosages, and what to look for in the resin reports.

Donald Downey, Purolite Corporation, Paris, ON, Canada

W6: Evaluating Business Cases for Industrial Water Reuse

Wednesday, November 7; 1:00 - 5:00 PM

This workshop will introduce a suite of tools for industrial operators to evaluate business cases for water reuse projects. These tools have been created in collaboration with a wide range of industrial end users using case study data to develop the framework. The workshop panelists will provide insight on their own experiences for industrial water reuse and be available for questions and networking.

Abigail Antolovich, Denver Water, Denver, CO

NOTE: Printed reference material not provided in this workshop

W7: Industrial Boiler Water Treatment

Wednesday, November 7; 1:00 - 5:00 P.M.

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

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

W8: Building a Best Practice Cooling Water Program

Wednesday, November 7; 1:00 - 5:00 PM

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

tower water) and cooling system information (metallurgy, hottest skin temperature) for an in-session exercises and review.

Jo Ordonez, Solenis, Kyle, Texas

W9: Wastewater Treatment 101

Wednesday, November 7; 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.

Joe Guida, Fluor, Sugarland, TX

W10: Water Treatment 201

Thursday, November 8; 1:00 – 5:00 PM

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

Americus Mitchell, Sundt Construction, Inc., Tempe, AZ

W11: Contaminants A to Z

Thursday, November 8; 8:00 AM - 12:00 Noon

The number of contaminants found in water supplies continues to grow with new information regarding emerging contaminants such as PFAS and incidental contaminants such as pesticides, pharmaceuticals, and personal care products take the stage alongside naturally occurring contaminants such as arsenic and gross alpha and problematic manmade contaminants such as mercury and lead. This years workshop includes both an

expanded list of contaminants (>100) plus an extensive back-up reference file of open literature pertaining to each contaminant. The oral presentation will include a selection from the list based on participants stated interests plus the latest available information on emerging and incidental contaminants.

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

W12: Electrodeionization (EDI)

Thursday, November 8; 8:00 AM -12:00 Noon

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

Jon Wood, Evoqua Water Technologies LLC, Lowell, MA

W13: Industrial Water Reuse – A Roadmap for the Future

Thursday, November 8; 8:00 AM - 12:00 Noon

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

- The three key aspects of water chemistry that drives design
- Options to get from point A to point B an unbiased comparison of the more popular water reuse flowsheets (i.e. membranes vs non-membrane approach)
- Navigating the changing water treatment technology landscape

 an unbiased comparison of the more popular treatment
 technologies (i.e. Clarifiers, MMF, MF, UF, GAC, IX, RO, ED,
 Chlorine, Ozone, AOP, UV)
- · Emerging technologies and opportunities
- · "Fit for purpose" water reuse strategies
- · Optimizing cost and reliability
- · Lessons learned and avoiding pitfalls

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

Ed Greenwood, Wood, Cambridge, ON, Canada

W15: UF, RO and EDI Maintenance and Cleaning

Thursday, November 8; 8:00 AM - 12:00 Noon

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

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

Robert Cohen, Evoqua Water Technologies, Rochester, NY

W16: Arsenic and Selenium in Wastewater Treatment

Thursday, November 8; 8:00 AM - 12:00 Noon

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

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

W2A: Ion Exchange Technology and Practical Operating Practices

Thursday, November 8; 1:00 - 5:00 PM

Repeated from Sunday. See full description in previous listing.

W4A: Wet FGD Chemistry and Operational Impacts on

Wastewater Quality Discharge

Thursday, November 8; 1:00 - 5:00 PM

Repeated from Sunday. See full description in previous listing.

W17: HRSG and High Pressure (>900 PSIG/60 BAR) Boiler Water Treatment and Operation

Thursday, November 8; 1:00 - 5:00 PM

This workshop will explain high pressure (>900 psig/60 bar) steam boiler treatment and new understandings and developments relative to control of deposition and corrosion. The course will also cover treatment issues related to preboiler systems and the condensate systems and a discussion of controls and corrective action. Operators, utility plant supervisors, managers, and engineers can all benefit greatly from the practical information provided in this course.

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

W18: Field Techniques for Quantifying Scale and Bacteria: A Hands-On Introduction

Thursday, November 8; 1:00 - 5:00 PM

We will provide a hands-on explanation of field analysis methods for scaling factors and biofilm assays in industrial and treatment processed waters. Participants will gain understanding on the importance of utilizing analytical field testing for finding, predicting, and preventing scaling and biofilm formation. Through lecture, desktop exercises and hands-on analyses of water samples, workshop attendees will increase their knowledge of how analytical methods are selected, the proper techniques for sampling and validating the testing results. Additionally, we offer insight on how to apply sample results to provide data on the scaling tendencies and biological potentials of their water. We introduce emerging analytical instrumentation for scale related water quality parameters and enhanced microbial testing assaying protocols. Attendees will employ innovative software that calculates the PSI, LSI and RSI scaling indices, the water aggressiveness index (AI), total planktonic bacteria count and different formats results reporting. With analytical data outcomes, through desktop exercises, participants will determine what steps are required to insure the water is balanced and chemically treated properly to prevent corrosion, scale and biofilm formation. Workshop attendees will also work in small groups allowing for enhanced learning from others in the industry and interact with two presenters who are leaders in their fields of chemistry, microbiology, laboratory testing and industrial water processes in this respective learning environment.

