The 76th Annual

INTERNATIONAL WATER CONFERENCE®

NOVEMBER 15-19, 2015

Hilton in Walt Disney World Resort®,
Orlando Florida, USA

WWW.ESWP.COM/WATER

Official Conference Guide

Reliable, sustainable and economical solutions for industrial water treatment

Advanced water solutions for oil & gas, power, mining, municipal desalination and water reuse. With extensive experience in the US and all over the globe, IDE delivers on time, every time while caring for the environment. We are Your Water Partners.

Visit us at IWC booth 211-213

IDE Technologies | Your Water Partners

Delivering Excellence 50 YEARS Through Partnership

www.ide-tech.com

GE Power & Water
Water & Process Technologies

Your FGD plant is unique.

Make sure your water treatment solution is as well.

As a coal-fired utility, you need to mitigate the risks associated with new government regulations and technology introductions. To do that, you need a long-term water treatment vision that will meet your current and future goals.

At GE, we work to find the solution that works for you.

With experience in membrane, evaporative, biological and chemical solutions, GE can help find a solution that meets your plant's specific requirement and helps you manage water treatment plans today and tomorrow.

Learn more at **www.gewater.com**.

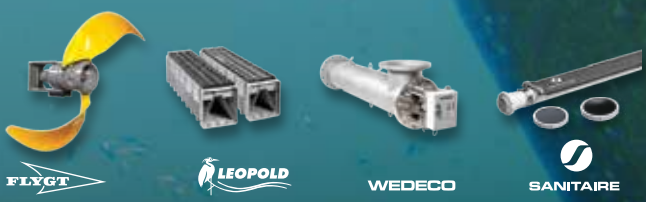
WE'RE ALL ABOUT WATER TREATMENT.

ONE COMPANY. STRONG BRANDS.

UNLIMITED OPPORTUNITIES.

Biological Treatment | Filtration & Clarification
UV Disinfection & Ozone Oxidation | Mixing Applications

Xylem offers a full spectrum of water and wastewater treatment solutions.



855-XYL-H2O1 (855-995-4261)
www.xyleminc.com/treatment

xylem
Let's Solve Water

Shallow Shell™ Technology

Uniform depth of functionality.
Every bead reacts at the same rate.

The Highest Performance

Our SST resins deliver the same throughput with reduced chemical regenerant usage and ultra-low leakage, shortening the length of the diffusion path and creating more rapid ion exchange.

The Best Economics

Regeneration is more complete requiring less regenerant to do the same job. The result is a group of resins with unsurpassed regenerant efficiency, lower leakage, and up to 40% increased rinse savings.

Minimum Environmental Impact

Systems using SST resins not only use less chemical regenerants they generate less waste.

Purolite®

www.purolite.com

FEDI®

INNOVATIONS

IN ADVANCED MEMBRANE PRODUCTS THAT ADDRESS THE MOST DEMANDING WATER CHALLENGES

Q-SEP®

CeraQ™

Headquartered in the USA, QUA enables OEM partners to provide cutting-edge systems and solutions to end users in industrial and infrastructure markets.

QUA's diverse product portfolio includes fractional electrodeionization (FEDI), polymeric (Q-SEP) and ceramic (CeraQ) ultrafiltration, and submerged membranes (EnviQ) for wastewater applications.

EnviQ™

IWC BOOTH 416

QUAGROUP.com

CONTENTS

	CRYSTAL	NORTH	CENTER	SOUTH
SUNDAY, NOVEMBER 15				
1:00–5:00 PM	CONTINUING EDUCATION WORKSHOPS - ADDITIONAL REGISTRATION REQUIRED			
5:00–7:00 PM	GET ACQUAINTED RECEPTION IN THE EXHIBIT HALL			
MONDAY, NOVEMBER 16				
8:00 AM	**ION EXCHANGE**	**MINE WATER**	**PRODUCED WATER**	**STEAM CORROSION**
11:00 AM	KEYNOTE SESSION IN INTERNATIONAL BALL ROOMS			
12:00 NOON	ATTENDEE LUNCHEON IN THE EXHIBIT HALL			
1:15 PM	**CHEMISTRY FOR STEAM TURBINES**	**MEMBRANES**	**PRODUCED WATER TREATMENT/DISPOSAL**	**TRACE CONTAMINANTS**
5:00–7:00 PM	ATTENDEE RECEPTION IN THE EXHIBIT HALL			
TUESDAY, NOVEMBER 17				
8:00 AM–12:00 NOON	**EVOLUTION OF INDUSTRIAL WASTEWATER**	**CHALLENGES IN RECYCLING & REUSE**	**FGD WASTEWATER TREATMENT**	**FRAC WATER SUCCESS**

	CRYSTAL	NORTH	CENTER	SOUTH
12:00 NOON	ATTENDEE LUNCHEON IN THE EXHIBIT HALL			
1:15 PM	**HISTORY KEY TO TODAY'S APPLICATIONS**	**ZLD DESIGN TECHNOLOGIES**	**FGD BLOWDOWN WATER**	**ASME PANEL SESSION IMPROVING BOILER RELIABILITY**
5:00–7:00 PM	ATTENDEE RECEPTION IN THE EXHIBIT HALL			
WEDNESDAY, NOVEMBER 18				
8:00 AM	**PLANT COOLING TOWER WATER**	**POWER WASTEWATER CHALLENGES**	**WASTEWATER TREATMENT STRATEGIES**	**PRODUCED WATER MAKEUP & FEEDWATER**
1:00–5:00 PM	CONTINUING EDUCATION WORKSHOPS - ADDITIONAL REGISTRATION REQUIRED			
THURSDAY, NOVEMBER 19				
8:00 AM–12:00 NOON	CONTINUING EDUCATION WORKSHOPS - ADDITIONAL REGISTRATION REQUIRED			
1:00–5:00 PM	CONTINUING EDUCATION WORKSHOPS - ADDITIONAL REGISTRATION REQUIRED			

WELCOME TO THE IWC


Colleen M. Layman

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 76th Annual International Water Conference® (IWC) and the city of Orlando, FL. The IWC is the premier source of technical information and training in the industrial water and wastewater business today spanning numerous industrial sectors and addressing today's most relevant technical topics.

As always you will find our technical program filled with current hot topics in the industrial water and wastewater treatment world including produced water treatment for the oil and gas industry, fluidized gas desulfurization wastewater, water management and reuse, and zero liquid discharge systems in addition to more traditional technical areas such as ion exchange, cooling water treatment, steam generator chemistry, and membrane treatment. Our unique format that includes peer review and prepared discussions for virtually every paper presented reflects our commitment to ensuring that sharing and discussion of technical information is the primary focus of our conference. Our technical program is really the heart and soul of our conference and I'd like to thank this year's Technical Program Chairperson, Debbie Bloom, for all of her hard work in coordinating this year's program. This is one of the most time consuming positions on the IWC Executive Committee and Debbie has done an excellent job in developing the program and coordinating with all of this year's Session Chairs, Discussion Leaders, Authors, and Discussers. A big thanks to all of those folks who have had a role in developing this year's technical program for their willingness to share their time and knowledge of the industry with all of us.

Our conference also offers the opportunity for you to gain more in-depth expertise by attending extended 4-hour training sessions presented by experts in the field and covering a wide-range of topics for beginner to experienced level water and wastewater treatment professionals. This year we are pleased to offer more than 25 different opportunities for you expand your knowledge base and to earn continuing education credits. Every year the list of our workshop offerings continues to grow and I'd like to thank Mike Sheedy for his hard work in putting together a great set of courses for us this year. The workshops are held post conference on Wednesday afternoon and Thursday and, for the first time this year, pre-conference on Sunday afternoon. 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 course of the conference.

We have again sold out our Exhibit Hall, which showcases the latest advancements in water and wastewater treatment. Be sure to take advantage of this great opportunity to meet with over 100 different company exhibitors and learn more about what's new in industrial water and wastewater treatment. A big thank to all of our exhibitors for their

continued support of the IWC. Lunch and other 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.

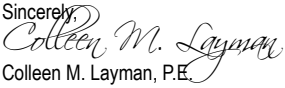
In addition to a full technical program, we are fortunate to have Snehal Desai, Global Business Director for Dow Water & Process Solutions, as our keynote speaker. We always strive to have our keynote address complement our technical program by being an educational and informative presentation on a highly relevant topic. We hope that you will join us for his keynote address on Monday morning and will find Mr. Desai's presentation to be both inspiring and informative.

On a sad note, I would like to take this opportunity to recognize and remember Steve Gagnon, who was originally the 2015 IWC General Chairperson, but who passed away earlier this year. Steve was a critical part of the planning effort that brought this year's conference to life and his passion, commitment, and expertise are definitely missed. He will be in my thoughts, and I am sure many of your thoughts, as we conduct our business this week in Orlando.

A conference of this size does not get put together without the hard work of a lot of people. I want to thank the ESWP staff, Dave Teorsky, Michael Gaetano, and Cori Weber. The success and growth that the conference continues to experience each year is a direct result of all their hard work. You will always find at least one of them at the registration desk during operating hours to answer any questions or provide any help that you might need. 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, workshops, and marketing to make sure the conference runs smoothly. I would also like to thank the Advisory Council companies that offer their support, expertise, and guidance to us to maintain 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 cafe 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 cherish your chance to network with and learn from everyone that you meet here. I look forward to talking with many of you during our time in Orlando and I, and the rest of the IWC Executive Committee, welcome your feedback as we use this information to make improvements in future conferences. The end of the 2015 IWC marks the beginning of the 2016 conference where we look forward to seeing you again in San Antonio.

Sincerely,



Colleen M. Layman, P.E.
HDR, Inc.
General Chair, 76th Annual International Water Conference

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, Colleen M. Layman, P.E. for her leadership thru the planning year!

George Abrahim, P.E.
Veolia Water Technologies
Moon Township, PA

Robert Applegate
Graver Water Systems, LLC
New Providence, NJ

Wayne Bernahl
W. Bernahl Enterprises Ltd.
Elmhurst, IL

Debbie Bloom
Nalco Champion, An Ecolab Company
Naperville, IL

Ken Dunn
Solenis
Skrewsbury, MA

Michael Gottlieb
ResinTech
West Berlin, NJ

Colleen M. Layman, P.E.
HDR, Inc.
Janesville, WI

John Lucey, Jr., P.E.
McKim and Creed
Raleigh, NC

Dennis McBride
Fluor Enterprises, Inc.
Greenville, SC

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

Paul Puckorius
Puckorius & Associates, Inc./Water Training Serv.
Arvada, CO

Michael B. Ryder, P.E.
Chester Engineers
Moon Township, PA

James Sabzali
Aldex Chemical Company Ltd.
Granby, QC

Patricia Scroggin
Burns & McDonnell
Kansas City, MO

Michael Sheedy
Eco-Tec
Pickering, ON

Jim Summerfield
DOW Chemical Company
Edina, MN

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

###

ADVISORY COUNCIL

The IWC Advisory Council is comprised of a group of companies that provide ongoing support for the planning of a successful conference. Membership is open to companies that have an interest in water & wastewater treatment, and are willing to make a commitment to participate in two meetings a year to plan the IWC.

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

Aquatech International Corp.
Patrick Randall
Canonsburg, PA
www.aquatech.com

Athlon Solutions
Charles Kuhfeldt
Houston, TX
www.athlonsolutions.com/

AVANTech, Inc.
Jim Braun
Columbia, SC
www.avantechinc.com/

Avista Technologies
Mike Graver
Lewes, DE
www.avistatech.com/

Baker Hughes
Sidney Dunn
Sugar Land, TX
www.bakerhughes.com/

Bechtel Power
Michele Funk
Frederick, MD
www.bechtel.com/

Black & Veatch
Mike Preston
Overland Park, KS
bv.com/

Bowen Engineering
Michael Soller
Indianapolis, IN
www.bowenengineering.com/

Burns and McDonnell
Andrew Erickson
Kansas City, MO
www.burnsmcd.com/

CGC, Inc.
Chris Graham
Calgary, AB
www.cgcinc.net/

CH2M Hill
Tom Higgins
Chantilly, VA
www.ch2m.com/

ChemTreat, Inc.
Raymond M. Post, P.E.
Langhorne, PA
www.chemtreat.com/

Chester Engineers
Jerry Penland
Moon Township, PA
www.chester-engineers.com/

De Nora Water Technologies
Charles J. Guzelli
Woodland Hills, CA
www.severntrentservices.com/

Degremont North America-Infilco
William Tuck
Dundas, ON
www.degremont-technologies.com/

Devon
Ivan Morales
Calgary, AB
www.devonenergy.com/

continued on next page...

ADVISORY COUNCIL (CONTINUED)

Dow Chemical Company
Clifford Gilbert
Westborough, MA
www.dow.com/en-us/water-and-process-solutions

Duke Energy Corporation
Joseph Potts
Cincinnati, OH
http://www.duke-energy.com/

Eco-Tec Inc.
Michael Sheedy
Pickering, Ontario
eco-tec.com/

Epicor Incorporated
Phil D'Angelo
Linden, NJ
www.epicorinc.com/

Evoqua
Douglas Gillen
San Francisco, CA
www.evoqua.com/en/Pages/default.aspx

Fluor Enterprises, Inc.
Rafique Janjua
Sugar Land, TX
www.fluor.com/pages/default.aspx

Fort Bend Services, Inc.
James Dromgoole
Stafford, TX
www.fortbendservices.com/index.html

French Creek Software
Robert Ferguson
Phoenixville, PA
www.frenchcreeksoftware.com/

GAI Consultants, Inc.
Scott Quinlan
Cranberry Township, PA
gaiconsultants.com/

GE Water and Process Technologies
Lanny Weimer
Ellicott City, MD
www.ge.com/

Golder Associates Inc.
Paul Pigeon, PE
Lakewood, CO
www.golder.com/location_map.php

Graver Water Systems, LLC
John Yen
New Providence, NJ
www.graver.com/

HDR Inc.
John Van Gehuchten
Pittsburgh, PA
www.hdrinc.com/

Hydranautics
Tony Fuhrman
Pittsburgh, PA
www.membranes.com/index.php

Johnson March Systems
John Sands
Ivyland, PA
www.johnsonmarch.com/

Kalluri Group, Inc.
Ramesh Kalluri
Houston, TX
www.kalluri.com/

LANXESS Sybron Chemicals, Inc.
Ed Nace
Birmingham, NJ
lanxess.com/en/corporate/home/

MPW Industrial Services
Justin Pierce
Hebron, OH
www.mpwservices.com/

Nalco Company
Jane Kucera
Naperville, IL
www.nalco.com/

newterra
Harry Cummings
Trooper, PA
www.newterra.com/

continued on next page...

ADVISORY COUNCIL (CONTINUED)

Public Services of New Hampshire
Richard Roy
Bow, NH
www.eversource.com/content/

Purolite Corporation
Donald Downey
Paris, ON
www.purolite.com

ResinTech
Peter Meyers
West Berlin, NJ
www.resintech.com/

Samco Technologies Inc.
Richard Posa
Buffalo, NY
www.samcotech.com/

Sargent & Lundy, LLC
Diane Martini
Chicago, IL
www.sargentlundy.com/home/

Solenis
Michael Bluemle
Wilmington, DE
http://solenis.com/en/

Southern Research Institute
Corey Tyree, Ph.D.
Birmingham, AL
www.southernresearch.org/

SWAN Analytical USA
Randy Turner
Wheeling, IL
www.swan-analytical-usa.com/

Tetra Tech, Inc.
Jonathan Shimko
Pittsburgh, PA
www.tetratech.com/en/water

Thermax
Cindy Gresham
Northville, MI
www.thermax-usa.com/

TriSep Corporation
Lyndsey Wiles
Goleta, CA
www.trisep.com/

Turner Designs Hydrocarbon Instruments
Chip Westaby
Fresno, CA
www.oilinwatermonitors.com/

US Water Canada
Michael Reniak
Fort Saskatchewan, AB
www.uswaterservices.com/

Veolia Water Technologies
Bill Willersdorf
Moon Township, PA
www.veoliawaterst.com/en

WesTech Engineering, Inc.
Bill Moore
Salt Lake City, UT
www.westech-inc.com/

Wigen
Steve McSherry
Chaska, MN
www.wigen.com/

Wunderlich- Malec
Brad Spindler
Green Bay, WI
www.wmeng.com/

###

MEDIA PARTNERS

Thank you to the media partners of the 2014 International Water Conference®, through their support and marketing efforts, we are able to introduce the IWC to more audiences! Thank you!

Process Cooling
www.process-cooling.com

Chemical Engineering
www.che.com/themagazine

Water & Wastes Digest
www.wwdmag.com

Ultrapure Water Journal
www.ultrapurewater.com

PowerPlant Chemistry Journal
www.ppchem.net

Pollution Equipment News
www.rimbach.com/cgi-bin/fronts/pen/frontpendisplay.idc

The Water Network
water.tallyfox.com/mosaic

GWI/AWI
www.desalination.com

Pollution Engineering
www.pollutionengineering.com

Chemical Processing
www.chemicalprocessing.com

Water Conditioning & Purification
www.wcponline.com

Sea Technology
www.sea-technology.com

BlueTech Research, an O2 Environmental Company
www.bluetechresearch.com

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 more than 900 end users, researchers, practicing engineers, managers, educators, suppliers and contractors. It is dedicated to advancing new developments in the treatment, use and reuse of water for industrial and engineering purposes.

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

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

Conference Proceedings
All registered attendees (except Exhibit Only) will receive a CD containing the Official Conference Proceedings of the 76th Annual International Water Conference®. The CD will be direct mailed to you approximately 2 months following the conference.

Call for Papers
To participate in the 2016 International Water Conference® as a presenter, please watch for the opening of the IWC Call for Papers. The Call for Papers is done exclusively on-line through the IWC home page at www.eswp.com/water. For more information on how to become active in the IWC as an Exhibitor, Advisory Council Company, Executive Committee member, please contact ESWP at 412-261-0170 ext. 10 or by e-mail at eswp@eswp.com.

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

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

Attendee Receptions
To help you enjoy your stay in Orlando during the 2015 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!

If your spouse is accompanying you to the IWC, please properly register him or her at the Registration Desk to gain admittance into these events.

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 16 at the Hilton Hotel. You will be able to meet and network with other spouses to plan your own agenda of activities. Please complete registration form at the IWC Registration Desk. Advance registration is required.

IWC Fun Run
Come join us for the 29th 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 17 at 7:00 AM Sharp; meet in the hotel lobby at 6:45 AM. Distance: 3 miles – flat and easy course.

Merchandise
IWC shirts and hats are available for sale! Pre-prints for (most) technical presentations are available at the Registration Desk. Pre-prints can be purchased for $5.00 per copy, or $35 per 1GB 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. In addition, important local phone numbers have been printed on the back of your badge for your use. To avoid any confusion with access to the events, please refrain from personalizing your official IWC name badge with any stickers, ribbons, etc., not provided by the Registration Desk.

Please note that exhibit hall only registrations are only entitled to attend functions in the exhibit hall. They are not permitted to attend technical 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 19. 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.

Social Media
Keep up on the latest details of the conference by using #IWC15 and follow @EngSocWestPA on Twitter, or like us on Facebook: International Water Conference

Future Conference Dates
See you next year on November 6-10, 2016 - Marriott Rivercenter, San Antonio, TX

Info Share Suites

VEOLIA WATER TECHNOLOGIES

Monday, November 16, 7:00–8:00 AM, in the Camelia Room on the Mezzanine Level. Join Veolia Water Technologies for Breakfast at 7:00AM on Monday, November 16th, to learn more about our CoLD™ process that uses HPD® evaporation and low-temperature crystallization to treat wastewaters containing lots of high solubility salts. The advantages are numerous: Less Sludge, Lower Energy Requirement, Simple System, Less Operator Attention, Robust System and Lower Capital Cost. Space is limited! Reserve your spot by emailing renee.look@veolia.com or stop by the Veolia Water Technologies booth #500 on Sunday evening to make your breakfast reservations!

DOW WATER & PROCESS SOLUTIONS

Dow Water & Process Solutions is driving performance in ion exchange resin, reverse osmosis, ultrafiltration and high-solids filtration technology. Visit the Dow Pit Stop on Tuesday, November 17th in the Quince Room on the Mezzanine Level. Visit booth #115 to learn more.

- 7:00–8:30 PM: Refreshments, food and ask questions to Dow experts
- 6:30–8:30 PM: Drinks, appetizers and signing with Austin Dillon, race driver of the No.3 Dow Chevrolet. Register to win diecast cars and race jersey.
- Open from 7:00 AM–8:30 PM; available to all attendees,

ASME CO-MEETINGS

Executive subcommittee: Sunday, Nov. 15, 7:00–9:00 PM

Produced Water Task Group: Tuesday, Nov. 17, 6:00–9:00 PM

Main Committee: Wednesday, Nov. 18, 2:00–5:00 PM

Main Committee: Thursday, Nov. 19, 8:00 AM–12:00 noon

Check at the IWC Registration Desk for room assignments!

IWC SPONSORS 2015

Thank you to our financial sponsors of the 2015 International Water Conference®.

Platinum Level

IDE Technologies Your Water Partners

Delivering Excellence 50 YEARS Through Partnership

Bronze Level

ChemTreat

DOOSAN

McKIM&CREED ENGINEERS SURVEYORS PLANNERS

HDR xylem

SPANNING THE SPECTRUM WITH ION EXCHANGE

Time: 8:00–11:00am; Room: Crystal

IWC Rep: Jim Sabzali, Aldex Chemical Company Ltd., Granby, QC, Canada

Session Chair: Frank Desilva, ResinTech, West Berlin, NJ

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

Ion exchange resins (IXR's) are a versatile group of products with known performance characteristics in "thin waters." However, efficiency and performance changes when used in a high TDS environment. This session spans the spectrum where IXR's are used with one author revisiting continuous ion exchange (CIX) technology patented in the1950's including a novel approach to turn its waste stream into a revenue stream. Another author uses 21st century simulation technology to predict how resins will respond in a high TDS environment while the final paper uses empirical data to support conclusions on resin selection.

8:00 AM

IWC 15-01: CSG Produced Water Purification via Ion Exchange with Brine Conversion to Regenerant Chemicals

Richard Dennis, De Nora Water Technologies, Tampa, FL

A new source of natural gas, coal seam gas (CSG) from deep coal deposits, was developed in the 1990's, first in Wyoming's Powder River Basin of. Unlike other gas and oil formations, CSG seams require pumping of water to extract the gas, about 1 to 4 barrels of water per MCF of gas. This water is natural but it contains elevated levels of sodium, bicarbonate, and in some regions, chlorides. Reinjection is too expensive, and the water is too high in salinity for discharge into the environment or for use in irrigation.Working with EMIT Technologies in 2002, Severn Trent Services (STS) developed and commissioned a Higgins Loop™ continuous ion exchange (CIX) system near Sheridan, WY to treat CSG water and concentrate the salts into a very small brine stream for disposal. EMIT provided CIX water treatment to the industry purifying as much as 350,000 barrels per day. It was the only commercial process permitted to discharge water by the state's DEQ.Production in the Queensland, Australia CSG basins started over 6 years ago and is now the largest source of CSG. Queensland water is more saline than that in Wyoming and also contains chlorides. STS successfully piloted the process in 2012, testing waters from 4 different producers. Today, STS is working with partners to commercialize the process on a service model approach. The ion exchange treatment is integrated with Severn Trent De Nora's chlor alkali systems which converts the spent brine regenerant into acid and caustic chemicals for reuse. It produces excess chemicals which are needed in the region for RO plant pretreatment and alumina processing.

Discusser: D. Hartwick, Buckman, North Lancaster, ON, Canada

8:50 AM

IWC 15-02: Softening Produced Water with High TDS Levels of Up to 15,000 ppm to Hardness Levels Below 0.1 ppm Using NaCl Regenerated Softeners

Michael Gottlieb, ResinTech Inc., West Berlin, NJ USA

This paper is a demonstration of simulation technology, functioning as a high speed pilot plant, and providing design information for counter current regeneration of softeners to treat influents with salt concentrations up to and beyond 15,000 ppm while producing effluents with less than 0.1 ppm hardness. All performance data in this paper was generated by MISTX, a unique software program that accounts for the effects of salt dose and purity, influent TDS and hardness levels, resin properties and other variables including controlled variations of run lengths on softener performance

Discusser: Bill Moore, GAI Consultants, Inc.,

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-03: Chelating Resin Selectivity in High Solids Aqueous Media

Rudy Labban, Infilco Degremont, Richmond, VA

Selective ion exchange resins promise higher contaminant selectivity and loading capacities. Resin vendors usually determine selectivity and loading capacities using simple aqueous matrices. The presence of high dissolved solids (TDS) affects the behavior of the resin and may reduce its capacity. A better understanding of the limitations of existing resins in terms of selectivity and capacity may enhance the selection process and promote choosing a resin that minimizes co-adsorption, therefore reducing O&M costs.

Equilibrium and column studies were performed to determine matrix effects on adsorption capacities of 3 target ions (boron, hexavalent chromium and mercury). Three resins from different manufacturers were compared for each of the target ions. The studies were performed using tap water and a synthetic water containing non-target anions and cations (15,000 ppm Na, 500 ppm Ca, 1,000 ppm Mg, 20,000 ppm Cl, 5,000 ppm SO4). Selectivity coefficients were calculated and compared across resins to choose the most appropriate resin.

Mercury removal in high TDS water decreased between 35 and 60% when compared to removal in tap water. Boron removal in high TDS water decreased between 20 and 35% when compared to removal in tap water. We observed no reduction in the removal of Chromium IV in the case of weak base anion (WBA) resins and a 25% reduction in the case of strong base anion (SBA) resin in high TDS water. There was no consistency in reporting resin loading capacities among manufacturers. Manufacturer reported loadings correlated with observed equilibrium loadings in tap water for some manufacturers and with kinetic loadings in high TDS water for others. Loadings on resins made by different manufacturers but having the same functional groups diverged significantly which may indicate the importance of the manufacturing process. Resins that showed higher loadings in tap water did not necessarily have the highest loading in high TDS water.

Discusser: Jeff Tate, Agape Water Solutions Inc., Harleysville, PA

RECENT ADVANCEMENTS IN MINE WATER TREATMENT TECHNOLOGIES

Time: 8:00–11:00am, Room: Int'l Ball Room North

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

Session Chair: Tony Vaughn, Monsanto, St. Louis, MO

Discussion Leader: Jay Harwood, GE Water & Process Technologies, Oakville, ON, Canada

This session presents some groundbreaking technologies for the treatment of water outfall from mining facilities that present a myriad of challenges to meet environmental limits. The session opens with a presentation on an improved method for the real-time measurement of sulfate from mine water that is expected to greatly improve discharge and remediation process control monitoring. In another instance, a novel electrochemical oxidation process provides improved reliability and significant cost reductions in the removal of ammonia from mine water impacted by blasting residues. The morning session will conclude with a review of selenate removal using a novel iron based adsorption media. Together these technological advancements offer great potential value in future water treatment processes, and the session presentations and discussion provide an excellent opportunity for more detailed learning on these subjects.

8:00 AM

IWC 15-04: Characterizing Fine Particle Water Filters

Ben Orton, Piyush Soni and Scott Burr, The Dow Chemical Company, Midland, MI; Abhishek Shrivastava, Clean Filtration Technologies LLC, Menlo Park, CA

TEQUATIC™ PLUS Filters are a family of self-cleaning filters offered by The Dow Chemical Company that can operate with feed streams containing high levels of total suspended solids (up to or greater than 10,000 mg/L) while providing high filtrate flow rates (20-400 gallons per minute). These filters are used in industrial wastewater treatment applications to target the rejection of solids 15 µm or more in size. Various factors affect the filter's ability to reject solids, including the nature of flow, the feed stream contaminant type and amount, and filter media. The flow inside the filter is highly turbulent and requires detailed experimentation to characterize its performance metrics such as pressure drop, flow rates, and filtration efficiency. Designed experiments were conducted and data was analyzed using statistical software package to better understand these performance metrics. Empirical models were built that expanded understanding throughout the experimental space. We uncovered a trade-off between the flow rate and filtration efficiency, understood factors that have most positive effect on the filtration performance and also learned the point of diminishing returns. The project utilized an unconventional characterization approach that combined hydraulic experiments, particle imaging techniques and statistical data analysis.

Discusser: Dr. Claudia C. Pierce, GE Power & Water, Trevose, PA

8:50 AM

IWC 15-05: Selenate Reduction from Mine Water by a Physical/Chemical Process

Kashi Banerjee, C.D Blumenschein, P.E., BCEE; S. Petrovich; and J.C. Schrader, Veolia Water Technologies, Moon Township, PA; H. Buisson, Veolia Water Technologies, Cary, NC

The selenium treatment system utilizes a filtration and adsorption process. A proprietary iron-based media was used as the adsorbent. Results reveal that the adsorbent is capable of removing selenium to ≤5 µg/l. The adsorption capacity of the media was not affected by the presence of co-occurring contaminants. TCLP test results reveal that the spent media can be disposed as a non-hazardous material.

Discusser: Brandon Kern, The DOW Chemical Company, Midland, MI

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-06: Innovative Sulfate Measurement for Mine-Influence Waters

Nicholas Ergang, and Ronald V. Davis, Ph.D. Nalco Company, Naperville, IL

The degradation of pyritic ore in waste rock piles and from exposed mine surfaces results in high concentrations of sulfate in both natural and anthropogenic water systems. The combination of increased sulfate concentrations in mine-influenced water and more stringent discharge regulations has resulted in the need for more routine monitoring of the sulfate levels in mine effluents and process waters. Traditional methods involve routine sampling followed by turbidity analysis via barium sulfate precipitation or IC analysis. Automation of barium sulfate precipitation typically results in cell fouling after repeated analyses. This paper describes a new on-line method utilizing Nalco TRASAR technology to effectively measure the sulfate concentration with little to no dilution of the water. The method is capable of reliably measuring a wide sulfate concentration range with a resolution of 10 mg/L and can be fully automated. The system can be wirelessly accessed remotely to investigate alarms, determine instrument conditions, download data or alter instrument operations.

Discusser: John Pugh, Monsanto, St. Louis, MO

PRODUCED WATER HANDLING FOR RE-INJECTION AND RE-USE

Time: 8:00–11:00am; Room: Int'l Ball Room Center

IWC Rep: Mike Ryder, Chester Engineers, Moon Township, PA

Session Chair: Chip Westaby, Turner Designs Hydrocarbon Instruments, Fresno, CA

Discussion Leader: Randy Harney, Fluor, Aliso Viejo, CA

To classify Produced Water as a single type of water can get chemical and equipment suppliers as well as oil field operators in a difficult position. Produced water make up will be different for each oil field and the disposal will also vary by location. This session will look at some of the issues and solutions for selecting treatment methods, corrosion mitigation and how to select re-injection locations for the water.

8:00 AM

IWC 15-07: Corrosion Mitigation of Carbon Steel Pipeline in Oil Sand

Jasbir S. Gill, Ph.D., Nalco Champion an Ecolab Company, Naperville, IL

Extraction of oil from Oil sands is a high water demanding enterprise and water sources are scarce and impaired. Water reuse is an absolute necessity which requires water moving from one site to another site. These inter and intra-site pipelines are generally made up of carbon steel. The objective of this study is to develop a proper water treatment able to minimize any corrosion issues during water transport in these mild steel pipelines. The holistic approach to corrosion treatment requires addressing all possible corrosion mechanisms such as water chemistry, temperatures, micro bio induced (MIC), suspended solids for under-deposit corrosion and galvanic corrosion (coupling on dissimilar metals). Corrosion studies were carried out using weight loss measurement as well as well microscopy surface analysis in order to guarantee the treatment efficiency against generalized and localized corrosion (pitting). Actual plant water from one of the oil sand sites was used for corrosion and micro bio study. The right dosage of corrosion inhibitors may vary according to water composition and characteristics of each system. The results from both traditional zinc phosphate and no P program are reported.

Discusser: Milton Crossen, Evoqua Water Technologies, La Mirada, CA

8:50 AM

IWC 15-08: Optimizing Produced Water Treatment for Re-injection

Howard McCarthy, Tetra Tech, Denver, CO

Oil and Gas Operators are carefully evaluating capital and operational costs and looking for ways to produce more oil and gas at less cost. Produced water treatment is one of the areas being scrutinized by operators to ensure the systems are fit-for- purpose and operated in the most efficient manner possible. Treatment systems that are either too robust or inadequate represent cost inefficiencies which will

have a negative impact on the bottom line, particularly at today's prices for oil and gas. Produced water end uses vary but much of the water is re-injected for enhanced oil recovery or disposal. This paper will evaluate key considerations that effect the selection of the treatment process and level of treatment required for re-injection. Key considerations include protection of the receiving formation and protection of the equipment and piping systems. Designing a treatment process that accounts for these important factors will result in an injection program that is a long term benefit to the operator and has the greatest potential for sustained injection flows and pressures that remain under the formation fracture pressure.

Discusser: Josh Lawrence, Fluor, Calgary, AB, Canada

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-09: Disposal in the Unconventional Oil and Gas Sector: Challenges and Solutions

Jon Fennell, Ph.D., P.Geol., Integrated Sustainability Consultants Ltd., Calgary, AB, Canada

Disposal of liquid wastes generated during extraction of unconventional oil and gas resources in North America is increasingly becoming a constraint to development. Currently, the bulk of these wastes are disposed of by injection into deep bedrock formations. In certain development areas, the presence of suitable disposal formations is scarce. To address this challenge, a process of identifying high-value disposal targets (i.e., formations and locations) was developed using a combination of multi-criteria analysis (MCA) and geospatial mapping. This paper will outline the process developed to identify potential disposal targets to support oil sands development in Alberta, and the results obtained.

Discusser: Latha Kumar, Fluor, Aliso Viejo, CA

STEAM CORROSION AND CONTROL

Time: 8:00–11:00am; Room: Int'l Ball Room South

IWC Rep: Ken Dunn, Solenis, LLC, Skrewsbury, MA

Session Chair: Bill Moore, WesTech, Salt Lake City, UT

Discussion Leader: Daniel Sampson, Worley Parsons, Folsom, CA

Steam corrodes the pipes and tubes that it passes through. At low corrosion rates this is actually a good thing as the corrosion creates and maintains a passive layer that lowers corrosion rates to almost zero. However, if corrosion rates are too high the passive layer is removed before it can form and the pipe can fail quickly. This session's papers address some of the conditions that cause high corrosion rates in the steam system. The first paper is a review of lessons learned in HRSG boiler tube failures. The second paper discusses the chemistry of passivation and film formation. The third paper discusses Flow Accelerated Corrosion – the causes and effects.

8:00 AM

IWC 15-10: The Importance of Steam Generation Chemistry Control and Monitorin Gas Illustrated by Case Histories

Brad Buecker, Kiewit Engineering & Design Company, Lenexa, KS

During the heyday of coal-fired power plant operation, many lessons were learned regarding proper water/steam chemistry control. These lessons were and continue to be greatly aided by research from such organizations as the Electric Power Research Institute (EPRI), the International Association of the Properties of Water and Steam (IAPWS), and others. Now, combined-cycle power plants dominate new plant construction. Unfortunately, many of the previously learned lessons from coal plants are not carried over to the heat recovery steam generators (HRSG) of combined-cycle units, even though these steam generators operate at high temperatures and pressures. A contributing factor to the lack of knowledge transfer is that combined-cycle units are often minimally staffed, with few or no chemistry-trained personnel. This paper utilizes case histories to outline issues that can arise due to improper chemistry control and monitoring, and examines such issues as waterwall tube failures due to corrosion and hydrogen damage, single-phase and two-phase flow-accelerated corrosion (FAC), superheater and reheater damage due to transport of impurities from the boiler, and turbine blade fouling and corrosion, also due to transport of impurities. It is a paper that will invite audience participation with additional examples.

Discusser: Cathie Loudenslager, Calpine, Houston, TX

8:50 AM

IWC 15-11: The Chemistry of Passivation And It's Role In Total System Corrosion Control For Industrial Boiler Systems

John Kelly, Ph.D., Water Treatment R&D Consulting, Inc., West Chicago, IL; D. Hartwick, H.B.Sc., Cornwall, ON, Canada

It was reported that there was a need to review the current experiments relating to alkalinity limits in industrial boilers before initiating a project to develop an Alkalinity Supplement/Addendum to the Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry in Modern Industrial Boilers. The addition of specified reducing agents/metal passivators assist in passive film formation. This paper will discuss these boiler system conditions in depth and will recommend a tightening of the coordinated phosphate range starting at ph 10. The role of the polymer in enhancing or maintaining passive film formation will also be covered.

Discusser: Kevin Boudreaux, Nalco, Cincinnati, OH

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-12: Flow Accelerated Corrosion in Steam Generation Power Plants: A Theoretical Approach to the Thermodynamics and Kinetics

Kenneth Chen, Fluor Enterprises, Inc., Aliso Viejo, CA; Dennis McBride Fluor Enterprises, Inc., Greenville, SC

Flow Accelerated Corrosion (FAC) is a process by which the protective magnetite film (Fe_3O_4) on the internal pipe/tube wall is chemically dissolved and removed by the flowing fluid. The cyclical formation of oxide and subsequent dissolution of this may lead to catastrophic failures in steam generation power plants. Some FAC failures have resulted in fatalities. Despite extensive research in the last 45 years to prevent catastrophic failures, such as a result of FAC, these failures still occur indicating that our knowledge and understanding of FAC can be further developed and expanded. FAC is caused by the environment to which the pipe/tube material, typically carbon steel, is exposed such as pH, flow velocity and turbulence, pipe geometry, oxygen content, and water chemistry. While there are other processes that cause pipe/tube degradation and catastrophic failures (e.g. erosion-corrosion, cavitation erosion, flashing-induced erosion, and shear stress erosion), this paper will focus on FAC and its impact on the internal pipe/tube walls in steam generation power plants. It will provide a brief overview and summary of the major research, lessons learned, and past experiences with FAC The paper will then quantify the chemical reactions, flow conditions, water chemistry, and various process conditions to provide an understanding of the theoretical limitations for the operating environment that is conducive for FAC. These theoretical limits will help engineers and operators design and operate a steam generation power plant that minimizes FAC and prolongs the life of the plant.

Discusser: Kevin Shields, Athlon Solutions, Manchester, MD

KEYNOTE SESSION

Chair: Colleen Layman, HDR, Inc.,

Time: 11:00–12:00noon; Room: Int'l Ball Room

2015 Awards of Distinction

The Annual Awards are presented to celebrate the following achievements in the water treatment industry. In addition to the presentation of the annual awards of distinction, we are pleased to have Snehal Desai as the Keynote Speaker of the conference.

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 Edward (Ted) Beardwood.

Paul Cohen Award:

As a memorial to Paul Cohen and his contributions to the power generation industry, the IWC is proud to recognize the authors of the most precise and innovative presentation in the field of power systems water technology that was presented at the 75th Annual IWC. This year, we honor Jim Robinson for his presentation of IWC 14-27, The Effects of Ammonia and Organic Amines on the Water Chemistry of Gas Turbine Heat Recovery Steam Generators and Associated Equipment.

Joseph A. Levendusky Scholarship:

This year, Epicor Inc. donated $1,500 to three scholarship recipients, Thomas Stanovich, Nicholas Kopp, and Josh Thompson, who are all furthering their education in water engineering.

Keynote Presentation:

Snehal Desai is the global business director for Dow Water & Process Solutions, a leader in sustainable separation and purification technologies, representing revenue of approximately $1 billion. In his role, Desai is responsible for developing and implementing the growth strategy for the business and leading the approximately 1,700 employees worldwide.

With industry-leading products, extensive expertise and experience in a broad range of water treatment applications, Dow is leading the discussion about critical issues related to water, food, pharmaceutical and energy resources with Desai at the forefront. Desai has more than 25 years of increasing leadership responsibility experience in the sales, marketing and business development of water, plastics, chemicals and renewable materials.

Highlighting his collaborative spirit, Desai is a founding member and past Chairman of the Board and Executive Committee member of the Association of Strategic Alliance Professionals (A.S.A.P.), and has held a variety of leadership positions there since 1998. He is also the Minnesota chapter president of The CMO Club, helping support the Club's mission to promote the exchange of ideas among CMO's and senior marketing heads.

He received bachelor's degrees in chemistry and chemical engineering from the University of Michigan and an M.B.A. from the Kellogg Graduate School of Management at Northwestern University.

MEMBRANES TACKLE NEW APPLICATION CHALLENGES

Time: 1:15–5:00pm; Room: Int'l Ball Room North

IWC Rep: Dennis McBride, Fluor Enterprises, Inc., Greenville, SC

Session Chair: Jane Kucera, Nalco, an Ecolab Company, Naperville, IL

Discussion Leader: Lyndsey Wiles, TriSep Corporation, Goleta, CA

Membranes have been used for decades now, but have traditionally treated relatively "clean," fresh water, make-up sources. As supplies of clean water dwindle and make-up quality declines, membranes are being tasked with treating more challenging sources of water. To tackle these challenges, advancements in membrane technology are being called upon to remove contaminants to a higher degree under highly fouling conditions. This session includes papers which discuss the treatment of make-up sources such as refinery wastewater and grey water, new membrane chemistries to improve rejection of contaminants, module design to minimize biofouling, and the improvement of membrane system efficiencies. This program will demonstrate how continued development in membrane technology will allow for membranes to meet the future challenges of declining

1:15 PM

IWC 15-13: Design and Piloting of an Integrated Membrane Facility for Treatment of Multiple Water Sources

Jacob (Jake) White, P.E., and Andrew Slotterback, P.E.
Burns & McDonnell, Kansas City, MO

As a temporary attempt to mitigate issues associated with the degrading water quality, a Midwestern refinery has operated leased trailer microfiltration (MF) and reverse osmosis (RO) membrane treatment units for several years. Realizing the cost savings and regulatory need for a lasting solution, the refinery engaged our team of engineers to accomplish their objectives:1) install a permanent water treatment plant facility to replace the current leased water treatment trailers; 2) resolve the water quality issues: and 3) address current concerns with further dewatering of the water aquifer. To begin solving for their needs, several water sources will be blended and routed to the new treatment facility including existing refinery wells, chloride remediation wells (installed to mitigate the potential impact of improperly injected waste), refinery wastewater, potable water, and gray water sources. This system will provide finished water at two water qualities: a lesser quality for cooling tower make-up water and higher quality permeate for boiler feed water. Key factors taken into consideration in meeting the needs of the refinery include:

- This facility will serve the entire refinery, providing both make-up water to the existing cooling towers and boiler feedwater to the boiler house.
- The process design is based upon water treatment technology including MF, nanofiltration (NF), and RO systems.

- A MF backwash reuse system will be installed to treat MF backwash thereby improving system recovery. This presentation will cover front-end loading phases one through three of this project and treatment system piloting.

Discusser: Brad Biagini, Veolia Water Technologies, Moon Township, PA

2:05 PM

IWC 15-14: New polyamide reaction chemistry for improved rejection of boron, nitrate, and silica in RO membrane process

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

The RO membrane process has been applied for the preparation of potable and industrial water applications. More recently, the World Health Organization (WHO) has published guidelines for critical ions like borate and nitrate in drinking water supplies. Likewise, the UltraPure water industry has demanded increased control of troublesome ions, like silica, to extremely low ppt levels. The classic RO membrane chemistry is based on a 0.1um polyamide barrier, and is common in nearly all commercial RO membrane products. More recently, a variant of this polyamide chemistry was introduced, and provides a more dense (higher cross-linked) barrier layer with a lower membrane surface charge. The resulting polyamide layer separates more on the basis of pore size/ solution diffusion than on anionic repulsion, resulting in improved rejection performance for troublesome ions like borate, nitrate and silicate. This allows the RO system to operate at a lower feed pH to achieve the same level of rejection. The difference in rejection performance allows RO systems to provide improved permeate quality at the same pH, or operate at a lower pH with the same rejection performance. The difference in pH levels can be monetized, providing the user with savings on NaOH addition. This paper will review present data demonstrating the improved rejection performance for specific ions like boron, nitrate, and silicate. In addition, the paper will provide case histories that demonstrate the savings in chemical addition (borate application), and the savings in regeneration costs in a downstream mixed bed operation, post RO process.

Discusser: Deb Mukhopadhyay, Consultant, Palo Alto, CA

2:55 PM COFFEE BREAK

3:15 PM

IWC 15-15: Long Term Operation Using Reverse Osmosis Brine for Backwashing Ultrafiltration Membranes

David Arias Peña, P.E. and Sonia Vila Cremer, P.E., Dow Water and Process Solutions, La Canonja (Tarragona), Catalonia, Spain

One of the most critical and important factors in water industry and its applications is the reduction of the total cost of the produced water. This research reviews the testing process and the results generated using Reverse Osmosis (RO) brine for Backwashing (BW) Ultrafiltration (UF). The

data obtained during experimentation allows concluding that the application of this cost-reducing concept is feasible, providing an equally sustainable and reliable operation as standard configuration for Ultrafiltration.

Discusser: Steve McSherry, Wigen Water Technologies, Chaska, MN

4:05 PM

IWC 15-16: Case Studies of PTFE-made Hollow Fiber Membrane Module for Oil-Containing Wastewater Treatment

Takafumi Shinozaki and Toru Morita, Sumitomo Electric Industries, LTD, Osaka, Japan; Millard Fore Innovation Core SEI Inc., San Jose, CA

PTFE (polytetrafluoroethylene) MF/UF membrane has a unique highly porous three-dimensional fibril structure not seen in other polymeric membranes. This structure traps oil droplets to individual fibers while the flow is not impeded. In addition PTFE is temperature resistant and exceptionally high chemical resistant. Its temperature resistance allows for treatment of raw water at higher temperature and the chemical resistance allows cleaning by harsh alkalis in pH ranging from 0 – 14, making it applicable for treatment of oil-containing wastewater. Several commercial installations of PTFE membranes are currently in operation for oil-containing wastewater such as oil refinery wastewater. An MBR commercial plant in an oil refinery of 6,000m3/d (1,100gpm) located in Asia started its operation mid-2013. Another MBR plant in a vehicle manufacturing factory of 550m3/d (100gpm) located in Southeast Asia, started its operation in early 2014. In both cases, oil and grease content in feed water is 10 – 20 mg/L with occasional upset in the system of 50-90mg/L. These processes do not include any specific pre-treatment to remove oil and grease while the membrane keeps oil and grease content in permeate to be less than 5mg/L even at an upset condition with stable flux and TMP. The permeate has SDI to be less than 3 and is directly charged to RO system for reuse application within the factory. There are additional similar projects both in commercial and pilot basis. The results indicates that PTFE MF/UF membranes can be a viable solution to oil-containing wastewater treatment, and also applicable to reuse application.

Discusser: Jacob Moen, Dow Water and Process Solutions, Edina, MN

TRACE CONTAMINANTS, A CLOSE LOOK AT HOW VARIOUS REGULATIONS AFFECT CHOICES FOR TREATMENT TECHNOLOGIES

Time 1:15–5:00pm; Room: Int'l Ball Room South

IWC Rep: Jim Summerfield, DOW Chemical Company, Edina, MN

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

Discussion Leader: John Schubert, HDR Engineering, Inc., Sarasota, FL

This Trace Contaminants Session mostly deals with the ways that regulations influence choices for treatment technologies used to remove trace contaminants from various waste streams. The first paper deals with a way in which site specific criteria can be used to influence where a specific discharge regulation might be set. The second paper deals with the ways that various technologies used to enhance compliance with air emissions standards can affect liquid wastes from FGD systems. The third paper also deals with FGD wastes but from the standpoint of the bigger picture of how changing regulations are dealt with by the Owners of Coal Fired Generating Stations. The final paper of the session covers an electro-adsorptive filter media used various trace contaminants from wastewater.