Keith McLeroy and Anthony Bennett, RETEGO Labs, College Station, TX

W20: Legionella Risk Management for Industrial Facilities

Thursday, November 8; 1:00 - 5:00 PM

Managing the risks of legionella infections from in industrial water systems requires a different kind of assessment and management than for commercial facilities described in the ASHRAE/ANSI 188-2015 standard. This workshop will equip professionals working in industrial facilities with a clear understanding of the nature of the risks, the complexities of various monitoring protocols for bacteria, operational issues during start-up and shutdown, operating strategies, biocide protocols and design options to minimize the risk of loss of control of the hazard as well as methods to address legal and reputation risks. We will review current guidelines and resources available to guide the design of monitoring and operating procedures and an analysis of the value of developing an internal corporate standard. Process engineers, consultants and industrial environmental health and safety professionals will benefit from this session.

Loraine Huchler, MarTech Systems, Inc., Lawrenceville, NJ





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* Please join us for Workshop 17: Field Techniques for Quantifying Scale and Bacteria: A Hands-On Introduction

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^{*} Workshop participants will receive a \$250.00 credit towards the Online purchase of RETEGO Equipment

IWC Exhibit Hall

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

- Sunday, November 4: 5:00-7:00 PM
- Monday, November 5: 11:30 AM-1:30 PM and 5:00-7:00 PM
- Tuesday, November 6: 11:30 AM-1:30 PM and 5:00-7:00 PM

Be sure to join us for lunch on Monday and Tuesday, as well as the evening receptions on Sunday, Monday and Tuesday. Luncheons and receptions are open to all registered attendees.

A listing by booth number of all 2018 IWC Exhibitors is provided below. On the following pages, you will find a detailed description* of our exhibitors, including contact information.

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

Outdoor Exhibit Space

New for 2018, we have introduced an outdoor exhibit area featuring mobile exhibits, each with their own focus. Our IWC Outdoor Exhibit draws companies in the water industry who want to highlight their mobile technology. We hope you will join us for this exciting new attraction at the IWC! Please make time to visit the outdoor exhibits, located on the North Patio near the Talking Stick Swmming Pool area. The Outdoor Exhibit Hours are:

- Sunday, November 4: 3:00–6:00 PM
- Monday, November 5: 11:00 AM-6:00 PM
- Tuesday, November 6: 11:00 AM-6:00 PM

Be sure to visit:

- MPW Industrial Services
- Pall Water
- SUEZ
- WesTech Engineering, Inc.



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206/208	LANXESS Sybron Chemicals Inc.
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209	Pulsafeeder
210	RETEGO Labs
211	LG Water Solutions
212	E2Metrix Inc.
213/215 214	Aqua-Aerobic Systems, Inc.
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F04	Efficient Thermal Energy	
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3M SEPARATION AND PURIFICATION SCIENCES DIVISION

Booth #: 405/407

Contact: Thomas Simpson Phone: 804-477-2325

E-mail: tsimpson@mmm.com Website: www.3M.com/Liqui-Cel

3M Separation and Purification Sciences Division is featuring 3M Liqui-Cel Membrane Contactors which provide efficient dissolved gas control in a compact design and are capable of adding gases to or removing dissolved gases and bubbles from compatible liquid streams. SPSD will also feature 3M High Flow Filter System, a result of 3M's extensive filtration experience for those customers who want filtration efficiency and a small footprint.

ABTECH INDUSTRIES INC.

Booth #: 514

Contact: Don Thompson Phone: 480-874-4000 Fax: 480-970-1665

E-mail: dthompson@abtechindustries.com Website: www.abtechindustries.com

AbTech Industries is a full-service environmental technologies and engineering firm dedicated to providing innovative solutions to communities, industry and governments addressing issues of water pollution and contamination. Offering innovative solutions for Stormwater Management, Oil & Gas Water Treatment and Industrial Waste Water Treatment, AbTech integrates its own advanced technologies along with third-party technologies and systems to provide customers with the most effective and economical solutions.

AKZONOBEL SURFACE CHEMISTRY

Booth #: 412/414 Contact: Jeroen Pul Phone: 312-659-6977

E-mail: jeroen.pul@akzonobel.com

Website: www.akzonobel.com/watertreatment

Surface Chemistry has been developing innovative technologies in the water treatment field for nearly 40 years. During that time, we've established a global presence and cultivated a team of dedicated technical experts to help you select and develop solutions for all of your boiler and cooling tower needs.

AMERICAN WATER CHEMICALS, INC.

Booth #: 604

Contact: Michael Lee Phone: 813-246-5448 Fax: 813-623-6678

E-mail: mlee@membranechemicals.com Website: www.membranechemicals.com/en

American Water Chemicals® (AWC) was created in 1993 by

a group of membrane desalination experts in response to the demand for more reliable membrane treatment chemicals and services. Over the years, our unique understanding of water chemistry has earned us a worldwide reputation for resolving complex operational issues. AWC® has become renowned as one of the most trusted suppliers of membrane chemicals for RO/NF systems. Our goal is to enable our customers to meet their...

AMERIWATER

Booth #: F01

Contact: Travis Tashjian Phone: 937-461-8833 Fax: 937-461-1988

E-mail: travis.tashjian@ameriwater.com

Website: www.ameriwater.com

AmeriWater is an industry leader in the design, manufacture, installation and supply of water purification systems and services for industrial applications. AmeriWater's products are duly certified and meet the most stringent FDA, ISO, Health Canada

and IEC/UL standards.

APPLIED MEMBRANES, INC.

Booth #: 214

Contact: Mike Faulkner Phone: 760-727-3711 Fax: 760-727-4427

E-mail: mfaulkner@appliedmembranes.com Website: www.appliedmembranes.com

Applied Membranes, Inc. is a membrane treatment solutions provider for water purification, reverse osmosis (RO) desalination and water reuse. For over 30 years, the company has pioneered many applications and system design concepts. When it comes to pre-treatment, post-treatment and membrane systems, we have been in the forefront of the industry to offer innovative solutions.

AQUA-AEROBIC SYSTEMS, INC.

Booth #: 213/215 Contact: Valeria Oteri Phone: 815-654-2501 Fax: 815-654-2508

E-mail: solutions@aqua-aerobic.com Website: www.aqua-aerobic.com

Aqua-Aerobic Systems is an applied engineering company specializing in adaptive water management solutions including aeration/mixing, biological processes, cloth media filtration, membranes, oxidation/disinfection and process control. Since 1969, the company has served the water and wastewater industry by providing both municipal and industrial customers around the world. From enhanced nutrient removal to primary filtration, ultra-low phosphorus removal or water reuse, Aqua-

Aerobic has proven solutions that offer the lowest cost of ownership with life-time customer service.

AQUATECH INTERNATIONAL CORP.

Booth #: 500

Contact: Larry Millar Phone: 724-746-5300

E-mail: millarl@aquatech.com Website: www.aquatech.com

Aquatech is a global leader in water purification technology for industrial and infrastructure markets with a focus on desalination, water recycle and reuse, and zero liquid discharge(ZLD). Headquartered in Canonsburg, Pennsylvania, Aquatech has offices throughout North America, and has a significant presence worldwide through subsidiaries in Europe, the Middle East, India and China. Through its network and world-wide operations, Aquatech has successfully executed more than 1,000 water management projects in over 60 countries around the globe.

ASA ANALYTICS

Booth #: 207

Contact: Jed S. Reemsnyder Phone: 262-717-9500 Fax: 262-717-9500

E-mail: jed@chemscan.com Website: www.asaanalytics.com

For over 20 years ASA Analytics has designed and manufactured analyzers for water and wastewater monitoring. The ActivTrac single parameter analyzers provide reliable and accurate measurement of Polymer, Molybdate, Ortho Phosphate, Silica, Copper, Hexavalent Chrome, Sulfite, Manganese, Chloramine, Ammonia and more. The analyzers are designed for minimal maintenance with only quarterly reagent refresh. The device complements the multiple parameter, multiple sample line ChemScan analyzers manufactured by ASA Analytics.

ATHLON, A HALLIBURTON SERVICE

Booth #: 404

Contact: Gretchen Blank Phone: 225-744-8024 Fax: 225-673-1970

E-mail: gretchen.blank@athlonsolutions.com

Website: www.athlonsolutions.com

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

ATLANTIUM TECHNOLOGIES

Booth #: 102

Contact: Dennis Bitter Phone: 714-305-6111 E-mail: info@atlantium.com Website: www.atlantium.com

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AVISTA TECHNOLOGIES

Booth #: 303

Contact: Naomi Rueth Phone: 760-744-0619 Fax: 760-744-0619

E-mail: nrueth@avistatech.com Website: www.avistatech.com

Avista Technologies is a trusted expert in membrane system chemistry and global process support for Reverse Osmosis and

Micro/Ultra Filtration membrane systems and Multimedia Filtration. Reverse Osmosis products include: Vitec® antiscalants, RoClean®, AvistaClean® membrane cleaners and RoCide® biocides. AvistaClean® MF cleaners restore MF/UF membrane performance when generics are no longer effective.

BASWOOD CORPORATION

Booth #: 511 Contact: Jaimi Klein Phone: 888-560-5517 E-mail: info@baswood.com Website: www.baswood.com

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Booth #: 613

Contact: Michael Soller Phone: 317-519-4327

E-mail: msoller@bowenengineering.com Website: www.bowenengineering.com

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BRENNTAG NORTH AMERICA

Booth #: 408

Contact: Barbara Nothstein Phone: 800-890-0355

E-mail: contactus@brenntag.com Website: www.BrenntagWater.com

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BROWN AND CALDWELL

Booth #: 609 Contact: Tom Sandy Phone: 704-373-7125 Fax: 704-358-7205

E-mail: asandy@brwncald.com Website: www.brownandcaldwell.com

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

BURNS & MCDONNELL ENGINEERING, INC.