1:15 PM

IWC 15-17: Selenium Management: Site-Specific Regulatory Options and Best Treatment Technologies

Ryan Kirkland, Scott Hall and Pat Campbell, Ramboll Environ, Nashville, TN

This paper examines the 2014 revised draft USEPA aquatic life criteria for selenium, the basis of criteria, options for site-specific criteria derivation, and a case study in which fish tissue selenium concentrations near a fly ash discharge were used to demonstrate lack of reasonable potential to exceed ambient water quality criteria, resulting in selenium being removed from the discharge permit. Additionally, selenium treatment techniques are reviewed and evaluated

Discusser: Chuck McCloskey, Evoqua Water Technologies, Schaumburg, IL

2:05 PM

IWC 15-18: Effects of MATS Compliance Technologies on FGD Wastewater

Gary Blythe and Mandi Richardson, AECOM, Austin, TX; Chethan Acharya, Southern Company Services Birmingham, AL; Charles Dene, EPRI, Palo Alto, CA

This paper presents and discusses results from full-scale trials of several technologies for achieving mercury emissions compliance with the Mercury and Air Toxics Standard (MATS) or state mercury control regulations on coal-fired generating units that are equipped with wet flue gas desulfurization (FGD) systems. The paper focuses on the effects of various mercury control technologies on the chemistries of the wet FGD systems and of the chloride purge streams (wastewater) produced from these FGD systems. Mercury

control technologies represented in the results include bromine addition to the coal; powdered activated carbon (PAC) injection into the flue gas upstream of the particulate control device; inorganic or organic reduced-sulfur additives to the FGD system to control mercury re-emissions (conversion of the mercury from an oxidized state back to the elemental state in the FGD system); and PAC addition to the FGD slurry (either injected directly into the flue gas stream or into the slurry system) to control re-emissions. Impacts to the wastewater considered include changes in oxidation-reduction potential (ORP); mercury, selenium, and arsenic concentrations; selenium speciation; phase partitioning of these trace elements between being dissolved in the liquor versus present in suspended solids; and concentrations of trace sulfur species such as peroxodisulfate. The technologies tested varied considerably in their effects on these wastewater parameters, and these observed differences are illustrated with plant data and discussed in the paper

Discusser: Bruce Keiser and Jitendra Shah, Nalco, an Ecolab Company, Naperville, IL

2:55 PM COFFEE BREAK

3:15 PM

IWC 15-19: Solutions and Practices to Address NPDES Compliance at Coal-Fired Generation Stations in light of EPA Proposed Effluent Limit Guidelines

Michael J. Soller, P.E., Bowen Engineering Corporation, Indianapolis, IN; Patricia Scroggin, P.E. Burns & McDonnell, Kansas City, MO

Steam generation power producers are currently evaluating many solutions to address the proposed EPA Effluent Limitation Guidelines (ELG) anticipated to be final in the fall of 2015. This is necessary to achieve renewal of their existing National Pollutant Discharge Elimination System (NPDES) permits now and in the future. A discussion of Owner considerations for wastewater treatment system selection in light of changing operations related to EPA mandated air quality control systems and changing fuel sources is provided. Further, the paper discusses the chemistry and operational considerations related to reuse and recycling of FGD and other power plant waters as Owners seek to improve plant operations and reduce discharges. This paper provides an overview of the interactive regulatory environment for Owners to evaluate as they make technology application decisions for their power plants. Insight is provided into the process equipment lead times and construction schedule considerations currently being experienced on some NPDES compliance projects throughout the United States.

Discusser: Thomas Stanko, Consumers Energy Company, Jackson, MI

4:05 PM

IWC 15-20: Electroadsorptive Filtration Media Effectively Removes Heavy Metals and Other Trace Contaminants from Water.

Tara Cole and Rod Komlenic, Ahlstrom Filtration LLC, Mt. Holly Springs, PA

Disruptor® is a novel electropositive, adsorptive filtration media that has been found to effectively remove a variety of trace contaminants from water when used in a standard pleated filter cartridge format. The filter media has a nominal pore size of 1.25 microns but due to the high electropositive charge it is able to remove many trace contaminants with great efficiency. The electroadsorptive properties of the media also allow it to maintain a high flow rate with a low pressure drop while still effectively removing these contaminants from water.

This electropositive filtration media has been found to remove organic constituents like humic acid as well as disinfection byproducts like bromine and chlorine. The media is capable of reducing viruses, bacteria, and cysts from drinking water, and recent testing has also shown an ability to remove 95-99% of lead at both pH 6.5 and 8.5, as well as several other metals.

Previous papers have reported on the media's capability to remove trace amounts of known endocrine disruptors such as bisphenol A (BPA), and pharmaceuticals like penicillin G, and Flumequine, which will be included in this paper as well.

This electropositive, adsorptive filtration media can be useful in point of use and point of entry applications as well as in industrial settings such as cooling towers and car washes. It has also been found to eliminate transparent exopolymer particles (TEP) which makes it an effective prefilter to extend the life of reverse osmosis membranes.

Discusser: Joseph Mandara, ResinTech Inc., West Berlin, NJ

PRODUCED WATER TREATMENT AND DISPOSAL

Time: 1:15–5:00 PM; Room : Int'l Ball Room Center

IWC Rep: Mike Sheedy, Eco-Tec, Pickering, ON, Canada

Session Chair: Tony Fuhrman, Hydranautics, Pittsburgh, PA

Discussion Leader: Greg Mandigo, Aquatech, Hartland, WI

Produced water is among the most challenging process waters to treat. High levels of precipitable salts, silica, and organic compounds are dissolved in petroleum bearing formations and flow to the surface along with the oil that is being produced. Technologies have been practiced successfully and many more are being studied and developed to meet this growing need for recycle, reuse and discharge of produced water. This session focuses on produced waters from the SAGD facilities of western Canada. The session will take you through technologies used to successfully treat steam EOR produced water, review the progress of a ZLD system, and explore new innovations to treat high TDS brines associated with produced water. If you want to truly learn about produced water treatment or have experience in the SAGD market, this is the session for you!

1:15 PM

IWC 15-21: SAGD and Industrial Wastewater Disposal Reduction

Lisa Lee-Johnson, AJ Macdonald and Kevin Drake, Integrated Sustainability Consultants Ltd, Calgary, AB, Canada

Many industries are experiencing limitations on the capability to dispose of wastewater. Disposal reduction studies were completed for a steam-assisted gravity drainage (SAGD) operation to evaluate alternative disposal options and new technologies to reduce liquid waste to disposal wells by enhancing process water recycle and reuse. Solutions included modifications to boiler tubes to increase steam quality, and evaporation of blowdown using a downstream boiler or evaporator. Methods for increasing recycle of wastewater are discussed, as well as alternative disposal options. Typical evaluation criteria are provided to facilitate selection of the preferred solution.

Discusser: Steve Portelance, Advisian - A WorleyParsons Group, Calgary, AB, Canada

2:05 PM

IWC 15-22: Advanced Treatment Technologies for Zero Liquid Discharge in SAGD Operations

Mark Smith and Andrew Crompton, Suncor Energy, Inc. Fort McMurray, AB, Canada; John Richardson, Jamie Kuzyk, Kevin A. Brown, Amit Sen, Hardeep Sehra and Rob Bedinger, ChemTreat, Inc., Glen Allen, VA & Fort Saskatchewan, AB, Canada

The SAGD process is an effective approach to heavy oil extraction through the efficient reuse of produced water for steam production. The aqueous and solid waste streams ultimately resulting from SAGD operations require careful handling and disposal considerations. This paper documents the progress towards achieving 100% water recycle efficiency at a SAGD facility with a focus on the treatment of excess effluent water from a wastewater lagoon. The site was de-

signed with a zero liquid discharge system; however, excess fluid that enters the wastewater lagoon from a number of sources including boiler blowdown, landfill leachate and rainfall often overwhelm the lagoon's capacity, resulting in off-site disposal of these fluids. The goal of this project is to eliminate off-site disposal by processing the effluent water through existing wastewater treatment facilities. This paper details the treatment technologies and equipment engineering used to accomplish this objective.

Discusser: Martin Godfrey, Nalco Champion, Eagan, MN

2:55 PM COFFEE BREAK

3:15 PM

IWC 15-23: Innovative Brine Treatment: High Recovery Hybrid Membrane Process and Zero Liquid Discharge Low Temperature Crystallization

Mitchell Frank, Malcolm Man and Ben Sparrow and Megan Low, Saltworks Technologies, Inc., Vancouver, BC, Canada

Water treatment specialists are seeking economic ways to maximize freshwater production and minimize liquid waste discharge. Performance and economics are presented for a novel membrane process consisting of an electrochemical softening and brine concentrating technology coupled with reverse osmosis (RO). The result is a membrane process that removes the need for upstream chemical softening and decreases brine volume, often by 50%. In addition, results from a low temperature crystallizer treating a variety of industrial saline waters for true zero-liquid-discharge (ZLD) are summarized.

Discusser: Craig Bartels, Hydranautics, Oceanside, CA

4:05 PM

IWC 15-24: The Use of Horizontal Tube Falling Film Evaporators to Treat Produced Water in Canadian Oil Sands

Charlotte Bessiere, Veolia Water Technologies, Plainfield, IL; Dorothy Neu, Veolia Water Technologies, Plainfield, IL

In the SAGD Process of the Alberta Oil Sands extraction, conventional treatment use OTSG boilers (Once Through Steam Generator) to generate steam from produced water but are associated with large quantity of blowdown as waste. Volume reduction of this liquid waste can be achieved by evaporation processes. The current choice of oil companies is to use vertical falling film evaporators, despite their significant installation cost. Horizontal tube falling film evaporators, which are used in other markets such as sea water desalination offer a good alternative to vertical evaporators in that particular OTSG blowdown application. The equipment cost is lower thanks to smaller tube thickness and high packing capacity, the reduced height and compact systems are associated with a lower Total Installation Cost, and they have an easier layout. This paper first demonstrates the technical feasibility of the process through the results of a pilot study using real OTSG blowdown from Alberta. It also describes operation related topics such as the cleaning of these systems. In a second part, the paper details the advantages of horizontal vs vertical orientation and compares the economics of the horizontal tube falling film evaporator with the traditional vertical technology.

Discusser: Dave Ciszewski, GE Water & Process Technologies, Bellevue, WA

CHEMISTRY CONSIDERATIONS FOR INDUSTRIAL AND POWER STEAM TURBINES

Time: 1:15–5:00 PM, Room: Crystal

IWC Rep: Colleen Layman, P.E., HDR, Inc., Janesville, WI

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

Discussion Leader: Jim Robinson, G.E. Water, Trevose, PA

The steam chemistry going to the turbine directly impacts its reliability, longevity, and efficiency. These four papers discuss how various impurities in the steam affect the turbine, critical instrumentation for monitoring steam purity, and the critical commissioning period for steam turbines.

1:15 PM

IWC 15-25: Chemical Processes in Steam Turbines

James Bellows, James Bellows and Associates, Maitland, FL

The chemical processes occurring in steam turbines are controlled both by thermodynamics and kinetics. The equilibrium solubility of sodium chloride in steam in a fossil turbine is reviewed. The deposition rates for fossil turbines are also reviewed. The deposition rates are applied to a real turbine showing the concentration of impurity remaining in the steam and the quantity of salt deposited at each stage. The implications for the operation of turbines and the need for steam purity at low loads are discussed.

Discusser: Michael Caravaggio, EPRI, Charlotte

2:05 PM

IWC 15-26: Practical Issues in Steam Turbine Commissioning

Colleen M. Layman, HDR, Inc., Janesville, WI

The time required to commission a steam turbine can vary substantially and these variations can have a significant impact on the overall cost of the project prior to commercialization or on costs associated with lost production revenue. Important issues or planning steps that are sometimes overlooked or disregarded as not critical, such as chemical cleaning or temporary lay-up practices, can ultimately have a significant impact on the ability to achieve and maintain chemistry and can threaten the integrity of the equipment and/or ultimately delay the start-up process.

This paper will explore the critical factors that should be considered when planning for steam turbine commissioning focusing on items related to the steam/water cycle and chemistry. It will address issues of concern related to not only the commissioning phase itself, but also items of note that should be considered during the engineering design and construction phases of the project. The discussion will include not only best industry practices, but will also include lessons learned from

Discusser: Ted Beardwood, Solenis, LLC, London, ON, Canada

2:55 PM COFFEE BREAK

3:15 PM

IWC 15-27: Sulfite and Sulfate in the Steam Cycle

Andrew Howell, Xcel Energy, Henderson, CO

Sulfite and sulfate are commonly present in the steam cycle of industrial and utility boilers. Their presence in various steam cycle locations may be due to the addition of sulfite for oxygen removal, contamination by cooling water ingress or other sources, or by volatile or mechanical carryover of boiler water into steam. These sulfur compounds can contribute to a variety of problems for steam cycle components, including under-deposit corrosion of boiler tubing, off-line corrosion of steam tubing, suppression of steam pH, steam turbine deposition, pitting and corrosion cracking, and corrosion of brass condenser tubes. A better understanding of the behavior of sulfite and sulfate in boiler steam cycles can assist in taking steps to ensure these problems are avoided or minimized.

Discusser: K. Anthony Selby, Water Technology Consultants, Inc., Evergreen, CO

4:05 PM

IWC 15-28: Monitoring Steam Purity-Critical Parameters

Vickie G. Olson, Honeywell Process Solutions, Sandy Springs, GA

Water and steam purity are critical to optimize boiler cycle performance and reduce steam turbine maintenance. Process analytical instruments have been available for decades to monitor for changes in this purity based on various parameters. This presentation will cover information on the latest instrumentation and how monitoring with them is successfully being used to prevent or reduce steam quality excursions. Specifics of various parameters will be discussed, such as for pH, conductivity, sodium and silica. The value over specific of ions analysis such as sodium compared to conductivity will be discussed.

Discusser: J.C. Dromgoole, Fort Bend Services, Inc., Stafford, TX

CHALLENGES IN RECYCLING AND REUSE

Time: 8:00am–12:00noon; Room: Int'l Ball Room North

IWC Bob Applegate, Graver Water Systems, LLC, New Providence, NJ

Session Diane Martini, Burns & McDonnell, Chicago, IL

Discussion Leader: Brian Powers, HDR Engineering, Charlotte, NC

This session will look at the challenges of reclaiming four very different and very challenging waste streams using a variety of technologies. This session will feature recovery of wastewaters as diverse as produced water, refinery wastewater, ash sluice water and municipal wastewater. We will look at technologies ranging from electrocoagulation and ultrafiltration to denitrification, and reuse potential from crop irrigation to boiler feed. Our papers include three pilot tests and an update and forecast on the challenges of denitrification, a concern for both the reuse of municipal grey water and the discharge of FGD wastewater under the proposed ELGs.

8:00 AM

IWC 15-29: Produced Water Treatment for Reuse in Cyclic Steam Boilers and Crop Irrigation

Lyndsey Wiles, TriSep Corporation, Goleta, CA; Lee Portillo, Eric Nichols OriginClear, Los Angeles, CA

As water scarcity increases, reuse of the water generated by oil & gas exploration methods is becoming more prevalent. This is especially true in California's Central Valley, where the combination of oil & gas activity and historic drought conditions have pushed reuse to the forefront of many energy companies' efforts. With the main goal to treat produced water for beneficial reuse in their cyclic steam boilers and for agricultural irrigation, Bakersfield, CA-based exploration and production company Vaquero Energy has found success with a treatment scheme featuring an electrocoagulation technology followed by a polymeric ultrafiltration (UF) membrane. Success of this treatment scheme was quantified via field testing in Bakersfield throughout the early part of 2015. The electrocoagulation technology provided upfront de-oiling and bulk suspended solids removal, while the UF membrane removed any remaining oil and suspended solids to acceptable reuse levels. The raw feed had an average turbidity of 842 NTU and the treatment scheme offered greater than 99.9% removal of turbidity. In addition, the oil levels being fed to the electrocoagulation unit were in the range of 50-150 mg/l, while the UF membrane consistently provided effluent with non-detectable levels of oil. The combination of solids and oil removal demonstrated to Vaquero Energy that this treatment scheme provided effluent appropriate for their reuse purposes.

Discusser: John Van Gehuchten, HDR Engineering Inc., Pittsburgh, PA

8:50 AM

IWC 15-30: Successful Pilot Trials of Reject Recovery Reverse Osmosis on A Refinery Effluent

Arun Mittal, Aquatech International Corporation, Canonsburg, PA; Ajanta Sarkar, Aquatech International Corporation, Pune, India

Due to acute water shortage and growing need for additional high quality water, a leading refinery in partnership with Aquatech decided to pilot a new technology to enhance the recovery of its existing waste water recycle plant from overall 85% to greater than 95%.

The pilot study was essentially done on the reject stream of the existing RO plant. The reject stream is rich in COD (1200 – 2000 mg/l) and hydrocarbons (15 – 20 mg/l) which limits the existing spiral wound membrane based RO technologies that can be applied with optimal operating costs. The existing RO plant already operates at 85-87% recovery. The main objective of the pilot was to enhance the recovery and further reduce the volume of the RO reject stream for disposal.

The successful pilot trials were concluded using R2RO (Reject Recovery Reverse Osmosis), an advanced membrane system that has a unique configuration and operating envelope that allows additional water extraction from reject streams that are otherwise saturated for further extraction by conventional membrane technologies.

The paper describes in detail the overall successful experience of the pilot, data on feed and product water quality, overall recovery and water balance of the pilot.

Discusser: Mike Preston, Black & Veatch, Overland Park, KS

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-31: The Water-Energy Nexus: Case Studies of Water Efficiency Auditing in the Distilling Industry

A. Todd Lusk, Ramboll Environ, Florence, KY; Patrick J. Campbell, Ramboll Environ, Brentwood,TN

This paper summarizes the results of water efficiency audits at five (5) distilled spirits production and bottling facilities. Relevant water consumption data are presented, along with distribution of water usage in the various production processes and supporting utilities for each site. Key water reduction/reuse opportunities identified at each facility are discussed, with specific emphasis on the inherent relationship between reductions in water consumption and frequently corresponding increases in energy consumption

Discusser: Ivan A. Cooper, P.E., BCEE, Civil & Environmental Consultants, Charlotte, NC

10:50 AM

IWC 15-32: Denitrification of Municipal Effluent for Power Plants and Industrial Facilities

Michael Rosen, Sargent & Lundy, LLC, Chicago, IL

This paper discusses the use of treated sanitary effluent (grey water) with elevated nitrate levels in power plants and industrial facilities. Elevated levels of nitrates can be pres-

ent if the municipal treatment facility does not include denitrification. An overview is provided of nitrate levels in grey water, potential impacts of elevated nitrate levels on cooling system operation, fundamental denitrification chemistry and treatment technologies, and specific technologies that can be implemented in a power plant or industrial facility or as a retrofit in municipal wastewater plants for enhanced biological nutrient removal. The ability of merchant power plants that may be out of service for extended periods to utilize biological treatment is also discussed.

Discusser: Michael L Pudvay, Veolia, Moon Twp., PA

EVOLUTION IN THE TREATMENT OF INDUSTRIAL WASTEWATERS

Time: 8:00am–12:00noon; Room: Crystal

IWC Rep: George Abrahim, P.E., Veolia Water Technologies, Moon Township, PA

Session Chair: Tom Lawry, McKim & Creed, Pittsburgh, PA

Discussion Leader: Jonathan Shimko, Tetra Tech, Pittsburgh, PA

As regulations evolve, so must treatment technologies to comply with stricter effluent limits and to provide affordable solutions. This session includes treatment technologies from different industries, each faced with unique challenges and restrictions that require innovative thinking to develop solutions and keep the industry moving forward. This session includes two papers that discuss upgrades to existing facilities to achieve compliance with regulatory drivers associated with organic and nutrient parameters. Another paper discusses the continuing evolution of traditional treatment technologies as it addresses recent improvements in flotation technologies to remove emulsions from wastewater streams. The fourth paper in this session walks through lessons learned from the startup of equipment where zero liquid discharge is achieved at a combined cycle power generation facility.

8:00 AM

IWC 15-33: Food Processing Facility Saves Millions with New Pretreatment, Utilizing Innovative Aeration Technology to Convert a Facultative Lagoon to an Aerobic Process

Christopher B. Milligan, P.E. and Nicholas J. Lombardo, EI BlueInGreen, LLC, Fayetteville, AR

Faced with increasing nutrient regulations and expanding plant production, a large food processor embarked on an innovative pretreatment project. The facility's wastewater contained high BOD, with concentrations regularly reaching 5,000-mg/L. In the past, the facility utilized a facultative lagoon to provide treatment before land applying the effluent on nearby property. Due to increased production, the facility commonly exceeded its allowable land application rate. Plant production slowed due to high precipitation, which prevented the effluent from being dispersed throughout the irrigation fields. Furthermore, increased nutrient regulations threatened the facility's ability to land apply due to phosphorus concentrations. Ultimately, plant officials opted into a pretreatment agreement with the local municipality. However, the existing process was unable to reduce influent BOD to 350-mg/L, as required by the municipality's contract. Design engineers developed a plan to convert the lagoon into an aerobic treatment process. The project introduced new influent screening, oxygenation technologies for aeration, a dissolved air flotation system for removing solids, effluent tanks for storage, as well as a pump station and forcemain to the municipality. The project was completed in fall 2014, however start-up and optimization continued for several months. pH levels in the facultative lagoon dropped significantly due to anaerobic conditions,

and chemicals were implemented to raise pH values within the neutral range. Once pH levels were stable, the lagoon was seeded with microbes to quickly establish aerobic treatment. Entering 2015, the facility's monthly surcharges decreased from approximately $450,000 to $19,000, resulting in an estimated annual savings of approximately $5,000,000.

Discusser: Caroline Dale, Veolia Water Technologies, Cary, NC

8:50 AM

IWC 15-34: Advanced Biological Wastewater Treatment for Specialty Chemicals Manufacturing

William Sheridan, Alan Greenberg and Steve Lupton UOP, LLC, Des Plaines, IL

A specialty chemicals plant produces a range of chemicals products, including melamine, acrylic compounds and stilbene based paper whitening chemicals. Local authorities required the plant to reduce the chemical oxygen demand (COD) to < 500 mg/L and ammonia-N to <50 mg/L in the discharge to the local sewer. One of the challenges in treating this wastewater was the variable contaminant composition and concentration of the wastewater. An existing aerated basin was not able to handle this variability. These basins were modified with UOP XCeed™ technology, a proprietary fixed-film bioreactor system. The basins were retrofitted to incorporate two parallel treatment trains consisting of an anaerobic stage for bulk COD removal, an aerobic stage for COD polishing and a nitrification stage for ammonia removal. This retrofitted XCeed treatment system was shown to be an efficient bioreactor configuration able to meet the discharge requirement for COD and ammonia in a very variable and recalcitrant wastewater due to the complexity of the organic constituents in this wastewater.