Booth #: 111

Contact: Patricia Scroggin Phone: 816-822-3097 Fax: 816-333-3690

E-mail: pscroggin@burnscmd.com Website: www.burnsmcd.com

At Burns & McDonnell, our engineers, architects, construction professionals, scientists and consultants do more than plan, design and construct. We tackle your most complex water and wastewater issues allowing for safe and cost-effective operations. With a mission unchanged since 1898 — make our clients successful – our more than 6,000 professionals partner with you on the toughest challenges, constantly working to make the world an amazing place.

CANADIAN WATER TECHNOLOGIES

Booth #: 515

Contact: Wayne Dyck Phone: 403-852-0351 Fax: 403-509-1569

E-mail: wayne.dyck@cwtcalgary.com

Website: www.canadianwatertechnologies.com

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

CENTRISYS/CNP

Booth #: 310

Contact: Jerod Swanson Phone: 612-401-2006

E-mail: jerod.swanson@centrisys.us

Website: www.centrisys.com

Centrisys Corporation is a U.S.A. manufacturer of dewatering and thickening centrifuges, as well as complete dewatering systems for municipal and industrial wastewater. The company's focus is centrifuge equipment, including the award-winning sludge thickening centrifuge THK series. 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 are AirPrex® and CalPrex , phosphorus recovery...

CHEMTRAC, INC.

Booth #: 600

Contact: Joe Zimmerman Phone: 770-449-6233 Fax: 770-447-0889

E-mail: chemtrac@chemtrac.com

Website: www.chemtrac.com

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.

CHEMTREAT

Booth #: 112

Contact: Stacy Freed Phone: 804-935-2000

E-mail: stacyf@chemtreat.com Website: www.chemtreat.com

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

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Booth #: 517

Contact: Ron Ruocco Phone: 800-763-2326 Fax: 980-237-0372

E-mail: rruocco@cecinc.com Website: www.cecinc.com

CEC's Water Resources practice offers expertise in the areas of watershed management and restoration, storm water compliance, municipal separate storm sewer systems (MS4s), and wastewater/process water. CEC balances regulatory compliance and environmental stewardship with the needs of industry, government, and community by providing feasible, innovative solutions in context with economic impacts. Our diverse team can tackle challenges at any point in a project's life-cycle or take projects from concept and design through construction and long-term monitoring.

COCHRANE BY NEWTERRA

Booth #: 516

Contact: James Almond Phone: 903-431-1196

E-mail: jalmond@cochrane.com Website: www.newterra.com/cochrane

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COOLING TECHNOLOGY INSTITUTE

Booth #: 510

Contact: Jalene Fritz Phone: 970-593-8637 Fax: 970-472-1304

E-mail: jalenemf@gmail.com

Website: www.cti.org

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.

DAVID H. PAUL, INC.

Booth #: 512

Contact: Charles Bedford Phone: 505-326-3431 Fax: 505-327-2934

E-mail: cbedford@dhptraining.com Website: www.dhptraining.com

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DELTA PURE FILTRATION

Booth #: 513

Contact: Todd Furbee Phone: 804-798-2888

E-mail: tfurbee@deltapure.com Website: www.deltapure.com

Delta Pure Filtration is a USA based, ISO 9001 certified, manufacturer of filter cartridges and systems. Products include String Wound, Melt Blown and Carbon/Resin filter cartridges, along with housings and systems. Applications for water and various process liquids. NSF 61 approved filter cartridges

available.

DMP CORPORATION

Booth Number: F03

Contact Name: Latrell Wigfall

Phone: 803-412-3808

Email: lwigfall@dmpcorp.com Website: www.dmpcorp.com

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- · Saving you money
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As a truly integrated provider of wastewater treatment solutions, we are uniquely positioned to help...

DOW WATER SOLUTIONS

Booth #: 507/509

Contact: Sundeep Ramachandran

Phone: 952-914-1094

E-mail: sramachandran1@dow.com

Website: www.dow.com/en-us/water-and-process-solutions

Since the 1940s, Dow has been an innovator in water

separation technologies, expanding and growing along the way.

Today,

Dow Water Solutions offers the most complete portfolio of industry leading products available, along with a team that is second to none. As the global leader in sustainable separation and purification technologies, we are helping customers across industries and countries make real progress in ways that not only improve productivity, efficiency and profitability, but also reduce waste, energy consumption and environmental impact.

DURAFLOW LLC

Booth #: 415

Contact: Joseph Lander Phone: 978-436-1652

E-mail: joelander@duraflow.biz Website: www.duraflow.biz

Manufactures tubular crossflow polymeric membrane filters used for removal of toxic elements for compliant effluent discharge and hardness and silica as pretreatment to high recovery RO desalination for pure water manufacturing and waste water recycling. We are "REINVENTING TUBULAR MEMBRANES" by re-engineering of the module configuration to provide the longest 20 module train for energy saving, and by creating new membrane products with higher surface area (24 tube) to reduce space for Capex reduction.

E2METRIX INC.

Booth #: 212

Contact: Tom Whitton Phone: 514-601-1316

E-mail: twhitton@e2metrix.com Website: www.e2metrix.com

With its unique, patented magnesium alloy anode and its advanced power management system, E2Metrix is introducing the ECOTHOR electrolysis technology platform to the marketplace for water and wastewater treatment. ECOTHOR is a robust, reliable and cost-effective solution for nutrient removal and recovery, and for the reduction of dissolved metals, FOG, BOD and many other wastewater contaminants, using electrocoagulation, electro-oxidation or electro-disinfection. E2Metrix is targeting both municipal (wastewater, landfill leachate) and industrial (mining, agri-food, environment) markets.