Discusser: Ramesh Kalluri, Kalluri Group, Inc., Houston, TX

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-35: Lessons Learned Performing Zero Liquid Discharge by HERO and Evaporation Ponds

Brian Clarke, P.E. and Allyson Stock, P.E. Kiewit Engineering and Design Co., Lenexa, KS

This paper will discuss lessons learned from a wet cooled 1x1 combined cycle power plant commissioned in 2012 where zero liquid discharge (ZLD) is achieved via a high efficiency reverse osmosis (HERO) system and evaporation pond. Many challenges were overcome on the project including water quality changes, UF membrane fouling, and plugging of evaporation pond discharge lines. The various engineering and startup issues and their resolutions are discussed to the benefit of design engineers and system suppliers. An additional topic will be potential improvements to the process of engineering and design within the EPC model. Kiewit has been the EPC contractor on numerous power projects and while each system requires different considerations several common challenges and uncertainties have been observed about the typical approach.

Discusser: James Beninati, HDR Engineering, Pittsburgh, PA

10:50 AM

IWC 15-36: Removal of Emulsified O&G and TSS From Wastewater

Sathishkumar Santharam and Mike Bradford, P.E., Jacobs Engineering Group, Inc., Houston, TX

Refinery wastewater and Produced water contain emulsified O&G/TSS. These emulsions are not removed by gravity oil separation technologies, such as API separators or CPI separators; instead, the emulsions pass right through these separators. This paper discusses technologies that can effectively be used to remove these emulsions, with a special emphasis on recent developments in flotation technologies.

Discusser: Paul Pigeon, Golder Associates Inc., Lakewood, CO

SUCCESS IN THE TREATMENT, REUSE & DISPOSAL OF FRAC WATER WHILE MANAGING RISKS

Time: 8:00am–12:00noon; Room: Int'l Ball Room South

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

Session Chair: Scott Quinlan, GAI Consultants, Inc., Cranberry Township, PA

Discussion Leader: Frank Johns, Tetra Tech, Denver, CO

There are currently several accepted alternatives for handling hydraulic fracturing flowback and produced water (aka brine). This session will discuss and explore some of these including evaporation and reuse. Results from a brine treatment facility that uses a thermal evaporator to produce safe, clean distilled water and a concentrated salt byproduct will be presented. The difficulties of handling produced water with radioactive material (known as NORM) and options for reuse and disposal will be discussed. A case study from a recent collaboration between three oil and gas service providers and a large producer in the Delaware Basin (New Mexico) for environmentally responsible, economically advantageous reuse of produced water for hydraulic fracturing will be presented. Another case study will present the concerted effort to maximize the degree of reuse of produced water, reviewing the water and performance tests results. The flowback water was collected, treated, stored, prevented biogrowth and was 100% reused as hydraulic fracturing make up water. The evaluation of economics for this zero discharge recycling system shows operational cost savings based on the deferred cost of water acquisition and disposal. Industry experts conclude that such an optimized approach could lead to improved well completions and wells that are more productive.

8:00 AM

IWC 15-37: Startup and Operating Experience at a Frac Water Crystallization Plant

Donald Olmstead, P.E., Venture Engineering & Construction, Inc., Pittsburgh, PA; Brian Kalt, Fairmont Brine Processing, LLC, Fairmont, WV

Fairmont Brine Processing owns and operates a plant for the production of sodium chloride from flowback and produced water, as an alternative to controversial deep well injection of brine. An existing facility in Fairmont, West Virginia, was refurbished and a triple effect evaporation and crystallization process was retrofitted to the site. The facility currently processes 3500 bbl/d and produces distilled water, sodium chloride, and a heavy mixed brine solution. This paper addresses the first 8 months of operating experience, including an overview of the patented process, a summary of issues encountered during commissioning and run-in, and characterization of influent, effluent, and salt.

Discusser: Howard McCarthy, Tetra Tech, Denver, CO

8:50 AM

IWC 15-38: Zero Water Discharge Water Management For Hydrofracturing Activities

Jeffrey R. Kissell, P.E. and Dr. Carl E. Adams, Jr., P.E., BCEE, Ramboll Environ, Brentwood, TN; Brent M. Jones, P.E., BCEE, Ramboll Environ, Houston, TX

On behalf of a major gas producer, Ramboll Environ developed a sustainable program for recycling waters generated during hydraulic fracturing. Ramboll Environ evaluated available data, held discussions with industry experts, environmental regulators, and state, federal and academic experts, and performed field sampling and treatability testing. Ramboll Environ identified a treatment strategy for complete recycle involving minimal treatment and minimal generation of residual solids, providing operational cost savings based on the costs of water acquisition and disposal.

Discusser: William Shaw, Veolia Water Technologies, Pewaukee, WI

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-39: NORM Management of Marcellus Shale Water

John Van Gehuchten, HDR Engineering, Inc., Pittsburgh, PA

Flowback and produced water from drilling and developing Marcellus shale formations contains measurable amounts of radium 226 and 228. Current recycling processes of these water sources can result in levels of radiation, primarily due to radium, that can make disposal difficult. Testing was done to see what can be done in the treatment process of reusing water so as to keep the radium in solution so it can be used when hydro-fracturing new wells. In this testing various coagulants were used, mixing was varied, and settling characteristics observed. Finally a feasibility study was conducted on disposing of this same flowback and produced water with certain solid wastes, such as those from coal fired power plants, so as to minimize final waste radioactive level, chloride mobility, and metal leaching. This paper will present the results of the bench scale testing as well as the feasibility study and provide recommendations for managing the challenges related to reusing and disposing of these difficult wastewaters.

Discusser: Devesh Mittal, Aquatech Energy Services, Canonsburg, PA

10:50 AM

IWC 15-40: Enabling Produced Water Reuse for Hydraulic Fracturing: Case Study from the Delaware Basin

Lance Rodeman, MYCELX Technologies, Houston, TX

New Mexico ranks as the sixth largest producing state for Oil and Gas in the United States. Despite nearly all of New Mexico's production occurring within 50 miles of the border with Texas, implementation of water reuse for hydraulic fracturing lags behind Texas. There are many factors causing this lag, among them are differing local regulations and misapplication of treatment technologies. Two differing

case studies will be presented, allowing comparison of the contrasting regulatory and commercial considerations in each of the neighboring states, and the technologies and methods deployed to perform a successful produced water recycling project for hydraulic fracturing.

Discusser: Sathishkumar Santharam, Jacobs Engineering Group, Inc., Houston, TX

FGD WASTEWATER TREATMENT

Time: 8:00am–12:00noon; Room : Int'l Ball Room Center

IWC Rep: Patricia Scroggin, Burns & McDonnell, Kansas City, MO

Session Chair: Richard Roy, Public Service of New Hampshire dba Eversource Energy, Bow, NH

Discussion Leader: Jeffery B. Preece, Electric Power Research Institute, Charlotte, NC

FGD wastewater is a varied and complex stream that requires innovative treatment. Operational variability and inconsistent constituent loadings add to the challenges requiring flexible yet robust treatment processes to continuously meet extremely stringent and evolving water quality technology based limits. The promulgation of the Steam Electric Power Generating Effluent Guidelines by the U.S. Environmental Protection Agency is driving attention to the research, design and operation of these treatment systems. This session is intended to provide Utilities and providers to the Utility industry information to treat this challenging stream.

8:00 AM

IWC 15-41: Sources of Variability in Flue Gas Desulfurization Wastewaters

William M. Kennedy, P.E., Duke Energy, Charlotte, NC; Joseph G. Potts, P.E. Duke Energy, Cincinnati, OH

The promulgation of the Steam Electric Power Generating Effluent Guidelines by the U.S. Environmental Protection Agency is bringing increased attention to the design and operation of flue gas desulfurization (FGD) wastewater treatment systems. The rule establishes limits for arsenic, mercury, selenium and nitrate/nitrites that must be met at the discharge of FGD treatment systems. This paper discusses key characteristics of FGD wastewaters and identifies operational parameters of coal fired, FGD scrubbed, electric generating units that may cause these characteristics to vary with time and lead to non-compliance of these new limits. The paper intends to provide an understanding of what operational parameters might be controlled upstream of and within FGD and the need to incorporate sufficient robustness into the design of the associated wastewater treatment system.

Discusser: Russ Huffmeyer, McKim & Creed, Sewickley, PA

8:50 AM

IWC 15-42: Encapsulation of FGD Wastewater using CCBS to Achieve ZLD: Opportunities, Challenges and Technology Readiness.

Kirk Ellison, Southern Company Services, Birmingham, AL

Pending regulatory challenges give reason to re-examine the status-quo approach for future flue gas desulfurization (FGD) wastewater and coal combustion by-products (CCB) disposal practices. The industry is being pushed toward dry stacking of ash into lined facilities and stringent treatment limits on FGD wastewater will be induced.

However, by integrating FGD wastewater, coal combustion byproducts, and encapsulation technologies, a potentially cost-effective alternative to CCB dry stacking and FGD wastewater treatment may exist. Passive deposition technologies, such as zero bleed water pastes, offer advantages for the integrated transport and disposal of CCB's as well as difficult to handle FGD salts and brines from zero liquid discharge (ZLD) volume reduction technologies. Co-disposal is achieved when ash, brine, and binders are mixed and pumped into the landfill as a thixotropic paste and allowed to set into an encapsulated monolith.

However, many challenges still exist before such an approach can be deemed commercially available. Work is ongoing to reduce water volumes, characterize and stabilize materials, develop mechanical systems for mixing and transportation of materials, create effective landfill placement and management practices, and prove long term sequestration of constituents.

Additionally, a demonstration scale research facility to create and test encapsulated materials has been established. This paper serves to give an industry update on the current state of the technology and its cost and outline a strategic vision for the commercialization of ZLD for certain wastewaters through encapsulation.

Discusser: Vincent (Tobi) Ogunro, The University North Carolina at Charlotte (UNCC), Civil & Environmental Engineering (CEE) Department, Charlotte, NC

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-43: Forward Osmosis based Membrane Brine Concentration of Wastewater Streams in Coal-fired Power Generation

John Tracy, Oasys Water, Boston, MA; MaryTheresa Pendergast and Marek Nowosielski, Oasys Water Inc., Daxin Wang and Xinyan Cheng, Beijing Woteer Water Technology Co., Ltd.

Demand for electric power worldwide is steadily growing as populations grow and increasingly demand digital and electrically driven capabilities of First World economies. The demand for water is growing in lock step, with power generation being the largest industrial user of water worldwide (GWI 2013). The emergence of both China and India have contributed to power generation growth, and the dependence of both countries on coal for meeting a large portion of their power needs has in turn driven the growth in requirements for environmental controls and for water treatment. China and India are expected to be the #2 and #3 power water system markets for the 2013 – 2017 time period, due to the combination of systems for pretreatment of water used in the steam cycle and waste treatment of streams generated in the power generation process (GWI

2013). Water scarcity within both countries compounds the increasing needs for water treatment. In China in particular, regulation of power plant wastewater discharge, to the level of zero liquid discharge (ZLD), for streams such as the wastewater from coal power plant flue gas desulfurization (FGD) and blowdown from recirculating cooling systems, has driven a requirement for water treatment systems to concentrate the wastewater stream to the point of salt crystallization while extracting a clean water stream suitable for reuse in the plant. For FGD wastewater treatment in the China coal power and chemical industries, the Industrial Design Institutes are favoring a process flow consisting of phys-chemical pretreatment, a forward osmosis (FO) based membrane brine concentrator, and an evaporative crystallizer. This paper will discuss design, start-up and operation of this treatment approach.

Discusser: Patrick Cottrill, Duke Energy, Roxboro, NC

10:50 AM

IWC 15-44: Understanding the Influence of pH on Boron Precipitation and Scaling Kinetics in Flue-gas Desulfurization Wastewater

John Williamson, Temple Ballard, and Denise Horner, SUEZ - Infilco Degremont, Ashland, VA

Boron is a well-known element that imposes a complexity of issues from a commodity, health, and environmental impact perspective. Typically found in the environment as a mineral, Boron is increasingly becoming a concern for fossil fuel power plants utilizing coal. Naturally occurring coal deposits generally contain a level of Boron that, when burned for power steam generation, will likely accumulate in flue gas-desulfurization (FGD) scrubber wastewater. As Boron levels cycle upwards, process treatment is required to reduce Boron levels in FGD wastewater prior to discharge. Several alternatives exist to meet this challenge including physical-chemical precipitation followed by ion exchange.

Ion exchange (IX) is a widely accepted process treatment technology for Boron removal. Once the IX resin is fully loaded, acid re-generation is typically followed to restore the resin's operating exchange capacity. The regenerate is then treated via physical-chemical precipitation to remove the bulk of Boron from the regenerate waste stream. Laboratory batch tests were performed to understand Boron precipitation kinetics and potential impact of post precipitation scaling on downstream processes. IX regenerate was treated with Calcium hydroxide at various pH set points to measure optimal Boron removal efficiency while evaluating post precipitation scale formation. The various pH set points were observed over a period of time and demonstrated a degree of scaling potential that varies at specified pH ranges. The degree of scaling appears to coincide with the type of Boron precipitate or crystallization. Further investigation into the type of Boron crystal revealed the importance of operating at the correct pH to achieve both optimal Boron removal efficiency and minimal scaling potential.

Discusser: Doug Orr, AECOM, Austin, TX

ZERO LIQUID DISCHARGE: DESIGN, TECHNOLOGIES AND…BUBBLES.

Time: 1:15–5:00pm; Room: Int'l Ball Room North

IWC Rep: Dennis McBride, Fluor, Greenville, SC

Session Chair: Clifford Gilbert, The DOW Chemical Company, Westborough, MA

Discussion Leader: J. Michael Marlett, PE, P. Eng, Aquatech International Corp., Hartland, WI

Zero liquid discharge (ZLD) is a reality for a few, a goal for many, and a design imperative for the future. In this session hear ZLD practitioners discuss design concepts for ZLD systems as well as the successful application of ZLD technologies in both the municipal water and power industries. Lastly hear how one practitioner dealt with the serious problem of foam formation in a Flue Gas Desulphurization (FGD) scrubber.

1:15 PM

IWC 15-45: Technology Evaluation for Zero Liquid Discharge at a Combined Cycle Power Plant with an Air Cooled Condenser

Nicole Makela, Advanced Power Services, LLC, Boston, MA; Michele Funk, P.E., Joel Davie, P.E., and Ian Mitchell, P.E. Bechtel Infrastructure and Power, Frederick, MD

To expedite the permitting process and reduce environmental impacts, combined cycle power plant developers are analyzing options for minimal wastewater discharge. Due to the interdependent relationship between plant water users and wastewater producers, analyzing options for minimal wastewater discharge requires a holistic approach, in which technology options for water users and wastewater producers are evaluated concurrently. Development of an approach that minimizes cost and risk, yet maintains flexibility to variable plant makeup water quality requires innovative applications of treatment and reuse technologies. This paper will analyze water and wastewater treatment options for a combined cycle power plant with an air-cooled condenser and no permit to discharge wastewater. The paper will also illustrate how ion-exchange technologies with off-site regeneration may be a favorable option for this application. Process schematics for alternate treatment technologies will be presented and compared, along with a qualitative discussion of each technology's ability to handle variable water quality. Additionally, operating considerations and risks associated with each design will be provided. Finally, order of magnitude rental and capital costs will be provided for ion exchange technologies with off-site regeneration.

Discusser: Prasad Kaniampal, Aquatech International Corp, Canonsburg, PA

2:05 PM

IWC 15-46: Feasibility of an Adiabatic Evaporator for FGD Wastewater ZLD Treatment Using Flue Gas Heat

Tyler Cromey, Southern Company Services, Inc., Birmingham, AL; Jay Renew Southern Research, Birmingham, Benjamin Laurent, Heartland Technology Partners, LLC Stoughton

The U. S. Environmental Protection Agency is expected to revise effluent guidelines for steam electric power generating units (EGUs). EGUs will potentially face stringent discharge limits for selenium, mercury, arsenic, and nitrite/nitrate in flue gas desulfurization (FGD) wastewater in the coming years. Traditional technologies for treating these wastewaters can be cost- prohibitive, operationally challenging, or resource-intensive. To address this issue, a pilot zero liquid discharge (ZLD) project was conducted to evaluate the effectiveness of an adiabatic evaporator (concentrator) for FGD wastewater treatment using flue gas from a coal-fired power plant as the thermal energy source for evaporation. This technology may be suited for sites required to meet a ZLD mandate and is well suited for its ability to treat streams with high total dissolved solids content, such as FGD blowdown and other power plant wastewaters. The pilot test demonstrated that: •The concentrator successfully treated and concentrated FGD wastewater, resulting in a net water volume reduction of 90- 95% yielding a slurry containing 70-80% total solids. •Fly ash within the flue gas provided a net benefit to the system by aiding in the management and stabilization of precipitated salts from the concentrated brine. •The concentrator maintained reliable operations, minimal operator requirements, and ease of cleaning and maintenance. •Solidification / stabilization of the brine slurry with Portland cement produced solids with significant to excellent immobilization of metals, particularly selenium, mercury, and arsenic. •Toxicity characteristic leaching procedure (TCLP) concentrations for all produced solids in the project were below the maximum RCRA metal TCLP limits.

Discusser: Bill Shaw, Veolia Water Solutions & Technologies, Pewaukee, WI

2:55 PM COFFEE BREAK

3:15 PM

IWC 15-47: Applying Foam Control Processes Associated with Wet Flue Gas Desulphurization Scrubbers to Thermal Evaporation Systems

Paul T. Brandt, P.E., and Don A. Schilling, P.E. Burns & McDonnell, Kansas City, MO

Foaming in wet scrubbers is a common problem experienced by coal-fired power plants. Thermal evaporation unit operations downstream of scrubbers are also susceptible to foaming. This paper discusses foam dynamics and recommends design and operational considerations to mitigate foaming, including optimized usage of anti-foam via a thorough laboratory analysis. Lower operating cost solutions to foaming are also discussed. Successful solutions to foaming are possible through analysis and a better understanding of foam dynamics.

Discusser: Ray Post, Chem Treat, Glen Allen, VA

4:05 PM

IWC 15-48: Applying Industrial ZLD Technologies to a Municipal RO Drinking Water Facility

Phillip J . Locke, P.E., McKim & Creed, Inc., Clearwater, FL; Ryan R. Popko, P.E. JEA, Jacksonville, FL; Jim Hogan, City of Palm Coast Palm Coast, FL

Diminishing potable water supplies and conservation initiatives have prompted utilities to explore unconventional sources and process applications to meet potable water demands, while leveraging existing resources. The City of Palm Coast recently implemented a unique chemical precipitation/ultrafiltration Zero Liquid Discharge (ZLD) process that treats 1.2 mgd of reverse osmosis (RO) concentrate for blending with potable water. By recycling six different waste streams within the ZLD process, the City treats and recovers 99.3% percent of the RO concentrate produced by the water treatment plant.

Discusser: Jim Woods, WestTech Engineering, Inc., Salt Lake City, UT

HISTORY KEY TO TODAY'S SUCCESSFUL APPLICATIONS

Time: 1:15–5:00pm, Room: Crystal

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

Session Chair: Brad Spindler, Wunderlich- Malec, Green Bay, WI

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

Understanding the History of fundamental water treatment technologies and applications provides a foundation for developing successful water treatment strategies today. This session is presented by Industry Leaders revealing the History of fundamental water treatment technologies including spiral wound membranes, treatment chemistries, and condensate polishers systems. Come and learn about the challenges met by these technologies in the past that have provided advancements and alternatives available to meet today's challenging water treatment needs.

1:15 PM

IWC 15-49: Membrane Product Evolution and Future Trends

Clifford Gilbert, The Dow Chemical Company, Southborough, MA

This paper provides a historical backdrop to the evolution of spiral-wound membranes from the early 20th Century up to the present day. Painting with a very broad brush rather than attempting to be comprehensive, the paper provides a high-level overview of the development of the technology. We discuss some of the specific developments in the technology and describe what the industry can look forward to in the future.

Discusser: Ted Darton, Genesys International Ltd., Middlewich, Cheshire, UK

2:05 PM

IWC 15-50: Role of Polymers in Water Treatment

Jasbir S. Gill, Ph.D., Nalco an Ecolab company, Naperville, IL USA

The use of natural polymeric materials such as tannins, starch, lignins, polysaccharides, etc. for scale control in the internal boiler treatments dates back to 19th century. Introduction of inorganic polyphosphate were the earlier synthetic polymers that were used in water treatment. The use of synthetic organic polymers such as polyacrylates, polymethacrylates and carboxymethyl cellulose showed a considerable improvement over the commonly used natural polymers and inorganic polymers. The use of such polymers were no longer limited to boilers but was extended to cooling water, and waste water. Subsequent, rapid advances in the synthetic polymers were the result of scarcity of water that forced the reuse of water and the use of impaired waters. Polymers that contain a multiple of monomers are now tailor made to meet specific needs of the water use. The smart copolymers can be made by incorporating a tag, generally an inert like fluorescent molecule, for easy and real time monitoring of the active polymer concentration

which is very helpful in optimizing the dose requirements. This paper highlights the development of polymer technology and its application in water treatment such as boilers, cooling water and waste water treatment.

Discusser: Jo A. Ordonez, Solenis, LLC, Wilmington, DE

2:55 PM COFFEE BREAK

3:15 PM

IWC 15-51: Cooling Tower Water Treatment Programs-A Brief History of Past to Current Practices and Trends,- The Why, When and How they Changed and the Impact that Occurred

Paul Puckorius, Puckorius & Associates, Inc. Water & Wastewater Consultants, Westminster, CO

This paper provides a detailed yet easily understood history of the changes that have occurred to cooling tower water treatment programs including corrosion inhibitors, scale inhibitors, antifoulants and microbiological chemicals. It reviews many of the driving forces responsible for these changes and the impact of these changes to both the chemical suppliers of these products and to the end users. A great review of cooling tower water treatments for the beginner as well as to all involved in cooling tower water systems and their treatments used in all industries.

Discusser: Armando J. Padrón, Nalco, Houston, TX

4:05 PM

IWC 15-52: Condensate Polishing Technology - Yesterday & Today

John Yen, Graver Water Systems, LLC, New Providence, NJ

This paper will provide a brief historical summary of Condensate Polishing beginning with a 1960 paper on "The Place of External Regeneration…" and trace the development of various technologies and regeneration techniques as the industry evolved and customer needs changed over the next 55 years. The historical summary will be followed by a discussion of the design, proper application and benefits of deep bed polishing, precoat filter-demineralizers, and several types of condensate filtration systems, highlighting each processes role in meeting the needs of modern plants. In particular, the paper will stress the benefits of condensate treatment in Natural Gas Combined Cycle facilities, with both water and air cooled condensers. The frequent cycling operation of the NGCC plants can derive a significant benefit from condensate polishing both in the reduction of the time required to come to full power and to protection for valuable assets such as the HRSG and steam turbine

Discusser: Peter Meyers, ResinTech, West Berlin, NJ

IMPROVING BOILERS RELIABILITY IN THERMAL ENHANCED OIL RECOVERY SYSTEMS, AN ASME-SPONSORED PANEL SESSION

Time: 1:15–5:00pm; Room: Int'l Ball Room South

IWC Rep: Debbie Bloom, Nalco Champion, An Ecolab Company, Naperville, IL

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

Discussion Leader: Chris Graham, C.G.C. Inc., Calgary, AB, Canada

This ASME sponsored session will consist of 4 papers followed by an open floor discussion. Papers being presented will relay applicable knowledge for monitoring Oil in Water, Iron, Alkalinity, and Silica. Field experience on silica deposition in Once Through and Heat Recovery Steam Generators and Evaporators will also be presented.

1:15 PM

IWC 15-53: Improving Produced And Boiler Feed Water Testing For Alkalinity and Silica

Steve Portelance, WorleyParsons Canada, Calgary, AB Canada

Many heavy oil producers using lime softening processes rely on titrimetric or colorimetric analytical procedures designed for use in the field to control lime and magnesium oxide dosages to balance lime softener chemistry. Two field tests of concern that have not compared well with duplicate samples analyzed by Certified Laboratories have been Silica and Alkalinity. The accuracies of the field tests are affected primarily by dissolved Total Organic Carbon (TOC) which causes Silica and Alkalinity concentrations to read higher than the certified lab results. For Silica this has resulted in magox overfeeding by as much as 40% and for Alkalinity the determination of the balanced lime dosage to total alkalinity ratio to be unreliable using the standard titration procedure. This paper presents two new procedures for Silica and Alkalinity.