EFFICIENT THERMAL ENERGY CORPORATION

Booth: F04

Contact: Glenn A. Fletcher Phone: 609-332-3298

E-mail: gfletcher@ethermalenergy.com Website: www.Ethermalenergy.com

NEW Desalination Technology powered by only Hot Water 180F/82C: Thermal Energy to Mechanical Energy. Uses RO Membrane; 100% Renewable; Scalable; No high pressure pumps or motor; Off grid; No Fossil Fuel; Solar Thermal;

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EISENMANN CORPORATION

Booth #: 106

Contact: Fabian Solberg Phone: 815-307-5746

E-mail: fabian.solberg@eisenmann.com Website: www.eisenmann.us.com

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

ENCON EVAPORATORS

Booth #: 413

Contact: Walter Gillis

Phone: 603-624-5110 x223 E-mail: wgillis@evaporator.com Website: www.evaporator.com

Manufacturer of wastewater evaporators and related technology for over 25 years. ENCON Evaporators can dramatically lower your wastewater disposal volume and cost. System capacities range from 2 to 4,000 gallons per hour. All ENCON Evaporators are designed to operate off shift and unattended to minimize manpower requirements and cost. In addition to evaporators, ENCON also manufactures related technology such as slurry dryers and pH adjustment systems.

FEDERAL SCREEN PRODUCTS INC.

Booth #: 403

Contact: Greg Colman Phone: 905-677-4171

E-mail: greg@federalscreen.com Website: www.federalscreen.com

FEDERAL SCREEN PRODUCTS manufacture 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.

FILTRA-SYSTEMS COMPANY

Booth #: 608

Contact: Andrew Knapp Phone: 248-427-9090

E-mail: info@filtrasystems.com Website: www.filtrasystems.com

Filtra-Systems is a global leader in custom-engineered industrial filtration & separation products, systems, and technology. From wastewater treatment to coolant filters, a strong commitment to

R&D is the common thread between all of our products. This commitment has resulted in over thirty-five patents awarded to Filtra-Systems. Products shown at the IWC include walnut shell filters, for oil and solids removal from water.

FLUIDRA USA

Booth #: 607

Contact: Carme Marine Phone: 3-460-820-9886 E-mail: cmarine@fluidra.com Website: www.fluidra.us

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FRONTIER WATER SYSTEMS, LLC

Booth #: 616

Contact: Launa Zanella Phone: 619-981-9023 Fax: 801-206-4110

E-mail: launazanella@frontierwater.com

Website: www.frontierwater.com

Frontier Water Systems specializes in engineered equipment solutions for the removal of selenium, nitrate, and heavy metals from wastewater using the first of their kind, efficient modular bioreactors. We've saved industry partners tens of millions of dollars to-date, setting new standards through practical process innovation.

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Booth #: 306

Contact: Timothy Cornish Phone: 630-845-4461 E-mail: tcornish@ftek.com Website: www.ftek.com

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GEMU VALVES

Booth #: 216

Contact:

Phone: 678-553-3400 Fax: 404-344-9350 E-mail: info@gemu.com Website: www.gemu.com

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

GLOBAL CHEM-FEED SOLUTIONS, LLC

Booth #: 508 Contact: Scott Wynn Phone: 267-963-7020

E-mail: scottw@globalchem-feed.com Website: www.globalchem-feed.com

Global Chem-feed Solutions (GCS) is a supplier of custom skid mounted chemical feed systems as well as wet dust suppression 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. Fugitive dust suppression systems are designed and fabricated for material handling and storage pile applications...

GLOBAL TREAT, INC.

Booth #: 603

Contact: David Vandergriff Phone: 281-370-3425 Fax: 281-370-3571

E-mail: info@globaltreat.com Website: www.globaltreat.com

Global Treat provides products such as Fiberglass Shelters; Acid Dilution Troughs; Chem-feed Equipment (for Gas, Liquid, and Solids); Chlorine Dioxide Solution and Generators; Highcapacity Chlorine, Sulfur Dioxide, and Ammonia Feed Systems (including Evaporators); Chemical Scales; Chemical Diffusers.

GOLDER ASSOCIATES INC.

Booth #: 400

Contact: Paul Pigeon Phone: 303-980-0540 Fax: 303-985-2080

E-mail: ppigeon@golder.com Website: www.golder.com

Golder is a full-service engineering and geosciences company, providing services to governments, industry and mining worldwide. Employee ownership heightens our dedication to client service and technical excellence throughout water management and treatment projects from planning and testing to design, construction and short- or long-term operations, as well as turnkey services. Golder's lengthy resume includes water treatment projects in mining, power, heavy industry, food and beverage, as well as remediation programs for private and government clients.