1:40 PM

IWC 15-54: Corrosion Monitoring in OTSGs using Ferrous Iron Testing

Logan LaRocque, Nalco Champion, An Ecolab Company, Fort McMurray, AB, Canada; Martin R. Godfrey Nalco Champion, an Ecolab Company, Eagan, MN; Thomas Miller, Nalco Champion, an Ecolab Company Naperville, IL

Guidelines for the concentration of iron in boiler feedwater are commonly aimed at limiting the deposition of that iron onto the heat transfer surfaces of the boiler. Total iron testing is most often used and specified useful for this routine testing application. However, tests that are specific for iron in the +2 or ferrous oxidation state have been used successfully in conventional drum boilers to monitor active corrosion of the boiler components. Using iron pickup type diagnostics over in once-through preboiler equipment such

as economizers has been used to study the corrosivity of certain internal treatment programs such as chelants. Iron generation diagnostics applied to boiler blowdown have identified corrosion mechanisms inside operational boilers. The current paper discusses applying oxidation state specific iron testing to OTSGs fed with produced water. Color interference is the main obstacle to the testing. A technique for removing the color interference is discussed along with validation testing for the method. The use of this method to study chelant corrosion and erosion- corrosion in OTSGs is demonstrated and insights into the mechanisms of those corrosion reactions are discussed.

2:05 PM

IWC 15-55: Free Oil Measurement in SAGD Steam Generation

Christopher Westaby, Turner Designs Hydrocarbon Instruments, Fresno, CA; Francois DuBois Benchmark Instrumentation and Analysis, Edmonton, AB, Canada

The steam injection enhance oil recovery method, Steam Assisted Gravity pushes a lot of energy into the formation to liquefy the bitumen so it can be recovered and lifted to the surface. This method causes the continuous release of water soluble organics more commonly known as WSO's into the produced water. The injected steam is recovered and recirculated for process efficiency reasons. In traditional industrial steam recovery processes the free oil concentration must be below 1 part per million. Detection of oil with an on line fluorescence monitor at this concentration can achieve reliable protection of the boilers or boiler feed systems. In the SAGD operations, the WSO's fluoresce similarly to bitumen. Because the concentration of the WSOs is significantly higher than the bitumen operators are challenged to have a reliable detection of Free Oil for the Once Through Steam Generators. A study was conducted to find a work around using a solvent to extract the bitumen from a sample of the produced water leaving the WSO's behind and measuring the level of oil in the solvent. Measurement of the bitumen in the extracted solvent provides the needed process information to protect the OTSGs in the SAGD plants. Determining the proper solvent to do this was important because the bitumen does not readily transfer from the produced water to a solvent. Field experience has shown that toluene is a more effective solvent then hexane at extracting the bitumen from the produced water especially in the presence of some surfactants.

2:30 PM

IWC 15-56: Silicate Deposit Control in Thermal Recovery Units

John E. Hoots, Ph.D. and Carol B. Batton Nalco Champion -an Ecolab Company, Naperville, IL

Large volumes of high-quality steam are essential to bitumen/heavy oil thermal recovery. Feedwater quality used in-situ recovery operations creates challenges introducing very high hardness, iron, and silica levels. Variable plant operating conditions can cause silicate-based scale deposition on heat transfer surfaces of the OTSG, HRSG or evaporator equipment.

The complex silicate deposits can significantly reduce the system efficiency, increase operating/maintenance cost, reduce productivity and in some cases lead to overheating/ failure of equipment. A silica-silicate inhibitor program has been developed to address this scaling issue.

This paper describes the type of deposits encountered in a variety of applications and presents field success of this inhibitor program. Data demonstrating improved steam quality, reduced deposit, better heat transfer, and extended run times are presented.

2:55 PM COFFEE BREAK

3:15 Panel Discussion

CHARACTERIZATION AND TREATMENT OF FGD BLOWDOWN WATER

Time: 1:15–5:00pm; Room: Int'l Ball Room Center

IWC Rep: John Lucey, Jr. P.E., McKim and Creed, Raleigh, NC

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

Discussion Leader: Joseph Potts P.E., Duke Energy, Cincinnati, OH

FGD wastewater treatment offers a variety of challenges from accurately characterizing the quality of the wastewater to treatment to achieve very aggressive regulatory requirements. Our Session will discuss a range of topics including work being done to better understand the nature of the contaminants in FGD wastewater, the sensitivity of wastewater quality to varying operating parameters, and innovative treatment approaches being developed. You will have an opportunity to learn about on going work in this field directly from those involved in the execution and research.

1:15 PM

IWC 15-57: Quantification of Colloidal Phase Metals of Concern in Limestone Forced Oxidized Wet FGD Effluent

Shannon Brown, Babcock & Wilcox Power Generation Group, Inc., Barberton, OH; Purusha Bonnin-Nartker, Richard DeVault, Daniel Johnson, and Ambareesh Murkute The Babcock & Wilcox Company, Barberton, ,

Investigation has indicated that the presence of specific metals of concern in wet FGD absorber slurry and effluent may be reported in the dissolved phase when some of this total loading is, in fact, present as very fine colloidal solids. These metals include, but are not limited to, mercury, selenium and arsenic. Such fine solids will pass through traditional sample preparation filtration procedures and are then digested as part of sample preparation. When this happens, solid, and sometimes stable, metallic compounds are reported in the results for total loading of a species within the effluent. A study of wet FGD slurry samples was conducted for various limestone forced oxidized systems burning a variety of coals. Analysis was then conducted to quantify the metals of concern present in the colloidal solids fraction in the absorber slurry and, by relation, within the system effluent prior to waste water treatment. When metals exist in the colloidal phase, rather than as dissolved ions in solution, more options for effective waste water treatment become available. Herein is presented the methodology for determination of and results for partitioning of metals of concern between the colloidal and liquid phase fractions of wet FGD absorber effluent.

Discusser: Mandi Richardson, AECOM, Austin, TX

2:05 PM

IWC 15-58: Challenges in Flue Gas Desulfurization Physical/Chemical Wastewater Treatment for Mercury and Arsenic

Thomas E. Higgins, Ph.D., P.E., CH2M HILL, Jacksonville, FL; Kristen Jenkins, P.E. Southern Research Institute, Cartersville, Paul Chu, EPRI Palo Alto ,Laura Reid, CH2M, Charlotte, NC; Mary McCloud, CH2M, West Palm Beach, FL,Christina Joiner, CH2M, Atlanta, GA Dennis Fink, CH2M, Oakland, CA

Electric utilities are facing a series of regulations that will likely require advanced treatment of flue gas desulfurization (FGD) wastewater. The proposed Effluent Limitations Guidelines (ELGs) of 2013 and water quality-based effluent limitations (WQBELs) will necessitate treatment of FGD water. The appropriate treatment technologies for meeting these limits will be driven by the pollutants regulated. This paper will focus on recent evaluations of physical/chemical treatment, with an emphasis on findings regarding mercury and arsenic removal.

Discusser: Bruce Keiser and Jitendra Shah, Nalco, and Ecolab Company, Naperville, IL

2:55 PM COFFEE BREAK

3:15 PM

IWC 15- 59: Treatment of FGD Wastewater in a Pilot Advanced Reactive Iron Media Wastewater Treatment System

Frank Sassaman and David Berger, Evoqua Water Technologies LLC, Warrendale, PA; Richard Garnett, Evoqua Water Technologies LLC, Lake Lure, NC; Tyler Cromey, Southern Company Services, Inc.,Cartersville, GA; Dr. Yongheng Huang, Texas A & M University College Station, TX

The approach of using Hybrid Zero Valent Iron (ZVI) process for treatment of various heavy metals and oxyanions was introduced during IWC 2014 (refer to papers IWC 14-52, IWC 14-58, and IWC 14-59). In the past year, additional data has been obtained from operating a 12 to 25 gpm pilot system where the Hybrid ZVI approach was successfully proven in treating difficult flue gas desulfurization (FGD) blowdown. The pilot system is located at a major coal fired power plant in the United States and is operating on actual FGD blowdown waters.

This paper will primarily focus on the performance associated with the reduction of selenium, mercury, arsenic, and nitrate. Reduction of numerous other trace heavy metals is also examined as well as the effect of hydraulic retention time, dynamic flow changes, influent chemistry changes, and response to typical real world upsets. Data will be specifically analyzed and discussed in association with meeting the pending effluent limitations guidelines (ELGs).

Discusser: Andrew Bohner, P.E., Envirogen Technologies, Ewing, NJ

4:05 PM

IWC 15- 60: Material Balance for Merrimack Station SEC

Richard Roy, Public Service of New Hampshire dba Eversource Energy/ Duke-Energy, Bow, NH; Prakash Pailwal Aquatech International Corporation, Canonsburg, PA

Merrimack Station owned and operated by Public Service Company of New Hampshire (PSNH) dba Eversource Energy installed a Wet Flue Gas Desulfurization (WFGD) system with design features to remove mercury to meet State law requirements. The Company worked with State environmental regulators to develop an acceptable incremental liquid effluent process design but EPA was unable to issue an NPDES Permit modification in time to support their WFGD installation and startup schedule. In order to avoid delays to the State-mandated compliance date of July 2013 and to avoid large and unnecessary customer costs due to delay of the WFGD in-service date, Merrimack Station proceeded with a Softening Evaporation and Crystallization System (SEC) consisting of an evaporator and crystallizers capable of processing their WFGD blowdown stream to a salt cake. The SEC system began operation in March 2012. The use of this technology required a comprehensive material balance from the coal pile to the salt cake. This paper will document the components of the material balance, operational sensitivities to changes in inputs to the balance and comparisons to operational data.

Discusser: John Wentz, P.E., Power Engineers, Cincinnati, OH

POWER WASTEWATER CHALLENGES AND SOLUTIONS

Time: 8:00am–12:00noon; Room: Int'l Ball Room North

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

Session Chair: Bill Willersdorf, Veolia Water Technologies, Randolph, NJ

Discussion Leader: Kristen Jenkins, Southern Research Institute, Cartersville, GA

There are many challenges facing the power industry, requiring a holistic review of the operation of the plant and its affect upon wastewater generation and treatment. If you don't have a complete plan in place, you will need one. If you have a plan, come share it. Actual case studies on work or studies performed for coal fired facilities will be presented. While the focus is on USEPA regulations recently passed, the issues of wastewater treatment and its potential reuse is global. Both the CCR Rule and the Steam Electric Effluent Limitation Guidelines (ELG's) will change the way coal fired stations operate. Certain states and organizations have passed even tighter regulations based upon locations near environmentally sensitive areas. We are sure you will learn information you can bring back to your organization to assist them in finding solutions!

8:00 AM

IWC 15-61: EPA ELG Compliance – Assessment and Mitigation Strategies

Daniel Sampson, WorleyParsons, Folsom, CA; David Fetterman, Gary Maurer WorleyParsons, Reading, PA

Water represents one of the most critical power plant resources. The need to efficiently manage water will only increase as pressures to close ash ponds, respond to drought, and conserve water grow. This paper describes work performed at a four-unit coal-fired plant in the Eastern United States to assess the impact of the pending changes, determine the current water/mass/chemistry balance, and determine options that would allow the plant to comply with the EPA effluent limitations guidelines and standards. Future work will evaluate options to direct all water away from the ash pond to other users while minimizing both capital and operating expense.

Discusser: Chethan Acharya, Southern Company Services, Birmingham, AL

8:50 AM

IWC 15-62: Water Balance Modeling for Coal-Fired Generation Facilities

Jacob Sauer, P.E., Ron Jorgenson and Todd Stong, P.E., Golder Associates Inc., Lakewood, CO

The current regulatory environment faced by the coal-fired generation industry means that operational changes at most facilities are inevitable. For water management systems as complex as those at generation facilities, a dynamic water balance simulation is an appropriate tool to evaluate water management in a holistic manner. This article describes how plant personnel can develop and apply

a water balance model to understand the relationship between CCRs and process water before making significant investments in operational changes based on the CCR and ELG rules.

Discusser: Richard Breckenridge, EPRI, Charlotte, NC

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-63: Approaching the CCR Rule from a Water Balance Perspective

Michael J. Roush, II, P.E, M.B.A., Kristin Glikbarg, P.E., Katie Bland, P.E., John Leach, P.E. Burns & McDonnell, Kansas City, MO

With the new Coal Combustion Residuals (CCR) rule in place, many coal-fired power generation facilities are being forced to consider closing existing ash ponds. Although removing CCR materials such as gypsum, bottom ash and fly ash from these ponds will be a prime focus for facilities, closing a typical impoundment involves much more than simply converting to dry ash handling and storage. The pond water contents will either require a pump and treat system for discharge or require re-use within the power generation facility. This rule also produces a ripple effect on a plants water balance as ash ponds typically receive ash transport waters along with a host of other wastewater streams. This paper will review several case studies of facilities challenged with dry ash conversions, pond closures and additional wastewater treatment for streams no longer treated within impoundments. Capital cost and implementation schedules will be included.

Discusser: William Kennedy, Duke Energy, Charlotte, NC

10:50 AM

IWC 15-64: Limiting Metal Discharge from Ash Storage Ponds: A Compliance Case Study

Chloe Grabowski and Josh Pruskiewicz HDR, Inc., Ann Arbor, MI; Brian Powers, P.E., HDR, Inc. Charlotte , NC

This paper will focus on a specific case study for a 200 MW coal fired power plant that explored several options to meet more stringent National Pollutant Discharge Elimination System (NPDES) permit limits at the plant's wastewater/ash storage pond outfall. The modified permit for this facility set daily limits targeting heavy metals removal where previously only monitoring of these contaminants was imposed. The major source of these heavy metal contaminants is coal combustion residuals from bottom ash sluicing.

Discusser: Eric Blumenstein, Golder Associates, Inc., Lakewood, CO

WASTEWATER TREATMENT AND MANAGEMENT STRATEGIES

Time: 8:00am–12:00noon; Room: Int'l Ball Room Center

IWC Rep: Bob Applegate, Graver Water Systems, LLC, New Providence, NJ

Session Chair: Mike Bluemle, Solenis LLC, Wilmington, DE

Discussion Leader: Michael Doenges, Bowen Engineering, Indianapolis, IN

A vast array of technical approaches have been developed to manage municipal and industrial wastewater due to differences in influent composition, effluent discharge requirements and operational constraints. These limitations and challenges have often resulted in innovative, cost-effective treatment strategies, which are critical to the operation of a well-run plant or facility. This session will include actual data collected from lab-scale through full-scale testing, water balance modeling and operational management experiences. These papers will demonstrate the importance of flocculant mixing for sludge dewatering, review the design and construction of a wastewater treatment plant to handle landfill leachate, update us on the installation and operation of an underground injection well at a zero liquid discharge coal-fired plant, and, lastly, review case studies related to the design and operation of wastewater facilities governed by the pending EPA Effluent Limitation Guidelines.

8:00 AM

IWC 15-65: How to Maximize the Value of Polymers for Improved Sludge Treatment

Yong Kim, Ph.D., UGSI Chemical Feed, Inc., Vineland, NJ

This paper demonstrates how to design a better polymer mixing system to maximize the value of polymers based on the knowledge of fluid dynamics and polymer chemistry. Extensive lab test results are illustrated regarding the effects of dilution water and different mixing schemes on polymer performance. Field evaluation at a wastewater treatment plant showed that a well-designed polymer mixing system can improve the performance of sludge treatment processes as well as significant polymer savings.

Discusser: Christopher R. Leitz, Solenis LLC, Wilmington, DE

8:50 AM

IWC 15-66: Design/Construct in an Accelerated Environment

Ivan A. Cooper, P.E., BCEE, Civil & Environmental Consultants, Inc., Charlotte, NC

Leachate discharge from a Midwest US landfill to the municipal sewer system was cut off because of the high strength, and the owner was forced to haul leachate great distances at high costs. Faced with this dilemma, and aggressive time agreements with regulatory agencies to reduce the leachate strength to previous levels, the owner embarked on an accelerated schedule to deliver a plant from initial conceptualization to startup in about a year, where conventional approaches would require 3-5 years. The program included bench and pilot tests concurrently

with design, and a Design/Construct/Operate approach. The challenges included toxic metals inhibition removal, biological wastewater treatment with high hardness and scaling in a calcium rich environment competing for biological activity, excessive heat generation removal, rapid corrosion and deposition on metal surfaces, and UV disinfection absorbance at the municipal wastewater plant, among others. The pretreated leachate discharge's interfered with UV disinfection at the POTW, and investigations for improving UV transmittance (UV-T) included ozone, ozone with hydrogen peroxide, Fenton's reagent, and nanofiltration, and results are presented in this paper. As none of these technologies were successful, a force main to discharge the pretreated leachate to a larger POTW was implemented concurrent with the construction program to allow discharge to commence.

Discusser: Sam Fackrell, Bowen, Lanham, MD

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-67: Underground Injection Well Installation and Operation at Great River Energy's Coal Creek Station

Ron Jorgenson, Judy Kuepfer and Todd Stong, P.E., Golder Associates Inc., Lakewood, CO

At Great River Energy's (GRE) Coal Creek Station (CCS), a two-unit 1,200-megawatt coal-fired energy generation facility in North Dakota, generation leaders worked with Golder Associates Inc (Golder) on a comprehensive site-wide water balance to evaluate and improve water management at the zero liquid discharge facility. As a result of the water balance evaluation, GRE submitted an aquifer exemption and a permit application for the installation of a Class 1 underground injection well to manage excess water at CCS. The injection well design and permitting was the subject of a 2013 IWC paper. In 2014 and 2015, Golder, in conjunction with Hydro Resources Inc. (Hydro) installed and tested the well for injection. This paper is an update to the 2013 IWC paper to provide information on the final permitting, installation of the underground injection well, initial operation of the well, and the effects on the site-wide water balance.

Discusser: James Beninati, HDR Engineering, Pittsburgh, PA

10:50 AM

IWC 15-68: Examining Design Challenges and Opportunities to Comply with Anti-Circumvention Provisions As Proposed in the ELG's

Kristin Glikbarg and Andrew Erickson, E.I.T. Burns & McDonnell, Kansas City, MO

Within the proposed Effluent Limitation Guidelines (ELG's) published in June 2013 and due to be finalized this fall, EPA has included provisions to prevent facilities from circumventing the effluent limitations guidelines and standards by requiring that specific wastewater streams meet effluent quality before they can be re-used or combined with other wastewater streams. The specific wastewater streams affected by the anti-circumvention are FGD wastewater,

gasification wastewater and leachate. These provisions introduce both challenges and unique design opportunities for wastewater treatment systems going forward. This paper will review several case studies of both existing and planned wastewater facilities and examine how the anti-circumvention provisions impact both system design and operations to achieve the required segregation of targeted streams.

Discusser: Tom Higgins, PhD, P.E., CH2MHill, Reston, VA

PRODUCED WATER - MAKE UP AND FEEDWATER

Time: 8:00am–12:00noon; Room: Int'l Ball Room South

IWC Rep: Jim Sabzali, Aldex Chemical Company Ltd., Granby, QC Canada

Session Chair: Rafique Janjua, Fluor Enterprise, Inc., Sugar Land, TX

Discussion Leader: Michael Soller, Bowen Engineering, Indianapolis, IN

Produced water (PW) end users, especially in steam generation like in SAGD operations, face many capital & technical intensive challenges to maintain their systems. This session presents methods to improve and enhance efficient PW design and operation. Authors will describe chemical modeling to predict reactions and prevent scale and corrosion problems, experience using mechanical vapor compression horizontal falling film evaporators, SAC ion exchange effects of regenerant salt purity, and advances in chemical free cleaning techniques.

8:00 AM

IWC 15-69: Chemical Modeling for SAGD and Industrial Water Applications

Emily Zevenhuizen, Kevin Drake and AJ MacDonald
Integrated Sustainability Consultants Ltd., Calgary, AB, Canada

Corrosion and scale precipitation are major concerns for industrial water treatment facilities for processes including steam-assisted gravity drainage (SAGD) and related enhanced oil recovery processes. To better predict water chemistry for industrial applications, chemical modeling has been implemented to accurately predict chemical reactions that take place during water treatment processes, as a result of stream mixing, chemical addition, ion exchange and changes in temperature and pressure. Chemical modeling predicts the thermodynamic equilibrium of a given chemical reaction. Some restrictions of chemical modeling include the effect of organics, and understanding the impact of kinetics and transport within a system.

Analysis of water quality verifies if corrosion and precipitation/scaling will occur and will help determine appropriate solutions for chemical optimization and mitigation of the corrosion and scaling issues. Chemical modeling and subsequent analysis and interpretation of the results based on process streams of known pressure, temperature and composition has allowed process specialists to assess the impact of stream mixing on scale precipitation to decrease the risk of formation of barite, calcite, strontium carbonate and other scales that interfere with or reduce the efficiency of industrial processes.

Other applications for which this chemical analysis is conducted include assessing the effects of stream mixing for downhole injection, evaluating chemical requirements, and predicting corrosive vapor formation. To ensure the chemical modeling outputs are representative to the reaction

under investigation, correlation to field data and mass balances are required, as well as an in-depth knowledge of reaction kinetics and chemistry.

This paper will discuss the benefits of implementing chemical modeling for SAGD process analysis, as well as the restrictions of the modeling software and how to supplement the software to mitigate software restrictions.

Discusser: Joe Bodeux, Baker Hughes, Bonnyville, AB, Canada

8:50 AM

IWC 15-70: Case Study: Horizontal Falling Film Evaporator for Produced Water in Canada

Yaniv Schmidt, IDE Technologies, Kadima, Israel

Alberta, Canada is becoming a major oil supplier by utilizing vast reserves of bitumen. This unconventional oil is accessed by an enhanced oil production technique - Steam Assisted Gravity Drainage (SAGD) [1], based on steam injection. Bitumen-producing sites require reliable and economic advanced water treatment systems. As part of the development work on the horizontal falling film in SAGD applications, IDE conducts an evaporator piloting program, which provides viable information on the technology's capabilities and advantages.

Discusser: Greg Mandigo, Aquatech International, Hartland, WI

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-71: Influence of Quality of Salt Used for Regeneration of SAC Resin

Guy Mommaerts, Ion Exchange Services (Canada) Inc., Elora, ON Canada

This paper presents a review of various SAC and SAC-SAC installations using different grades of salt. The presence of hardness in the salt has a direct influence on the leakage that can be obtained by such systems under various ranges of TDS. Under certain conditions, this allows to avoid the need for a WAC Polisher. Importance and Benefits of Counter-Current Regeneration will also be covered. Data presented are based on actual data collected from the field. Also presented will be the influence of some other factors on the hardness leakage from SAC systems.

Discusser: Mike Wethern, GE Water & Process Technologies, Mandeville, LA

10:50 AM

IWC 15-72: Chemical-Free Cleaning Solution for SAGD/CSS Filtration and Ion Exchange Equipment

René Bélanger, P.Eng., Baker Hughes, AB, Canada; Edward J. Van Doorn, Ph.D. Baker Hughes, Calgary, AB, Canada; Guy Boisvert, Eng., Baker Hughes, Red Deer, AB, Canada

The Steam-Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS) industries commonly face fouling of their filtration and ion exchange equipment causing a reduction in water quality and throughput performance.

Acids, caustic, surfactants or sodium hypochlorite are the generally accepted chemicals to restore cleanliness and capacity depending on the fouling material whether inorganic or organic. This paper describes the strategy used to remove oil fouling from walnut shell filters and SAC resin without the use of any chemicals but instead relying on the inherent properties of saline water.

Discusser: Joseph W. Guida, P.E., Fluor, Sugar Land, TX

PLANT COOLING TOWER MAKEUP ALTERNATIVES AND COOLING WATER TREATMENT OPTIONS

Time: 8:00am–12:00noon, Room: Crystal

IWC Rep: Paul Puckorious, Puckorius & Associates, Inc./Water Training Serv., Arvada, CO

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

Discussion Leader: Charles Kuhfeldt, Athlon Solutions, Taylor Lake Village, TX

Due to the ever increasing scarcity of water, power plant developers are turning to alternate sources of makeup for cooling towers. These alternative makeup water sources are typically wastewaters in lieu of freshwater. Use of wastewater comes with chemistry challenges in order to prevent biological growth, corrosion and scale in the cooling tower. The papers in this session will include comparisons of alternate sources of cooling tower makeup at power facilities, in addition to cooling water chemical treatment options to meet discharge limitations and minimize chemical handling.

8:00 AM

IWC 15-73: Use of Secondary Treated Municipal Waste Water for Cooling in Power Plants

Caroline Sui, James Scattolini, Daniel Obermann, Ian Haber, James Kotz, and Jeffrey Melzer GE Power and Water, Water & Process Technologies, Trevose, PA

As the world's population and water scarcity concerns increase, the competition between agricultural, consumer, and industrial uses for the limited supply of fresh water is intensifying. With its dependency on water for energy production, the thermoelectric power industry will be forced to look for and use non-traditional water sources, including treated municipal waste water (MWW), (i.e., reclaimed water, which is considered an abundant and accessible alternative water source), to operate their cooling towers. In recent years, reclaimed water is becoming the standard for new power plant construction or the only source considered as existing facilities look to expand production.

The use of treated MWW, especially secondary treated MWW, represents a dramatic departure from the use of fresh water for cooling towers. The propensity for deposition due to high levels of phosphate and corrosion from high chlorides and sulfates increases significantly. Also biological considerations tied directly to TOC, BOD, COD, ammonia and TKN must be integrated into the treatment approach, and the presence of suspended solids and heavy metals further complicates cooling tower treatment requirements. A cooling water treatment program for this tough to treat water must be more robust to resist problems associated with these challenges, more resilient to handle make-up water variability, and requires a complete system approach for success.

This paper will discuss the challenges of using secondary treated MWW as a cooling water source and technology developed to treat this water. The successful application of

this technology in a power plant using secondary treated MWW for cooling tower make up will be reviewed, emphasizing how a complete program of chemistry, instrumentation, monitoring, program management, and communication with the reclaimed water provider are required to achieve excellent results.

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

8:50 AM

IWC 15-74: Cooling Tower Water Management Strategy for Large Combined Cycle Power Plant

Jared S. Troyer, Duke Energy, Charlotte, NC; Katie L. Jones, P.E.; Daniel B. Wilkinson, P.E.; Leigh-Ann Dudley, P.E. Dewberry Engineering, Inc., Raleigh, NC

Duke Energy and Dewberry evaluated technical, operational, and regulatory alternatives to optimize the cooling tower (CT) water management strategy at a large gas fired power plant. The project involved two interrelated components as alternatives were evaluated for make-up water supply and blowdown water discharge. The plant receives make-up water from a municipal water treatment plant (WTP) which has a dedicated non-potable treatment train. Duke Energy requires an average of 6.0 MGD and a peak supply of 7.5 MGD, and requires make-up water quality to be <2 NTU turbidity and <5 mg/L TSS. The make-up water quality is variable and does not regularly meet the above requirements. This increases CT maintenance/operational costs and negatively impacts the cooling tower blowdown water quality. During poor make-up water quality events, supplemental potable water is used at higher cost.

The two major project objectives were:

• Develop strategy to facilitate delivery of consistent high quality make-up water to meet future demand requirements.

• Develop blowdown discharge strategy that is robust, compliant, and economically attractive.

The following make-up water alternatives were evaluated:

• Upgrade/optimize the WTP make-up train

• Install new treatment infrastructure at the plant

• Install new groundwater well system

The following blowdown discharge alternatives were evaluated:

• Indirect discharge (POTW)

• Direct discharge (surface water)

• Land application

• Onsite reuse

Capital/operating cost data were developed for each alternative and the technical merits of each alternative were compared. The study provided technical, regulatory, and economic justification for Duke Energy to develop and implement a new cooling tower water management strategy.

Discusser: Jasbir Gill, Nalco an Ecolab company, Naperville, IL

9:40 AM COFFEE BREAK

10:00 AM

IWC 15-75: Advances In Pretreatment, Passivation, and Layup of Cooling Systems

Raymond M. Post, P.E., Prasad Kalakodimi, Ph.D. and Richard H. Tribble, ChemTreat, Richmond, VA; Jeffrey Lamm and J.L. Nelson, NAES, Roanoke Valley Energy Facility, Weldon , NC

Cooling system assets should be protected from corrosion at all times, whether the system is in normal operation, just being placed in service, coming out of service, in layup, or long term storage. Cooling systems that are improperly treated during intermittent operation or layup will experience corrosion problems that are difficult to overcome once the system is returned to service. Traditional pretreatment and layup practice involves the use of high levels of polyphosphate, organic phosphate, or ortho phosphate. These protective phosphate films are not as persistent as the zinc phosphate and chromate films that were once permitted, allowing unacceptable corrosion performance following pretreatment or during stagnant conditions that can occur following hydrotesting and during layup or cycling operation. High levels of orthoand poly- phosphate can be expensive, difficult to dispose, and cannot be applied to the system with heat load, often causing the passivation process to be omitted entirely. This paper describes the development and application of a new treatment that forms a truly passive film on steel surfaces. Electrochemical techniques used in the development and evaluation of the chemistry including cyclic voltammetry and electrochemical impedance spectroscopy are discussed. Case histories are provided to illustrate the effectiveness of this technology for cleaning and passivation and as part of a comprehensive program for protecting power plant cooling systems from corrosion during cycling operation.

Discusser: Chris Friesen, FUSE Inc., Red Deer, AB, Canada

10:50 AM

IWC 15-76: Purate™: An Alternative Oxidant Technology for Water Pretreatment, Cooling Water Biocontrol, and Discharge Management

Kun Xiong, Shane Rife, Amit Gupta, Jim Boak, Tom Woodruff, Nalco - An Ecolab Company, Naperville, IL

A 750 MW gas fired combined cycle zero liquid discharge power plant in North America wanted to test a new chlorine dioxide technology, PurateTM, as a replacement for their current biocide (sodium hypochlorite) and oxidant (sodium permanganate) treatment programs. To demonstrate this new alternate oxidant technology, a three-month trial was completed where ClO2 was dosed instead of the hypochlorite and permanganate to the pretreatment system, hypochlorite to the clarified water storage tank and cooling tower. The addition of ClO2 also allowed the plant to eliminate the permanganate feed to the clarifier inlet for removal of manganese from the water entering the plant. The goals

of the trial were to maintain or improve microbial control and manganese removal, minimize chemical handling and exposure to operators, while reducing total cost of operation. This paper discusses the results of this ClO2 trial and the potential benefits to the plant operations. The success of the trial was best summarized by the plant's Operations Manager who said "the operational benefits are very positive for us"

Discusser: Chris Baron, Solenis, Newark, DE

CONTINUING EDUCATION WORKSHOPS

The IWC Continuing Ed Workshop program is designed to provide practical information that includes a basic understanding of the topic as well as detailed case studies. They are presented by experts in the field and are loaded with technical content, not for sales information. Each workshop will provide an opportunity for a technical exchange between the students, the instructor and other workshop participants. The workshop will provide attendees four (4) professional development hours (PDHs) and a certificate of completion. A separate fee of $250.00 per workshop is required. Discounts are given for multiple registrations. All workshops are scheduled based on minimum reservations; please inquire with conference staff about the current status of any of the workshops.

SUNDAY, NOV. 15; 1:00–5:00 PM

W1*: Water Treatment 101 (repeated on Wednesday)

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

W2**: Ion Exchange Technology and Practical Operating Practices (repeated on Thursday)

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 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, Elmhurst, IL

WEDNESDAY, NOV. 18; 1–5:00 PM

W1A*: Water Treatment 101 (repeated from Sunday)

This workshop is a great introductory course covering the basic concepts of water treatment for industry. It will

address unit operations (clarification, filtration, lime/soda ash softening, iron and manganese removal, membrane filters, and roughing demineralizers) used in water preparation for industry with emphasis on power, chemical industry, and refineries. It was include treatment of makeup water for cooling water systems as well as boiler water makeup. Wastewater generated by these unit operations and their treatment and disposal will be discussed. Basic water chemistry requirements for low, medium, and high pressure boilers will be considered with chemical conditioning as required.
Dennis McBride, Fluor Enterprise, Greenville, SC

W3: Industrial Boiler Water (up to 1800 PSIG/120 Bar)

The course 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.
James Robinson, GE Betz Trevose, PA

W4: Introduction to Cooling Tower Water Systems and How to Develop a Cooling Tower Water Treatment Program 101

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

W5: Thermal Zero Liquid Discharge Processes

This course is designed to give a basic understanding of the information required for the selection and design of an evaporation system in a wastewater application. It will include the impacts of chemistry, equipment selection and energy source selection as well as provide case studies based on real world applications in a variety of industries.
J. Michael Marlett, Aqua-Chem ICD, Hartland, WI

W6: Treating Produced Water with Ion Exchange Technologies

General introduction on Softening with Ion Exchange. Description of the nature of SAC resin and of WAC resin. Influence of TDS on selection of which resin to select. Advantages to consider SAC-SAC systems. Why single WAC are able to produce soft water (<0.1ppm) on water with up to 25000ppm TDS. Why WAC Primary followed by WAC Polisher should be considered. Potential foulants of ion exchange resins in the process of softening Produced Water, and how to deal with them. All data presented is based on actual plant experience!

Guy Mommaerts, Ion Exchange Services Canada, Inc, Elimira, ON, Canada

W7: Arsenic and Selenium in Wastewater Treatment

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

W8: Produced Water – Treatment Chemicals Step-by-Step in SAGD and CSS Processes

This course is intended for SAGD and CSS chemical technologists, engineers, plant operators and supervisors interested in better understanding the effects of various chemicals on produced water throughout the entire processes in plant facilities. Some basic theory is covered but the primary goal of the course is to provide practical information that can be applied to prevent common system problems. The program material includes inlet separation, de-oiling, evaporators, warm or hot lime softening, filtration and ion exchange. The setting is interactive with past or present plant experiences being shared for the benefit of the course audience.

Rene Belanger, Baker Hughes, Calgary, AB, Canada

W9: Wet Flue Gas Desulfurization (FGD) Chemistry and Operational Impacts on Wastewater Quality Discharge

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, PE, Burns & McDonnell, Centennial, CO

W10: Environmental Compliance Regulations in the Power Industry

Never has there been a time in the history of electric generation that so many regulations are going into effect or planned to go into effect at the same time in multimedia fields. This workshop will examine in detail all of these rules and their impact on environmental compliance and their impact on electric generation.

Rules that will be reviewed, MATS, Effluent Guidelines, CASPR, 316B, CCR, 111D and new source review. The workshop will also look at the impact of NSR settlements. We will also look at what is going on in SPCC, Land and Avian Protection. The workshop will not only focus on the rules but the impact on the future of electricity and fuel sources.
Bert Valenkamph, Northern Indiana Public Service Company (NIPSCO), Merrillville, IN

THURSDAY, NOV. 19; 8:00 AM–NOON

W11: Treatment of Water for Steam Generation in SAGD Enhanced Oil Recovery Plants

"Once you know the fundamentals, acquiring experience is just a matter of time." This course explores the theories and fundamental practices for treating de-oiled produced and brackish waters to generate high pressure steam for use in SAGD enhanced oil recovery operations. We will explore hot and warm lime softening, filtration and ion exchange options such as strong acid versus weak acid cation softening including in-situ versus external regeneration.
Robert Holloway, Holloway Associates, Etobicoke, ON, Canada

W12: HRSG and High Pressure (>900 PSIG/60 BAR) Boiler Water Treatment and Operation

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

W13: Water Treatment 201

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

Kumar Sinha, Private Consultant, Frederick, MD and Rafique Janjua, Fluor, Sugarland, TX

W14: Advanced Ion Exchange

This workshop is designed to build on basic ion exchange principals and will provide the opportunity to acquire an in depth knowledge of how ion exchange resins can be used in applications other than traditional softening and deionizing applications. The workshop is divided into four sections.

1. Ion exchange fundamental theories and a review of the four basic types of ion exchangers, how their properties differ, and how they are used.
2. Capacity calculations for any virtually any ion and solution and how to make preliminary calculations to determine if ion exchange is feasible and/or practical.
3. Trace ion removal, principal of concentration difference, an over view of selective resins, and brief discussion of how some of the more common trace contaminants can be treated.
4. Identification of problems causes, troubleshooting approaches, cleaning strategies, and how to set up spreadsheet models of operating ion exchange systems that normalize operating data.

In order to get the most out of this workshop, students will need to bring laptops that have MS Office software including Excel.

Peter Meyers, Resin Tech, Inc, West Berlin, NJ

W15: Reverse Osmosis - Back to the Basics, Design and Operation

The application of reverse osmosis (RO) has grown rapidly over the last 15 year. However, some of the basics have been lost in shuffle. Furthermore, many times professionals and operators familiar with ion exchange are now faced with operating RO systems with little or no training. This Workshop covers the basics of RO, 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 basics of RO.

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

W16: Fundamentals of Evaporative Water Treatment for Steam Generating EOR Processes

Evaporative water treatment may seem complex at surface level, but once the underlying principles are understood, evaporation system design and operation become very straightforward. This course is designed to explore everything from the fundamentals of evaporator technology to its integration into various EOR processes: steam injection processes such as SAGD and CSS. Course matter will cover the basics of producing water suitable for steam generation (either drum boilers or OTSG's) and maximizing water recycle by employing concentration and crystallization systems. A particular emphasis will be placed on water chemistry design implications and unit operations such as falling film evaporation and crystallization will be covered in-depth. Several real world case studies will be examined to reinforce theoretical principles.

Greg Mandigo, Aquatech International Corp., Hartland, WI

W18: Produced Water OTSG Scaling and Corrosion

Thermal oil recovery operations require large quantities of high pressure steam. Produced water, water separated from the emulsion produced by the oil wells, is the most readily available and efficient source of boiler feedwater. Unfortunately, produced water contains many impurities that can cause a variety of scale and corrosion problems in the system. This workshop will focus on the major scale and corrosion challenges posed by operating once through steam generators (OTSGs) on produced water. Produced water chemistry and major unit operations for pretreatment will be reviewed. Mineral scale formation and coke formation on OTSG heat transfer surfaces will be examined in detail including methods for diagnosing, monitoring and mitigating these deposition problems. Major corrosion mechanisms such as oxygen corrosion, erosion corrosion and steam system corrosion will also be discussed as will the special challenges for monitoring and preventing those damaging reactions. Participants will be encouraged to consider OTSG scale and corrosion problems in the broader context of total plant operation and the impacts of water recycle and system design in the SAGD process will be discussed.

Martin Godfrey, Nalco, An Ecolab Company, Eagan, MN

W19: Electrodeionization (EDI)

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 are required to regenerate ion exchange resins. EDI is now over 25 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.
Jonathan Wood, Evoqua Water Technologies, Lowell, MA

W20: Cooling Water Treatment Programs and Guidelines When Switching from Fresh to Reuse Water Makeup

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

THURSDAY, NOV. 19; 1–5:00 PM

W2A**: Ion Exchange Technology and Practical Operating Practices (repeated from Sunday)

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 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, Elmhurst, IL

W22: De-oiling Produced Water for In Situ Oil Sands

Upstream of "Produced Water Treatment" in SAGD or CSS, water that has been separated from the bulk bitumen/dilbit phase, contains varying amounts of hydrocarbon. If not removed from the system this hydrocarbon will negatively impact the performance of Boiler Feed Water pre-treatment equipment such as Lime Softening, Ion Exchange and Evaporators. This introductory course looks at the fundamentals of the De-oiling system. We will explore the purpose and system design, of specific equipment such as Skim Tanks, Induced floatation (ISF and IGF), as well as Oil Removal Filters (ORF's). We will also discuss industry standards, chemistry, and lessons learned.

Chris Graham, C.G.Consulting, Inc., Calgary, AB, Canada

W23: Water and Wastewater Treatment for Natural Gas Development

The ongoing development of the unconventional natural gas market was made possible by developments in the fields of directional drilling and hydrofracturing. Hydrofracturing requires large volumes of water, processing of that water to use in hydrofracturing, and handling of the return water from the well after Completion of hydrofracturing. As hydrofracturing water comes in contact with shale, some of the soluble shale constituents dissolve into the hydrofracturing water.

Current options for handling of hydrofracturing water include treatment for reuse, treatment for discharge, and deep well disposal. The focus of this course is to provide a foundational understanding of the use of water in hydrofracturing, and the disposition of return water (flowback and produced water) from hydrofractured wells. Areas of emphasis include hydrofracturing water preparation, treatment of flowback water for reuse, evaporation-crystallization of hydrofracturing water, and overall economics of water management. The course serves as a sound introduction to the area for those wishing to learn about shale gas development, and provides detailed information for professionals who may be working with shale gas water.

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

W24: UF, RO and EDI Maintenance and Cleaning

Presentation of common practices in the maintenance of ultrafiltration, reverse osmosis and deionization systems, including best practices for off-line clean-in-place process as well as on-site membrane cleaning practices membrane and system life and minimizing operations cost.

For ultra-filtration and reverse osmosis the training review will cover preventive maintenance practices, spares replacement frequencies, and non-scheduled maintenance repairs. There will be a detailed discussion of membrane maintenance practices, including why cleaning is important, when CIP or onsite site cleaning should be triggered, the common foulants, preparation of cleaning solutions, standard cleaning procedures, tips and shortcuts, and when off-site membrane

cleaning should be considered.

Attention will be focused on the key performance indicators for RO/NF membranes and hollow fiber ultrafiltration membranes that should trigger a membrane cleaning process and the variation in procedures and solutions for onsite cleaning for RO/NF membranes for removal of silt, biological materials, naturally occurring organics, calcium carbonate, iron and silica as well as UF membranes for removal of biological materials, silt, naturally occurring organics, and iron.

There will also be discussion of membrane autopsies, when they are needed and how to interpret the results. With the increasing use of electrodeionization technology such as continuous deionization the instructor will also touch on best practices in determination when unit cleaning is required as well as proper chemical cleaning and off site cleaning practices.

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

W25: Wastewater Treatment for Energy and Chemicals

Subjects discussed:

- Identification of wastewater streams
- Selective segregation of wastewater streams
- Pretreatment of segregated streams
- Terminology & Microbiology of wastewater treatment
- Primary wastewater treatment unit operations
- Secondary wastewater treatment unit operations
- Solids production, its treatment and disposal management

Rafique Janjua, Fluor, Sugarland, TX

W26: Mine Water Treatment

Mining activities have resulted in significant environmental impacts all over the world. Local communities, state, and federal authorities are enforcing stricter effluent discharge limitations on new and existing facilities. Mine water management, handling of acid mine drainage, and water reuse are some of the major challenges in the mining industry. Mining processes, mine water characteristics, current practices and emerging physical/chemical and biological treatment technologies pertaining to mine water management and treatment will be the focus of this workshop.

Conventional and new physical/chemical technologies for removal of heavy metals, arsenic, selenium and other oxyanions will be reviewed. Cyanide chemistry and treatment technologies will be presented. Technologies to meet the latest stringent sulfate discharge limitations also will be discussed. The growing emphasis on mine water reuse and technologies to make reuse possible will be considered.

Interest is growing in biological treatment as an economically viable solution for removing various constituents from mine water. Mining effluents can contain nitrogen in a variety of forms. When explosives such as ANFO are used, ammonia and nitrate are present. In gold mining where cyanide

extraction is used, CN, SCN, OCN and NH4-N are present. All of these can be removed biologically through nitrification/denitrification processes. Coal and copper mine effluent may be contaminated with selenium present as selenate or selenite. These contaminants can be reduced to elemental selenium, a particulate form of the mineral, which can then be separated from the water phase. Particular attention will be given to MBBR (moving bed biofilm reactor) technology, which has been used successfully in several mining applications.

All technologies discussed will include detailed information such as pilot study results as well as case studies and performance data for full-scale installations. Don't miss this opportunity to learn about the latest developments in water management and treatment for the mining industry.

Kashi Banergee Ph.D., P.E., BCEE, Veolia, Moon Twp., PA; Caoline Dale, Veolia, Cary, NC

Exhibitors

IWC EXHIBIT HALL

The IWC Exhibit Hall features countless different opportunities to learn about practical and innovative solutions for the industrial water treatment industry from industry leaders. The Exhibit Hall is located inside the Grand Ballroom. The Exhibit Hall hours of operation are:

- Sunday, November 15 from 5:00–7:00 PM
- Monday November 16 from 11:30 AM–1:30 PM and 4:00–6:00 PM
- Tuesday November 17 from 11:30 AM–1:30 PM and 4:00–6:00 PM

Be sure to join us for lunch on Monday and Tuesday, as well as the evening receptions Sunday, Monday, and Tuesday. Luncheons and receptions are open to all registered attendees. A listing by booth number of all IWC Exhibitors is provided below. On the following pages, you will find a detailed description of these Exhibitors, including contact information and company description.

Booth - Company:

100 Graver Water Systems/ Ecodyne Water
101/103 SUEZ
102 Wunderlich - Malec Engineering, Inc.
104 AbTech Industries Inc
105 Pall Corporation
106 Univar
107 Sumitomo Electric Industries, Ltd.
108 Global Chem-feed Solutions
109 Carus Corporation
111 Heartland Technology Partners, LLC
113 RODI Systems Corp.
115 DOW Water and Process Solutions
200 Nalco, An EcoLab Company
201 Aquatech International Corp.
202 Nalco Champion
203 ASA Analytics
204 Waters Equipment Co.
205 PSI Onsite Disinfection
206 GRUNDFOS Pump Corporation
207 Justeq LLC
208 MAR Systems, Inc.
209 H2O Innovations
210 University of Wisconsin- Madison
211/213 IDE Technologies
212 FLUIDRA USA
214 ITOCHU Chemicals America Inc.
215 Ramboll Environ
216 American Water Chemicals
217 Ovivo USA
300 Turner Designs Hydrocarbon Instruments, Inc.
301/303 LANXESS Sybron Chemicals
302 Sentry Equipment Corp.
304 Bowen Engineering Corporation
305 U.S. Water Services
306 TriSep Corporation
307 OLI Systems, Inc.
308 Chemtrac, Inc.
309 USP Technologies (formerly U.S. Peroxide)
310 UOP, A Honeywell Company
311 BKT
312 Honeywell Process

Exhibitors

Exhibitor listing, continued

Solutions
313 Atlantium Technologies
314 BluMetric Environmental Inc.
316 newterra
317 Swan Analytical USA
400 Golder Associates, Inc.
401 De Nora Water Technologies
402 ResinTech, Inc.
403 SAMCO Technologies
404 MPW Industrial Services
405 Illinois Water Technologies
406 Genesys International, Ltd.
407/409 GE Water & Process Technologies
408 AMSA, Inc.
410 CLO2 Services, LLC
411 Lechler, Inc.
412 Advanced Sensors Limited
413 Brenntag North America
416 QUA Group, LLC
417 LMI
500 Veolia Water Technologies
501 WesTech Engineering, Inc.
502 Schreiber, LLC
503 Parkson Corporation
504 Thermax, Inc.
505 METTLER TOLEDO Thornton
506 WaterTectonics
507 Advanced Inspection Technologies
508 Baker Hughes Process & Pipeline Service
509 Avista Technologies, Inc.
510 Hach Company
511 Jacobi Carbons, Inc.
512 WaterColor Management
513/515 Wigen Water Technologies
516 Solenis LLC
517 Burns and McDonnell Engineering Company, Inc.
600/602 Purolite Corporation
601 ChemTreat, Inc.
603 AVANTech, Inc.
604 BlueInGreen
605 Federal Screen Products Inc
606 Mitsubishi Electric Automation, Inc.
607 Curran International
608 Chlorinators Incorporated
609 Centrisys Corporation
610 ProChem, Inc.
611/613 Neptune Chemical Pump Co.
612 CHEMetrics, Inc.
614 Burkert Fluid Control Systems
615 Taylor Technologies
616 Howden North America
617 Stenner Pump Company
700/702 Evoqua Water Technologies
701 French Creek Software, Inc.
703 Johnson March Systems, Inc.
704 Southern Research Institute
706 Filtrafine Corp.
707 Athlon Solutions
708 Danfoss High Pressure Pumps
709 Frontier Water Systems, LLC
710 Shandong Taihe Water Treatment Co.
712/714 Doosan Hydro Technology LLC
713 Eisenmann
716 FilterBoxx Water & Environmental Corp.