GRAVER WATER/ECODYNE LTD

Booth #: 301 Contact: John Yen Phone: 908-516-1400 Fax: 908-516-1401 E-mail: sales@araver.ci

E-mail: sales@graver.com Website: www.graver.com

For over 75 years, Graver Water / Ecodyne designs and manufactures water and wastewater treatment equipment for the Power utility, Petrochemical and industrial markets. Using technologies such as ion exchange, clarification, filtration, and reverse osmosis, meet or exceed your desired water quality, decrease outage costs, increase uptime and help stabilize chemistry in your system. We are the leader in Condensate Treatment with our Deep Bed Polishers with SepraEight regen system, CP Filters, and Powdex precoat filter...

GRUNDFOS

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Contact: Michael Kobal Phone: 412-295-5600

E-mail: mkobal@grundfos.com Website: www.grundfos.us

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H2O INNOVATION

Booth #: 108

Contact: Gregory Madden Phone: 515-473-2959

E-mail: gregory.madden@h2oinnovation.com

Website: www.h2oinnovation.com

H2O Innovation designs and provides state-of-the-art, custom-built and integrated water treatment solutions based on membrane filtration technology for municipal, industrial, energy and natural resources end-users. The Corporation's activities rely on three pillars which are i) water & wastewater projects, and services; ii) specialty products, including a complete line of specialty chemicals, consumables and specialized products for the water treatment industry; and iii) operation and maintenance services for water and wastewater treatment systems. For more information, visit www.h2oinnovation.com.

HACH

Booth #: 406 Contact: Ken Kuruc Phone: 330-723-0220 E-mail: kkuruc@hach.com Website: www.hach.com

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HOWDEN ROOTS

Booth #: 417

Contact: Becky Gibson Phone: 765-827-9285 Fax: 765-827-9317

E-mail: becky.gibson@howden.com Website: www.howdenroots.com

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IDE TECHNOLOGIES

Booth #: 308 Contact: Hila Koren

Phone: +972-52-4299731 E-mail: hilak@ide-tech.com Website: www.ide-tech.com

IDE, a world leader in water treatment solutions, specializes in the development, engineering, construction and operation of enhanced small to mega-size sea and brackish water desalination facilities, industrial water treatment and water reuse plants. IDE has a unique, well-proven track record in large-scale membrane and thermal desalination projects, including some of the largest plants worldwide.IDE provides high quality water for a wide range of customers with over 400 plants in over 40 countries.

ITOCHU CHEMICALS AMERICA INC.

Booth #: 110

Contact: Mike Kearney Phone: 984-234-0261

E-mail: mike.kearney@itochu-ca.com Website: www.itochu-purification.com

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Booth #: 103

Contact: Jim Knepper Phone: 412-400-0981 Fax: 215-546-9921

E-mail: jim.knepper@jacobi.net

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Contact: Justin Shim Phone: 224-515-8352 Fax: 224-515-8327

E-mail: justin@justeq.com Website: www.justeq.com

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LAYFIELD USA CORP

Booth #: F02

Contact: Chris Morrison Phone: 619-214-6064

E-mail: chris.morrison@layfieldgroup.com

Website: www.layfieldgroup.com

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LG WATER SOLUTIONS

Booth #: 211

Contact: Tony Fuhrman Phone: 412-213-2323

E-mail: afuhrman@lgchem.com Website: www.lgwatersolutions.com

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Booth #: 615

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MICRODYN-NADIR

Booth #: 610

Contact: Travis Schlepp Phone: 805-964-8003

E-mail: t.schlepp@microdyn-nadir.com Website: www.microdyn-nadir.com

MICRODYN-NADIR is a membrane manufacturer that delivers the membrane products to meet all of your water and process needs. We offer the widest range of membrane products, including MF, UF, NF, and RO in flat sheet, spiral-wound, and hollow-fiber configurations. With over 50 years of membrane experience and expertise, we look forward to talking to you about your membrane requirements.

MPW INDUSTRIAL SERVICES

Booth #: 107

Contact: Nicholas Tennant Phone: 740-928-0213

E-mail: nhtennant@mpwservices.com Website: www.mpwservices.com

MPW offers a variety of industrial cleaning, water purification, facility management and environmental management services to thousands of clients throughout North America. Our diversified industrial services are applicable to a wide array of customer needs and enable clients to prosper in today's competitive environment. MPW's Industrial Cleaning Division is one of North America's leading providers of technology-based industrial cleaning services for companies in power generation, steel, pulp and paper, refineries, automotive and manufacturing.

NALCO CHAMPION, AN ECOLAB COMPANY

Booth #: 506

Contact: Michelle Samuels Phone: 630-305-1052

E-mail: msamuels@ecolab.com

Website: www.ecolab.com/nalco-champion

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NALCO WATER, AN ECOLAB COMPANY

Booth #: 504

Contact: Kathy Schillinger Phone: 630-305-1239

E-mail: kschillinger@nalco.com

Website: www.ecolab.com/nalco-water/

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OLI SYSTEMS, INC.

Booth #: 409

Contact: Pat McKenzie Phone: 973-998-0240 Fax: 973-539-5922

E-mail: pat.mckenzie@olisystems.com

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OLI provides simulation software for industrial gas and water treatment, because accurate modeling of your chemistry is essential for process optimization and meeting environmental regulations. OLI's accurate, comprehensive simulation of 81 elements of the periodic table – and water – can be combined with electrolyte flowsheet simulation and aqueous corrosion prediction. Used by the oil and gas, chemical process, power generation (FGD), nuclear energy and metals & mining industries. Software includes the OLI Studio and Flowsheet: ESP.

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Booth #: 218

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E-mail: kate_koerber@pall.com Website: www.pallwater.com

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Booth #: 614 Contact: Lydia Ebert Phone: 954-917-1886

E-mail: lebert@parkson.cm Website: www.parkson.com

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Contact: David Martin Phone: 540-353-4792

E-mail: dmartin@prochemwater.com Website: www.prochemwater.com

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PROCHEMTECH INTERNATIONAL, INC.

Booth #: 315

Contact: Timothy Keister, CWT FAIC

Phone: 814-265-0959 Fax: 814-265-1263

E-mail: tek@prochemtech.com Website: www.prochemtech.com

ProChemTech was founded in 1987 to provide commercial and industrial clients with a single source for water and wastewater treatment chemicals, equipment, systems, and professional on-site service. Our core personnel all formerly worked at the Brockway Glass R&D Center, so the Company has always had an innovative approach to water related problems as demonstrated by the eleven patents obtained to date. Almost all chemical products are manufactured to order in the two Company owned manufacturing...

PROMINENT FLUID CONTROLS, INC.

Booth #: 101

Contact: Joe Kramer Phone: 412-787-2484 Fax: 412-787-0704

E-mail: kramer.joe@prominent.com

Website: www.prominent.us

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

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PROTEC-ARISAWA AMERICA

Booth #: 411

Contact: Richard Chmielewski

Phone: 760-599-4800

E-mail: RDC@protec-arisawa.com Website: www.Protec-Arisawa.com

Protec Arisawa is the global leader in design and manufacture of Fiber Reinforced Pressure vessels for membrane filtration systems. We are an international company producing in California, Spain and Japan and a global sales network that provide expert technical assistance. We produce vessels for desalination, municipal, industrial, and commercial markets. Our facilities are fully ASME certified to produce Section X pressure vessels.

PULSAFEEDER

Booth #: 209 Contact: Kim Reid Phone: 1-800-333-6677

E-mail: kreid@idexcorp.com Website: www.pulsatron.com

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

PUROLITE CORPORATION

Booth #: 317/416 Contact: Don Downey Phone: 800-343-1500 Fax: 484-384-2763

E-mail: americas@purolite.com Website: www.purolite.com

Purolite is a leading developer, manufacturer and supplier of ion exchange, adsorbent and specialty resins. Headquartered in Pennsylvania, USA, we have ISO 9001 certified manufacturing facilities in the USA, China, and Romania and operate five R&D centers. Established in industrial and potable water treatment, Purolite brings more new products to the market than any other resin company. We focus exclusively on resin technology, and have the largest, most knowledgeable technical sales force.

Purolite can help solve your process challenges.

PWT/PIEDMONT

Booth #: 104

Contact: Ryan Furukawa/ Leo Tua Parra Phone: 858-945-7953/587-228-2103

E-mail: ryan.furukawa@pwtchemicals.com/Leo.TuaParra@

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Website: www.pwtchemicals.com/www.piedmontpacific.com

PWT focuses on chemical manufacturing and supply for the membrane industry, with a product line developed around its unique dendrimer-based antiscalant chemistry for scale and fouling control.

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Booth #: 401

Contact: Frank DeSilva Phone: 856-768-9600

E-mail: fdesilva@resintech.com Website: www.resintech.com

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RETEGO LABS

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E-mail: Imerrill@retegolabs.com

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Booth #: 313

Contact: Sydney Juzenas Phone: 604-628-6508 Fax: 604-676-2463

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Contact: Robert Bellitto Phone: 716-743-9000 Fax: 716-743-1220

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Booth #: 502

Contact: William Kunzman Phone: 205-655-7466 Fax: 205-655-7669

E-mail: billk@schreiberwater.com Website: www.schreiberwater.com

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SENTRY EQUIPMENT

Booth #: 612

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SOLENIS LLC

Booth #: 307

Contact: Michael Bluemle Phone: 302-440-1158

E-mail: mbluemle@solenis.com Website: www.solenis.com

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

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SOUTHERN RESEARCH

Booth #: 105

Contact: Young Chul Choi Phone: 205-704-3479

E-mail: ychoi@southernresearch.org Website: www.southernresearch.org

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STANTEC

Booth #: 312 Contact: Rob Simm Phone: 602-438-2200 Fax: 602-431-9562

E-mail: rob.simm@stantec.com Website: www.stantec.com/water

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STENNER PUMP COMPANY

Booth #: 602

Contact: Stacy Nelson Phone: 904-642-1012 Fax: 904-642-1012

E-mail: snelson@stenner.com Website: www.stenner.com

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 tool less tube replacement. Visit the booth for hands-on demonstrations.

SUEZ WATER TECHNOLOGIES & SOLUTIONS

Booth #: 203/205

Contact: Sales Coordinator North America

Phone: 905-465-3030

E-mail: sandra.brunell@suez.com

Website: www.suezwatertechnologies.com

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

SUMITOMO ELECTRIC INDUSTRIES LTD.