ABTECH INDUSTRIES INC

Booth: 104
Contact: Jeff Gutierrez
Phone: 480-874-4000
Fax: 480-970-1665
E-mail: jgutierrez@abtechindustries.com
Web: www.abtechindustries.com

AbTech Industries is a full-service environmental technologies firm dedicated to providing innovative solutions to customers addressing issues of water pollution and contamination. Bacteria, hydrocarbons and heavy metals are among the most problematic and dangerous contaminants of runoff and yet often are the most challenging to treat. AbTech offers 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 effective and economical solutions. AbTech products include advanced filtration media technologies and various water treatment systems. The filtration media technologies are generally based on our patented and proven Smart Sponge® products capable of removing hydrocarbons, heavy metals, sediment and other foreign elements from still and flowing water. The antimicrobial product, Smart Sponge® Plus, reduces total coliform bacteria found in stormwater, industrial wastewater, and municipal wastewater and is registered with the EPA (EPA Registration #86256).

ADVANCED INSPECTION TECHNOLOGIES

Booth: 507
Contact: Paul Fitzgerald
Phone: 321-258-5901
Email: paul@aitproducts.com
Website: www.aitproducts.com

A leading supplier of remote visual inspection equipment to industrial customers. AIT also rents video borescopes and pipe cameras for a variety of inspections.

ADVANCED SENSORS LIMITED

Booth: 412
Contact: Solene Nugent
Phone: 028-933-5646
E-mail: solene.nugent@advancedsensors.co.uk
Website: www.advancedsensors.co.uk

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

AMERICAN WATER CHEMICALS

Booth: 216
Contact: David Russell
Phone: 951-216-0240
Fax: 951-302-9042
E-mail: drussell@membranechemicals.com
Web: www.membranechemicals.com

American Water Chemicals (AWC) manufactures specialty chemicals for pretreatment and maintenance of reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) membrane systems. AWC is an international ISO 9001:2008 certified company that serves clients around the world. AWC has pioneered advanced membrane autopsy techniques and investigative services and supports all business sectors. We improve membrane system performance and optimize cost of operation by diagnosing and solving complex operational problems.

AMSA, INC.

Booth: 408
Contact: Janice Shawl
Phone: 989-662-0377
Fax: 989-662-6461
E-mail: sales@amsainc.com
Web: www.amsainc.com

AMSA, Inc. manufactures DTEA II™ an organic deposit cleaner, penetrant aide and dispersant. DTEA II™ provides a Biofilm Control Program (BCP™) when used with a biocide (now sold under the BCP™ 1000 label). DTEA II™ in typical acidic scale and corrosion one-drum formulas provides scale & deposit control, plus the full benefits of DTEA II™.

AQUATECH INTERNATIONAL CORP.

Booth: 201
Contact: Patrick Randall
Phone: 724-263-7040
E-mail: randallp@aquatech.com
Web: www.aquatech.com

Aquatech is a global leader in water technologies, with a focus on desalination, wastewater reuse, and zero liquid discharge, that help industrial and infrastructure markets solve water challenges.

ASA ANALYTICS

Booth: 203
Contact: Bernie Beemster
Phone: 262-717-9500
Fax: 262-717-9530
E-mail: bernie@chemscan.com
Web: 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 SOLUTIONS

Booth: 707
Contact: Charles Kuhfeldt
Phone: 225-673-2436
Fax: 225-673-1970
E-mail: charles.kuhfeldt@athlonsolutions.com
Web: www.athlonsolutions.com

Athlon Solutions provides industrial water, process and finished fuel additive chemicals and engineering services to the Refining, Petrochemical, Fertilizer and Power industries. Our 50 year history in industrial water, process and finished fuel treatment offers an experienced engineering based approach to address our customer's unique challenges. Athlon Solutions provides our customers operational confidence by safely delivering high-quality local services, corporate technical support, R&D innovation, supply and delivery efficiencies and effective communication.

ATLANTIUM TECHNOLOGIES

Booth: 313
Contact: Dennis Bitter
Phone: 714-305-6111
E-mail: dennisb@atlantium.com
Web: www.atlantium.com

Atlantium Technologies, Ltd. Is a proven solution for chemical free dechlorination to protect RO membranes. As well as, a proven control for combined macro (AIS) and micro bio fouling. Treatment is a continuous control for boiler feed water, cooling water, process water and raw water systems. A "new era" in water treatment, Hydro Optic™ Science is a cutting edge, environmentally-friendly, disinfection solution based on new generation UV technology. Systems are compact easy to install with lower Capital and Energy costs then traditional UV technology. HOD UV has achievements not seen by any other UV science.

AVANTECH, INC.

Booth: 603
Contact: Jim Braun
Phone: 803-622-5426
E-mail: pbarnello@avantechinc.com
Web: www.avantechinc.com

AVANTech is a comprehensive leader in providing innovative solutions to improve efficiencies in water treatment and waste minimization practices. We have enjoyed the opportunity to work with a diverse group of clients including the power industry and government sectors. With our wide range of engineers and design teams, we have the knowledge and expertise to deliver timely quality results allowing us to drive down costs and minimize wastes. The company is a global leader in the safe recycling, processing and disposal of nuclear material. We provide an integrated service to many of the commercial US nuclear plants and can respond to emergency efforts such as what was needed following the result of the Fukushima Daiichi incident. Technologies include demineralization, polymer solidification, filtration and ultrafiltration, reverse osmosis, dewatering, and drying. Our units can be furnished on a stand-alone basis, or can be combined to provide the most efficient means of processing while minimizing radiological effects and the generation of waste material. Systems have demonstrated superior performance when it comes to process stream or pool cleanup programs, sludge collection, silica removal, boric acid recovery, and / or zero environmental release activities. Come by and see us at booth 603 to learn more about what AVANTech can offer.

AVISTA TECHNOLOGIES, INC.

Booth: 509
Contact: Cheddy Tobias
Phone: 760-744-0536
Fax: 760-744-0619
E-mail: sales@avistatech.com
Web: www.avistatech.com

Avista Technologies is a trusted expert in membrane system chemistry and global technical and laboratory support for Reverse Osmosis and Micro/Ultra Filtration membrane systems and Multimedia Filtration. Reverse Osmosis products include: Vitec® antiscalants, RoClean and AvistaClean® membrane cleaners and RoCide® biocides. A Green line of proven antiscalants and cleaners are free of phosphate, phosphonate, and EDTA. AvistaClean® MF are one-step cleaners formulated to restore MF/UF membrane performance when generics are no longer effective.

BAKER HUGHES PROCESS & PIPELINE SERVICE

Booth: 508
Contact: Mark Wieczorek
Phone: 302-753-703
Web: www.bakerhughes.com

Baker Hughes is a leading supplier of oilfield services, products, technology and systems to the worldwide oil and natural gas industry. We offer downstream technology services for the worldwide hydrocarbon processing, and petrochemical industries to help you to increase your throughput, improve plant safety, and equipment reliability.

BKT

Booth: 311
Contact James Kim
Phone 714-578-0676
Email jsk@bkt21.com
Website www.bkt21.com

BKT provides treatment technology for various types of wastewater including FGD, produced and flowback, along with industrial wastewaters.

The antifouling membrane system, FMX, specializes in the liquid-solid separation for high density, high viscosity, and high solid applications. FMX can successfully achieve significant removal of contaminants and need can meet strict discharge limits with downstream reverse osmosis. BKT provides biological wastewater treatment, membrane filtration, and energy solutions to clients, including many global Fortune 500 companies.

BLUEINGREEN

Booth: 604
Contact: Christopher Milligan
Phone: 479-527-6378
Fax: 479-668-0841
E-mail: admin@blueingreen.com
Web: www.blueingreen.com

BlueInGreen offers the most efficient method of transferring gas into liquid. With over a decade of experience, the company has grown into four revolutionary solutions – the SDOX®, for adaptable aeration, the CDOX®, for precise pH adjustment, the HyDOZ®, for dependable disinfection, and the SDOX-CS®, for optimized odor control - all working together to improve water quality at a fraction of the cost. When you think water, think BIG.

BLUMETRIC ENVIRONMENTAL INC.

Booth: 314
Contact: Gary Black
Phone: 613-818-4611
Fax: 613-839-0697
E-mail: gblack@blumetric.ca
Web: http://blumetric.ca/

BluMetricTM is a multidisciplinary Environmental Engineering company and equipment manufacturer based in Ottawa, Ontario. We provide design-build and pre-engineered industrial/commercial water and wastewater treatment product solutions as well as professional environmental consulting services. Our equipment solutions include the COBRA™ MBR (featuring LG membranes), Rotordisk RBCs, Package Treatment plants and High Strength Industrial Treatment Systems. We operate under the philosophy that we will provide a single source solution, from process definition through construction, commissioning, and on-going support. BluMetric designs proprietary water and wastewater management systems and deploys them around the world.

BOWEN ENGINEERING CORPORATION

Booth: 304
Contact: Michael Soller
Phone: 317-842-2616
Fax: 317-841-4257
E-mail: msoller@bowenengineering.com
Web: www.bowenengineering.com

Bowen is a self-performing general contractor who delivers owners EPC and self-perform construction services including site, civil, structural, boilermaker and mechanical construction. With 48 years serving the Water/Wastewater and Energy/Industrial Markets, Bowen is your nationwide Industrial Water, CSO, ELG, MATS, and CCR construction expert. Bowen has constructed over 1,000 treatment facilities, and has strong phys-chem, biological, evaporator experience. We are your most Resourceful, and Responsive construction firm bringing you the best results.

BRENNTAG NORTH AMERICA

Booth: 413
Contact: Barbara Nothstein
Phone: 610-916-3858
Web: www.brenntagnorthamerica.com

Brenntag Water Additives your partner in Solutions for Industrial, Commercial and Municipal Water Treatment. Experienced and dedicated team members apply knowledge from Brenntag's global network to meet local needs. Brenntag is a full line chemical distributor with over 140 stocking locations in the US and Canada. Our broad product line includes coagulants, flocculants, biocides, scale inhibitors, corrosion inhibitors, defoamers, permanganates, filtration media, NSF certified products and facilities, as well as products for heavy metal removal and odor control. Contact Brenntag today to learn how we can be your trusted partner in delivering quality chemicals safely, and on time. Connecting Chemistry

BURKERT FLUID CONTROL SYSTEMS

Booth: 614
Contact: Ursula Johns
Phone: 949-223-3102
Fax: 949-223-3198
E-mail: ursula.johns@burkert.com
Web: www.burkert-usa.com

Burkert Fluid Control Systems is a global system solution provider in the water treatment industry. Our focus is on reliability and innovation, with the goal of creating lasting and effective results for the customer. Our manufacturing expertise encompasses process control and automation in a consultant system minded approach. We bring this wide range of knowledge to the water treatment industry for the purpose of offering: improved automation, accuracy and safety for processes within the industry. Aiding our customers in areas of desired improvement is our goal.

BURNS AND MCDONNELL ENGINEERING COMPANY, INC.

Booth: 517
Phone: 816-822-3230
Fax: 816-333-3690
E-mail: ggrothen@burnsmcd.com
Web: www.burnsmcd.com

Burns & McDonnell comprises more than 5,000 engineers, architects, construction professionals, scientists, consultants and entrepreneurs. Our dedicated water group for utility plants stands ready to solve your toughest problems. We are steadfast in our mission to make our clients successful. For more information, visit burnsmcd.com.

CARUS CORPORATION

Booth: 109
Contact: Sheryl Ivy
Phone: 800-435-6856
Fax: 815-224-6697
E-mail: salesmkt@caruscorporation.com
Web: www.caruscorporation.com

Carus Corporation offers cost-effective and environmentally attractive alternatives to oxidize and remove unwanted pollutants and contaminants from waste streams and industrial processes. Our long history, unmatched experience and expertise provides customer specific solutions to many diverse industries. We wish to provide value to your business and applications with innovative, cost-effective solutions which will exceed your expectations. We welcome the challenge to work with you and meet your needs.

CENTRISYS CORPORATION

Booth: 609
Contact: Jerod Swanson
Phone: 262-654-6006
Fax: 262-764-8705
E-mail: info@centrisys.us
Web: www.centrisys.com

Centrisys is a USA manufacturer of dewatering and thickening centrifuges for municipal and industrial wastewater. The Centrisys team is and always has been focused on centrifuge technology. This includes the award winning THK Series Thickening Centrifuge, 2 and 3 phase technologies and custom design solutions. Centrisys provides global service, repair and parts for all manufacturers' centrifuges. The Centrisys team is known for their process optimization expertise and hands on approach to find the most efficient dewatering solutions.

CHEMETRICS, INC.

Booth: 612
Contact: Deanne Casey
Phone: 540-788-9026
E-mail: marketing@chemetrics.com
Web: www.chemetrics.com

CHEMetrics, Inc. manufactures test kits and instruments for more than 50 water quality analysis parameters. All kits feature self-filling reagent ampoules that simplify water quality testing. Applications for the products include pure water, drinking water, wastewater and environmental water testing. Industries served include water treatment, food and beverage, power generation and aquaculture.

CHEMTRAC, INC.

Booth: 308
Contact: Joe Zimmerman
Phone: 770-449-6233
Fax: 770-447-0889
Web: 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, INC.

Booth: 601
Contact: Stacy Freed
Phone: 804-935-2000
E-mail: stacyf@chemtreat.com
Web: 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.

CHLORINATORS INCORPORATED

Booth: 608
Contact: Chris Myers
Phone: 772-288-4854
Fax: 772-287-3238
E-mail: regal@regalchlorinators.com
Web: www.regalchlorinators.com

Chlorinators Incorporated has been manufacturing the Regal gas chlorinator for 40 years, making our products the top choice for the water and waste water industries. The Regal gas chlorinator mounts directly on the cylinder, which makes it the safest and most reliable method of chlorination and has been proven by years of usage worldwide. Made in the USA, the Regal system offers the strongest materials and fewest parts making it the most cost effective disinfection option available today. The Regal Gas Chlorination System… Your Trusted Selection for Water Disinfection.

CLO2 SERVICES, LLC

Booth: 410
Contact: Patrick Kostella
Phone: 361-541-8419
E-mail: pkostella@clo2services.net
Website: www.clo2services.net

CLO2 Services, LLC is an Industrial Service Provider of Chlorine Dioxide utilizing a patented generation process that minimizes risk to equipment while maximizing the inherent benefits that ClO2 brings as a biocide and sanitizer. CLO2 Services, LLC offers a wide range of generators for every application. Our process is not a batch process, so no storage is required, and we produce an inherently safe ClO2 solution with NO CHLORINE or OZONE in the product.

CURRAN INTERNATIONAL

Booth: 607
Contact: Ed Deely
Phone: 281-339-9993
Fax: 281-339-9994
E-mail: edeely@curranintl.com
Web: www.curranintl.com

Curran International is a global leader in the preservation and restoration of mild and alloy steel used in industrial water service. We provide global applications and are expert at in-situ project execution for the following disciplines; thin film foul release coatings for heat exchanger tube IDs; epoxy cladding systems for condenser tube sheets and water boxes; alloy tube repair sleeving; high pressure tubular plugging; flanged pipe ID coating; pressure vessel internal coating; metalization and alloy spray applications for CUI.

DANFOSS HIGH PRESSURE PUMPS

Booth: 708
Contact: Gary Ford
Phone: 772-219-0745
E-mail: gford@danfoss.com
Web: www.ro-solutions.com

Danfoss High Pressure Pumps is a Global Leading supplier of high-pressure pumps (APP) and energy recovery devices (iSave) for SWRO applications - landbased, marine, offshore and mobile/containerized applications. The axial piston pumps are among the most reliable and energy-efficient on the market. The pumps are compact and easy to maintain. The isobaric energy recovery devices provide up to 95% efficiency. Flexible and compact, iSave ERDs are as easy to install as they are to operate.

DE NORA WATER TECHNOLOGIES

Booth: 401
Contact: Charles J. Guzelli
Phone: 412-841-2399
Fax: 747-300-2456
E-mail: Charles.Guzelli@denora.com
Web: www.denora.com

De Nora Water Technologies represents more than 50 years experience of water treatment applications through brands such as Capital Controls®, TETRA®, ClorTec® and EST, combined with the product development and electrolytic disinfection expertise of a true global leader. The company's products, systems and technologies, boosted by continuous investments in R&D, are used across multiple industries and applications including the municipal water and wastewater, oil and gas, power generation and marine sectors.

DOOSAN HYDRO TECHNOLOGY LLC

Booth: 712/714
Contact: Michael Henin
Phone: 813-549-0182
Fax: 813-623-6666
E-mail: bdev@doosanhydro.com
Web: hwww.doosanhydro.com

Doosan Hydro Technology is a leading supplier of Water & Wastewater treatment solutions, serving the Industrial, Power & Municipal markets. Backed by 30 years of experience and over 150 successful installations, we are an integrated solution provider for design, manufacturing, assembly & operation of membrane based Water & Wastewater Treatment (UF, NF, RO & MBR). Our Company also provided associated treatment processes such as chemical precipitation, Ion Exchange, Demin, Remin & ZLD systems.

DOW WATER AND PROCESS SOLUTIONS

Booth: 115
Contact: Katie Mann
Phone: 952-914-1002
E-mail: mann2@dow.com
Web: www.dowwaterandprocess.com

The global leader in sustainable separation and purification technology, Dow Water & Process Solutions is making a clear impact in the world. We offer a broad portfolio of ion exchange resins, reverse osmosis membranes, ultra filtration membranes and high-solids filtration products, with strong positions in a number of major application areas, including industrial and municipal water, industrial processes, pharmaceuticals, power, residential water and waste and water reuse.

EISENMANN

Booth 713
Contact: Sabine Nickel
Phone: 224-795-1982
E-mail: sabine.nickel@eisenmann.com
Web: www.eisenmann.us.com

Eisenmann provides environmental technologies from air pollution control to water and waste water treatment. Eisenmann customers stand to benefit in two ways: from our far- reaching experience with environmental technology, and from our comprehensive engineering skills in manufacturing and process technology.

EVOQUA WATER TECHNOLOGIES

Booth: 700/702
Contact: Debra Johnson
Phone: 719-550-2074
Fax: 719-550-2232
E-mail: debra.johnson@evoqua.com
Web: www.evoqua.com

Evoqua is the global leader in helping customers protect and improve the world's most fundamental natural resource: water. We have a more than 100-year heritage of innovation and industry firsts, market-leading expertise, and unmatched customer service. Customers worldwide have turned to proven products from such Evoqua brands as Wallace & Tiernan, Aquamedia, Chlorco, Himsley International, and many more. Today, our continuing investment in new and innovative technologies keeps Evoqua at the leading edge

FEDERAL SCREEN PRODUCTS INC

Booth: 605
Contact: Greg Colman
Phone: 905-677-4171
Fax: 905-677-8959
E-mail: greg@federalscreen.com
Web: www.federalscreen.com

FEDERAL SCREEN PRODUCTS, manufactures Wedge Wire screen and fabricated Wedge Wire products for straining, screening, filtering and media retention in water purification, conditioning and waste water equipment. Custom designs include Nozzles, Header and Lateral assemblies, Radial Hub assemblies, Flat Panels and Strainer baskets. We manufacture to our customer's drawings and specifications in materials such as 316L SS, 304L SS, Alloy 20, Hastalloy C-276, Monel, Super Duplex, Zeron 100 and Titanium. Federal Screens takes pride in their high quality products, reliable customer service, prompt deliveries and competitive pricing.

FILTERBOXX WATER & ENVIRONMENTAL CORP.

Booth: 716
Contact: Krystal Markiewicz
Phone: 403-203-4747
Fax: 403-203-4774
E-mail: krystal.markiewicz@filterboxx.com
Web: www.filterboxx.com

FilterBoxx is a recognized leader in the design and supply of packaged and modular water and wastewater solutions. These include both industrial water and wastewater treatment systems for a broad range of industries. We have also provided drinking water systems and sanitary wastewater treatment packaged units in plants, facilities and camps around the globe.

FILTRAFINE CORP.

Booth: 706
Contact: Ken Ansell
Phone: 864-415-0463
E-mail: ken.ansell@filtrafine.com
Web: www.filtrafine.com

Filtrafine Corp is a worldwide leader in the design and manufacture of disposable filter cartridges, filter bags and filter housings. . Filtrafine has developed an in depth understanding of how its filtration products provide critical benefits in a wide array of applications by working closely with its customers to improve processes and products. Filtrafine's main expertise lies in the designing and manufacturing of filter cartridges, bags filters and housings. With extensive and solid experience designing and producing pressure vessels we specialize in the manufacturing of pressure vessels according to Pressure Equipment Directive (92/23/EC) and ASME Boiler and Pressure Code. Our filter materials are FDA compliant with more established products bearing NSF and RoHS certification.

FLUIDRA USA

Booth: 212
Contact: Carme Marine
Phone: +34608209886
E-mail: cmarine@fluidra.com
Web: www.fluidra.us

A United States manufacturing facility serving the North American market Fluidra USA is a very unique business unit of the Fluidra group. Our most valuable sector is the manufacturing of vertical and horizontal fiberglass filtration vessels of different sizes with different connections. Our filters can be used for swimming pools, aquaculture, mining, irrigation, water treatment, desalination and other industrial applications. They are suitable for mechanical filtration, ion exchange, activated carbon filtration, biological filtration, denitrification or remineralisation.

FRENCH CREEK SOFTWARE, INC.

Booth: 701
Contact: Baron Ferguson
Phone: 610-935-8337
Fax: 610-935-1008
E-mail: info@frenchcreeksoftware.com
Web: www.frenchcreeksoftware.com

French Creek develops and markets software tools for water treatment including industry standard WaterCycle(R) for cooling water, DownHole SAT(R) for oil field brinesand flow back systems, MineSAT(tm) for waste streams and process waters, WatSIM(tm) for potable water, and hydROdose(R) for membrane systems. All tools feature the French Creek engine for scale prediction, corrosion modelling, and inhibitor optimization. Advanced version allow the development of inhibitor models from laboratory and/or field data, as well as the development of system specific corrosion models. Private label and web versions available. Windows DLLs and static UNIX libraries available for license to add the French Creek Engine and capabilities to your in house applications and controllers.