Booth #: 109

Contact: Takashi Harada Phone: 647-546-5582

E-mail: takashi.harada@bell.net

Website: www.sumitomoelectricusa.com/poreflon

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

SWAN ANALYTICAL USA

Booth #: 113

Contact: Steve DeVilleneuve Phone: 847-229-1290 Fax: 847-229-1320

E-mail: info@swan-analytical-usa.com Website: www.swan-analytical-usa.com

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

THERMAX, INC.

Booth #: 305 Contact: Ajit Dighe Phone: 248-921-0779 Fax: 281-600-1336

E-mail: ajit@thermax-usa.com

Website: www.thermaxglobal.com

Thermax Inc is part of Thermax Group, a company providing a range of engineering solutions to the energy and environment sectors of our global market. We operate globally through 19 International offices, 12 Sales and Services offices, and 14 manufacturing facilitates, 8 of which are in Indian and 6 overseas. Our Ion Exchange Resin Division falls under our Chemical portfolio. Thermax Chemicals is one of the leading manufacturers of a gamut of TULSION brand...

TOMORROW WATER (BKT)

Booth #: 410

Contact: Jon Liberzon

Phone: 714-578-0676 Ext. 124

E-mail: jl@bkt21.com Website: www.bkt21.com

BKT produces the FMX system, a proprietary anti-fouling membrane filtration platform specifically designed for challenging high-solids, high viscosity & high scaling applications. FMX is a paradigm-shift solution for solid-liquid separation, product concentration, and resource recovery. FMX technology is being demonstrated at several power plants for FGD wastewater treatment. With its anti-fouling mechanism and membrane, FMX can achieve up to 80% volume reduction in single-pass mode to meet discharge (2015 ELG) limits.

TURNER DESIGNS HYDROCARBON INSTRUMENTS, INC.

Booth #: 300

Contact: Chip Westaby Phone: 559-253-1414 Fax: 559-253-1090

E-mail: sales@oilinwatermonitors.com 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

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U.S. WATER

Booth #: 611

Contact: Jeff Carlson Phone: 866-663-7633 Fax: 763-553-0613

E-mail: info@uswaterservices.com Website: www.uswaterservices.com

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UNIVAR

Booth #: 316

Contact: John Fulcher Phone: 847-452-4745

E-mail: john.fulcher@univar.com

Website: www.univar.com

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USP TECHNOLOGIES

Booth #: 304 Contact: Rick Fuller Phone: 630-391-2669

E-mail: rfuller@usptechnologies.com Website: www.usptechnologies.com

USP Technologies vision is to enable our customers to meet their water quality objectives by providing eco-efficient solutions that reduce and recover costs, energy, resources and space. USP Technologies' specific mission is to develop cost effective, peroxygen-based technologies and full-service chemical treatment programs for municipal and industrial water and wastewater treatment applications that provide low-risk, value-added solutions to our customer partners.

VEOLIA WATER TECHNOLOGIES

Booth #: 201

Contact: Jill Browning
Phone: 1-800-337-0777
E-mail: water.info@veolia.com
Website: www.veoliawatertech.com

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.

WATERCO USA

Booth #: 116

Contact: Scott Maddox Phone: 706-524-5944

E-mail: scott.maddox@waterco.com

Website: www.waterco.com.au/water-treatment

Waterco is a leading manufacturer of FRP pressure vessels employed as media filters and contact chambers in a wide array of water treatment applications. Vessels can be built to 150 psi and are available in a wide range of sizes in both horizontal and vertical orientations. All vessels are available with deep-bed options to maximize media bed depth and volumes.

WATERCOLOR MANAGEMENT

Booth #: 309

Contact: Elena Peredkova Phone: 561-338-7452 Fax: 256-355-3070

E-mail: info@watercolormanagement.com Website: www.watercolormanagement.com

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

WESTECH ENGINEERING, INC.

Booth #: 114

Contact: Jake Blattman Phone: 801-265-1000 Fax: 801-265-1080

E-mail: info@wetech-inc.com Website: www.westech-inc.com

WesTech Engineering, Inc. is an employee-owned company that provides global industrial clients with reliable, cost-effective process solutions, installed on site or as a mobile unit, for their cooling water, hydrofracturing, water reuse, raw water pretreatment, and industrial wastewater treatment needs. Celebrating 45 years in liquids-solids separation technology and ISO 9001 certified, WesTech works with integrity to collaborate on project commitments in process solution design, project management, manufacturing, operations, and retrofits. The company's industrial products range...

WESTERN RO

Booth #: 115 Contact: Noemi Kis

Phone: 858-356-8155

E-mail: noemi@westernro.com Website: www.westernro.com

Western RO, Inc has been in operation since 2010. We are a wholesale supplier of Reverse Osmosis Membranes by brands such as Dow FilmTec, Hydranautics, Toray and many others. We ship Internationally and Domestic within the U.S. We provide quick quotes for lead times, pricing and freight options. (Usually same-day). We stock most products thus no lead times and quick shipping (usually next-day).

WIGEN WATER TECHNOLOGIES

Booth #: 605/606 Contact: Steve McSherry Phone: 800-448-4886 Fax: 952-448-4884

E-mail: steve.mcsherry@wigen.com

Website: www.wigen.com

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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