FRONTIER WATER SYSTEMS, LLC

Booth: 709
Contact: Tim Pickett
Phone: 801-206-4116
Fax: 801-206-4110
E-mail: info@frontierwater.com
Web: www.frontierwater.com

Frontier Water systems is North America's supplier of premium, engineered biofilters for the treatment of selenium, mercury, arsenic, and nitrates. From the core team of scientists and engineers, to our construction and manufacturing partners, we foster and build upon the most applied experience in effective and practical biological solutions for power and mining. The use of biology to address our most pressing treatment challenges is now rapidly evolving – and Frontier Water Systems is leading the charge. Our advances in biological metals removal technology will save heavy industry hundreds of millions of dollars today, while providing the cleanest water possible to our lakes and rivers. Our customers and environment will always demand a better answer. That's exactly what we are delivering at Frontier.

GE WATER & PROCESS TECHNOLOGIES

Booth: 407/409
Contact: Renee Twardzik
Phone: 215-942-3288
E-mail: renee.twardzik@ge.com
Web: www.gewater.com

With operations in 130 countries and employing nearly 8000 worldwide, GE Water & Process Technologies brings together experienced professionals and advanced technologies to solve the world's most complex challenges related to water availability and quality, increased productivity and cost reduction, and environmental regulations.

GENESYS INTERNATIONAL, LTD.

Booth: 406
Contact: Ursula Annunziata
Phone: +44 (0)1628 667605
E-mail: uannunziata@genesysro.com
Web: www.genesysro.com

GENESYS - an industry leader in the development and manufacture of speciality membrane antiscalant and cleaning chemicals for RO/NF/UF systems. Developed from 2001, our team of industry experts supports a network of over sixty distributors. New innovations include:-
GENAIRCLEAN™, RO membrane cleaning incorporating micro-bubbles and effervescent reagents in our GENESOL™ cleaners, enhancing deposit removal.
MEMBRANE MASTER 4™, our scaling prediction software, available for distributors and consultants, supporting our extensive range of GENESYS™ antiscalants.

GLOBAL CHEM-FEED SOLUTIONS

Booth: 108
Contact: Don Crawford
Phone: 215-840-5664
Fax: 215-675-0895
E-mail: donc@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. Additionally, GCS manufactures Chlorination Systems as well as Ammonia Storage feed systems.

GOLDER ASSOCIATES, INC.

Booth: 400
Phone: 303-980-0540
Fax: 303-985-2080
E-mail: paul_pigeon@golder.com
Web: www.golder.com

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

GRAVER WATER SYSTEMS/ ECODYNE WATER

Booth: 100
Contact: Robert Applegate
Phone: 908-516-1404
Fax: 908-516-1401
E-mail: rapplegate@graver.com
Web: www.graver.com

Graver Water Systems and Ecodyne Water design and manufacture water and wastewater treatment systems and equipment. Our engineers are knowledgeable in pretreatment, degasification, hot lime softening, boiler make-up, condensate polishing, waste treatment and oil/water separation for industry and electric utilities.

GRUNDFOS PUMP CORPORATION

Booth: 206
Contact: Michael Salvato
Phone: 505-792-4744
E-mail: msalvato@grundfos.com
Web: www.grundfos.com

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

H2O INNOVATIONS

Booth: 209
Contact: Gabrielle Roy
Phone: 418-688-0170
Email: gabrielle.roy@h2oinnovation.com
Website: www.h2oinnovation.com

H2O Innovation designs, manufactures and assembles water treatment systems. Each project is customized by our multidisciplinary team with extensive knowledge of water treatment and membrane filtration. This knowledge added to our capacity to think outside the box allows us to provide unique solutions that truly meet your requirements whether it is the production of drinking water or wastewater treatment, treat process water or even recycle water. H2O Innovation also offers complete technical & maintenance service in order to support your system's operation on a continuous basis.

HACH COMPANY

Booth: 510
Contact: Tori Schneider
Phone: 800-227-4224
Fax: 970-669-2932
E-mail: tschneid@hach.com
Web: www.hach.com

Hach is committed to providing solutions for better management and testing of water quality by offering high- quality products that are simple to use and accurate. Our analytical instruments and reagents are used to test water quality in a variety of industries and markets around the globe. Water analysis has to be right. You deserve complete solutions you can be fully confident in. Hach is your resource for expert answers, outstanding support, and reliable, easy-to-use products.

HEARTLAND TECHNOLOGY PARTNERS, LLC

Booth: 111
Contact: Craig Clerkin
Phone: 1-800-759-1758
E-mail: info@heartlandtech.com
Web: www.heartlandtech.com

Heartland develops and markets proprietary wastewater treatment technology and services to the oil and gas, electric power generation, and landfill leachate industries. Our proven approaches treat these challenging waste streams in a single-step evaporative process without the need for pretreatment. Our reliable treatment system is capable of processing the diverse range of water chemistries found in evaporation ponds, FGD purge water and landfill leachate created from bottom ash, fly ash, boiler slag, and other FGD byproducts.

HONEYWELL PROCESS SOLUTIONS

Booth: 312
Contact: Nour Al Hadrami
Phone: +971 2 409 0581
Fax: +971 2 443 2536
E-mail: nour.alhadrami@honeywell.com
Web: www.honeywellprocess.com

Honeywell is a leading supplier of process control instrumentation, including a broad range of analytical instrumentation. Conductivity, pH, ORP and dissolved oxygen analysis systems are available for high purity water and other industrial and municipal liquid applications.

HOWDEN NORTH AMERICA

Booth: 616
Contact: Brian Boyle
Phone: 716-845-0600
E-mail: Brian.Boyle@howden.com
Web: www.howden.com

Howden people live to improve our products and services and for over 160 years our world has revolved around our customers. This dedication means our air and gas handling equipment adds maximum value to your operations. We have innovation in our hearts and every day we focus on providing you with the best solutions for your vital operations.

IDE TECHNOLOGIES

Booth: 211/213
Contact: Schmidt Yaniv
Phone: 052-382-6317
E-mail: yanivs@ide-tech.com
Web: www.ide-tech.com

IDE. Your Water Partners

IDE is a world leader in water treatment solutions, specializing in the development, engineering, construction and operation of some of the largest and most advanced desalination, industrial water treatment and water reuse plants. IDE works in partnership with a wide range of customers on all aspects of water projects, delivering 3 million m3/day of high quality water worldwide. IDE brings technological leadership, proven reliability and consistent delivery to all our customers.

ILLINOIS WATER TECHNOLOGIES

Booth: 405
Contact Paul Byrd
Phone 815-636-8884
Email paulb@illinoiswatertech.com
Website www.illinoiswatertech.com

Illinois Water Technologies is a service provider for industrial and commercial water treatment providers. Our services include start up and commissioning, installation management,system integration and general service support. We have a experienced staff of Field Service Engineers that are available for short and long term assignments throughout the world.

ITOCHU CHEMICALS AMERICA INC.

Booth: 214
Contact: Fred Ghanem
Phone: 856-207-4370
Fax: 913-333-7848
E-mail: fred.ghanem@itochu-ca.com
Web: www.itochu-purification.com

ITOCHU Chemicals America products include premium ion exchange resins from Mitsubishi Chemical as well as Manganese/Iron filtration sand from Quantum. In November 2015, Mitsubishi Chemical is starting their new Korean plant with over 700,000 cft supply of various uniform cation and anion exchange resins for water and specialty applications. Known for its lot to lot reproducibility and superior performance, Mitsubishi is now capable of supplying such resins within a short lead-time. Please stop at booth 214 to learn more and meet our technical team.

JACOBI CARBONS, INC.

Booth: 511
Contact: Matt Potok
Fax: 215-546-9921
E-mail: matt.potok@jacobi.net
Web: www.jacobi.net

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

JOHNSON MARCH SYSTEMS, INC.

Booth: 703
Contact: John Sands
Phone: 215-364-2500 x 552
Fax: 215-364-5425
E-mail: john.sands@johnsonmarch.com
Web: www.johnsonmarch.com

A worldwide leader in the design and fabrication of custom Chemical Dosing Systems for Boiler, Cooling Tower and Waste Water Treatment, Process Additive Systems, Steam and Water Sampling Panels, Ammonia Feed Systems, ASME Code Pressure Vessels, Electrolytic Chlorination Systems, Gaseous Chlorination Systems,Equipment Shelters, Dust Suppression Systems and Sample Coolers.We are ISO 9001-2008 Certified by Underwriters Laboratories. All welders are ASME code certified and CWB (Canadian Weld Bureau) certified. We have completed projects in over 63 countries. Johnson March was founded in 1935.

JUSTEQ LLC

Booth: 207
Contact: Sang-Hea "Justin" Shim
Phone: 847-656-8626
Fax: 847-656-8627
E-mail: justin@justeq.com
Web: www.justeq.com

Justeq sells a revolutionary biocide called Justeq07, which is unlike any other, that forms bromine within slime masses. Thus, it is able to break-up slime masses from within and is able to do this at significantly lower costs than stabilized bromine products. Because it is so stable, it is much less corrosive, is effective in contaminated water, and is completely compatible with other supplemental chemicals, such as corrosion inhibitors. Come see us to find out more about Justeq07!

LANXESS SYBRON CHEMICALS

Booth: 301/303
Contact: Cheryl Shemeley
Fax: 609-894-8921
E-mail: cheryl.shemeley@lanxess.com
Web: www.lanxess.com

LANXESS is a major global solution provider for liquid purification, with a leading position in ion exchange resins and a strong commitment to its reverse osmosis (RO) membrane business. We have more then 75 years of experience in water treatment and purification applications. LANXESS manufactures state-of-the-art Lewabrane® RO membrane elements for desalination of seawater, brackish and low-salinity waters in industrial and potable water (NSF certified) applications and are supported with a full service package that includes RO system design with our innovative LewaPlus™ software tool.

LECHLER, INC.

Booth: 411
Contact: Diana Lent
Phone: 630-845-6830
Fax: 630-377-6657
E-mail: DianaLent@Lechlerusa.com
Web: www.lechlerusa.com

Lechler strives to provide the best engineering resolutions that produce precision spray nozzles and engineered solutions. Our nozzles and systems are an important part of spray applications in industries such as environmental, wastewater treatments, power generation and general applications.

LMI

Booth: 417
Contact: Donn Davis
Phone: 941-426-9872
Fax: 941-426-9873
E-mail: donn@fscflorida.com
Web: www.lmipumps.com

LMI provides one of the most extensive lines of chemical metering pumps and controllers for water and wastewater treatment industries. Our globally recognized yellow and black electronic and motor-driven pumps are designed for flow proportional applications that can withstand slurries and high viscosity chemicals. Our customers rely on us for our versatility and experience in the municipal, industrial and commercial markets.

MAR SYSTEMS, INC.

Booth: 208
Contact: Missy Hayes
Phone: 440-505-0962
Fax: 440-505-0964
E-mail: mhayes@marsystemsinc.com
Web: www.marsystemsinc.com

MAR Systems Inc. manufactures a patented eco-friendly, economical solution to permanently remove a wide variety of soluble heavy metals from water streams. MAR's Sorbster® technology, a high macro porosity, beaded media, is widely recognized as a significant advancement in water treatment, and the Company is considered an emerging industry leader to be watched.

METTLER TOLEDO THORNTON

Booth: 505
Contact: Peggy Banarhall
Phone: 781-301-8822
E-mail: peggy.banarhall@mt.com
Web: www.mt.com

METTLER TOLEDO Thornton is a leader in pure and ultrapure industrial water monitoring instrumentation used in microelectronic and power applications. Thornton core competence is the in-line measurement of conductivity & resistivity, TOC, dissolved oxygen, sodium, and silica in a variety of cycle chemistry and make up water applications. Recent additions to its portfolio of power products in Degassed Conductivity, optical dissolved oxygen and pH sensors designed for low conductivity applications.

MITSUBISHI ELECTRIC AUTOMATION, INC.

Booth: 606
Contact: Mike Canney
Phone: 847-478-2100
E-mail: Mike.Canney@MEAU.com
Web: https://us.mitsubishielectric.com/fa/en

Mitsubishi Electric provides solutions for a wide range of applications in the water industry ranging from small booster pumps to large municipal pumps and wastewater treatment facilities. Our broad range of technologies allows us to provide a single-source solution from field-level devices, VFDs, controls, to SCADA and network integration. Built-in features for energy savings lower TCO, while our focus on quality and years of experience lead to greater equipment uptime.

MPW INDUSTRIAL SERVICES

Booth: 404
Contact: Angela Rolfe
Phone: 740-927-8790
E-mail: arolfe@mpwservices.com
Website: www.mpwservices.com

MPW Industrial Services is the leading provider of integrated, technology-based industrial cleaning, facility management, water purification and container management services in North America.

NALCO CHAMPION

Booth: 202
Contact" Michelle Samuels
Phone: 630-414-2413
E-mail: Msamuels@nalco.com
Web: www.nalcochampion.com/

Nalco Champion, an Ecolab company. We are where you need us, when you need us. With a singular focus on providing specialty chemistry programs and related services, we enable and enhance your productivity, while reducing operating costs. Our cutting-edge technologies and innovative programs, combined with the experience and foresight of the industry's top scientists and researchers, are transforming the oil and gas industry. Together, we're taking energy further. Visit nalcochampion.com to learn more.

NALCO, AN ECOLAB COMPANY

Booth: 200
Contact: Kathy Schillinger
Phone: 630-305-1239
E-mail: kschillinger@nalco.com
Web: www.nalco.ecolab.com

Nalco an Ecolab company is "reinventing the way water is managed," in order to help customers' manage this critical component of their business. Nalco's expertise and innovation can help you minimize water usage, maximize results, and optimize your total cost of operation. Learn more about this as well as Nalco's exciting new PURATETM program, a best-in-class biocide program for challenging water conditions, designed to improve efficiencies and cost. For more information, visit www.nalco.ecolab.com or www.purate.com

NEPTUNE CHEMICAL PUMP CO.

Booth: 611/613
Contact: Thomas R. O'Donnell
Phone: 215-699-8700
Fax: 215-699-0370
E-mail: tom.odonnell@psgdover.com and greg.kriebel@psgdover.com
Web: www.psgdover.com

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

NEWTERRA

Booth: 316
Contact: Tom Vanden Heuvel
Phone: 941-441-1256
Fax: 941-480-9201
E-mail: tvandenheuvel@newterra.com
Web: www.newterra.com

newterra is recognized as a leader in the development of sustainable treatment solutions for water, wastewater and groundwater remediation for the power, petrochemical and pulp and paper markets. Our heritage of innovation in providing clean water solutions dates all the way back to 1863 with our legacy brands of COCHRANE, CHICAGO HEATER AND CRANE WATER.

OLI SYSTEMS, INC.

Booth: 307
Contact: Pat McKenzie
Phone: 973-998-0240
E-mail: pat.mckenzie@olisystems.com
Web: www.olisystems.com

OLI is a technology company with a core competency in electrolyte ther modynamics.OLI delivers its technology through rigorous, first-principles software that predicts the properties and chemical composition of multi-phase aqueous and non-aqueous system. OLI software and consulting technology is used in oil and gas production, chemical process, electricity generation, and other industries where water and non-aqueous electrolyte processes are involved. For more information contact us at oli.info@olisystems.com, visit us at www.olisystems.com.

OVIVO USA

Booth: 217
Contact: Guy Beauchesne
Phone: 801-931-3113
Fax: 801-931-3080
E-mail: guy.beauchesne@ovivowater.com
Web: www.ovivowater.com

Ovivo is a world leader Solution Provider for high quality water and wastewater treatment for for the Energy market; such as Automatic Raking System, Dual Flow Traveling Band Screen, Automatic Online Condenser Tube Cleaning, Debris Filters and Fish Protection. We also offer solutions for the Boiler Feed Water and treatment of industrial wastewater, as well as Fresh Water Maker and Produced Water for the Offshore.

PALL CORPORATION

Booth: 105
Contact: Kate Koerber
Phone: 919-621-7689
E-mail: Kate_Koerber@pall.com
Web: www.pall.com/water

Where fresh water is scarce, alternative sources of water are sought for industrial use. Your source water needs for industrial water applications can be met by using the Pall Aria™ FIT system. This is a pre-assembled, packaged water system that has a flexible design, small footprint and can produce high-quality water for industrial processes as well as meet stringent environmental discharge limits. Contact us today at water@pall.com or +1-516-484-3600.

PARKSON CORPORATION

Booth: 503
Contact: Alan Loncar
Phone: 954-974-6610
Fax: 954-974-6182
E-mail: technology@parkson.com
Web: www.Parkson.com

Parkson is a supplier of equipment for industrial process water and wastewater applications. The company, founded in 1960, has been owned by Axel Johnson Inc. since 1967. Parkson was a pioneer in inclined plate clarification and continuous backwash sand filtration. Today, Parkson is a complete industrial water and wastewater solutions provider with a wide range of technologies. Parkson can provide a complete solution for headworks, to pre-treatment for boiler feed water, to cooling tower clarification and filtration, to waste

PROCHEM, INC.

Booth: 610
Contact: Barry Shelley
Phone: 540-380-8523
Fax: 540-268-9874
E-mail: bshelley@prochemwater.com
Web: www.prochemwater.com

Leading provider of industrial water and wastewater treatment systems and supplies, including end-of-pipe water reuse systems, all tailored to the need, fully automated, and equipped with customized web-based remote monitoring. ProChem employs chemists, engineers, fabricators, and service technicians who ensure full quality control over the system's performance. ISO 9001:2008 certified.

PSI ONSITE DISINFECTION

Booth: 205
Contact: Pamela Castro
Phone: 408-370-6540
E-mail: pam@4psi.net
Web: www.4psi.net/

PSI now retains on a full-time basis nine individuals who jointly possess over 300 years of combined experience selling, designing, manufacturing, installing, and servicing similar onsite hypochlorite generation equipment and tank management equipment. With PSI systems across North America, the Pacific Rim, and Latin America, the team has been able to adapt to a wide variety of customer needs and preferences. No company in the water industry has more relevant experience, know-how or technology to meet customer needs in the area of OSHG and reservoir management.

PUROLITE CORPORATION

Booth: 600/602
Contact: Doree Jacobs
Phone: 800-343-1500
Fax: 484-384-2792
E-mail: doree.jacobs@purolite.com
Web: www.purolite.com

Founded in 1981, Purolite is a leading manufacturer of ion exchange media, polymeric adsorbents, catalysts, and advanced polymers. Purolite Corporation is also one of the world's largest developers and manufacturers of high-quality APIs, blood purification polymers, enzyme carriers, and chromatographic resins for life sciences. Our Life Science products bring advanced technology to laboratories and biomolecule manufacturing. We provide scientists and biomanufacturers with the highest-quality products to support upstream and downstream bioprocesses. Headquartered in Bala Cynwyd, PA., the company has ISO-certified manufacturing facilities in the USA, China, and Romania and operates dedicated R&D centers in the USA, China, Romania, Russia and the UK. Purolite, the only company focused exclusively on resin technology, has 40 sales offices in more than 30 countries.

QUA GROUP, LLC

Booth: 416
Contact: Fred Wiesler
Phone: 412-613-7088
E-mail: wieslerf@quagroup.com
Web: https//quagroup.com

QUA is an innovator of advanced membrane technologies and ultrafiltration products that address the most demanding water purification challenges. Headquartered in the USA, QUA enables OEM partners to provide cutting-edge systems and solutions to end users in industrial and infrastructure markets throughout North America and worldwide.

RAMBOLL ENVIRON

Booth: 215
Contact: John Driver
Phone: 615-277-7506
Fax: 615-377-4976
E-mail: jdriver@environcorp.com
Web: www.ramboll-environ.com

A premier global consultancy, Ramboll Environ is trusted to manage the most challenging water resources, wastewater, and storm water issues. We integrate treatment process selection and engineering, operational services, and regulatory management and planning to deliver innovative solutions.

RESINTECH, INC.

Booth: 402
Contact: Frank DeSilva
Phone: 856-768-9600
Fax: 856-768-9601
E-mail: fdesilva@resintech.com
Web: www.resintech.com

ResinTech is a manufacturer and supplier of ion exchange resins and activated carbon. This year ResinTech is showcasing their line of products for the power generation industry, including demineralization, condensate polishing, and nuclear radwaste treatment. Specialty medias include selective resins for the removal of antimony, silica, and chromate.

RODI SYSTEMS CORP.

Booth: 113
Contact: Stan Lueck
Phone: 505-334-5865
Fax: 505-334-5867
E-mail: info@rodisystems.com
Web: www.rodisystems.com

RODI Systems Corp. is a multi-faceted design and manufacturing business specializing in water treatment technology. Our products include membrane-based water treatment systems (microfiltration, ultrafiltration, and reverse osmosis) for water purification and wastewater treatment and recycling. We also offer instrumentation and control products for membrane systems including our unique EZ SDI silt density index analyzers.

SAMCO TECHNOLOGIES

Booth: 403
Contact: Robert Bellitto
Phone: 716-743-9000
Fax: 716-743-9209
E-mail: bellittor@samcotech.com
Web: www.samcotech.com

Process, design, engineering and manufacture of industrial water, waste and process separation systems for the oil/gas, chemical, power, mining, chlor alkali and petro chemical markets. Technologies include: membrane, ion exchange, physical chem, biological, filtration. Custom turn-key packages for demineralization, removal of metals and organics, brine purification, recycle/reuse. Licensed technology provider for DOW Up-Core, Amberpack and Advanced Amberpack technologies. Expertise in medium to large scale industrial, water treatment, waste, lithium, brine systems.

SCHREIBER, LLC

Booth: 502
Contact: Bill Kunzman
Phone: 205-655-7466
Fax: 205-655-7669
E-mail: billk@schreiberwater.com
Web: www.schreiberwater.com

Serving Industrial & Municipal markets since 1979, Schreiber LLC solves wastewater treatment problems through the application of energy-efficient, innovative, and proprietary equipment/process technology. Schreiber offers a complete system from head works to tertiary filtration. Our patented treatment processes such as the Continuous Sequencing Reactor® and compressible media filter "Fuzzy Filter®" combine effectiveness and efficiency to produce the industry's highest quality products.

SENTRY EQUIPMENT CORP.

Booth: 302
Contact: Joe Kreinus
Phone: 262-567-7256
Fax: 262-567-4523
E-mail: sales@sentry-equip.com
Web: www.sentry-equip.com

With proven sampling expertise since 1924, Sentry® products and services provide the power generation industry with the critical insights to optimize process control and protect plant assets. We deliver true representative sampling and analysis techniques to customers around the globe, empowering them to accurately monitor and measure processes for improved production efficiency, output and safety. With complete steam and water analysis systems and water chemistry services, we are determined to tackle any application, anywhere.

SHANDONG TAIHE WATER TREATMENT CO.

Booth: 710
Contact: Jessica Yuan
Phone: +86-632-5113066
Fax: +86-632-5112055
E-mail: jessica@thwater.net
Web: www.thwater.net

Shandong Taihe Water Treatment Technologies Co., Ltd. is the largest professional manufacturer of water treatment chemicals in China, with sales volume being No. 1 for years. Taihe focuses on manufacturing and devotes itself to be the production workshop for global water treatment industry. The turnover has reached USD 162 million with sales volume of 127,700 MT in 2014. Taihe's new project of 300,000 MT water treatment chemicals in Zhongtai Chemical Zone have been put into production.

SOLENIS LLC

Booth: 516
Contact: Michael Bluemle
Phone: 302-440-1158
Fax: 302-995-4161
E-mail: mbluemle@solenis.com
Web: 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 quality, protect plant assets and minimize environmental impact. Headquartered in Wilmington, Delaware, the company operates 30 manufacturing facilities strategically located around the globe and employs a team of 3,500 professionals in 118 countries across five continents. For additional information about Solenis, please visit www.solenis.com.

SOUTHERN RESEARCH INSTITUTE

Booth: 704
Contact: Laura Berry
Phone: 205-581-2502
E-mail: lberry@southernresearch.org
Web: www.southernresearch.org

Southern Research is a non-profit research organization of scientists, engineers and technicians which provides independent testing and technology development to solve environmental and energy challenges. Southern Research operates the world-class Water Research Center in Cartersville, GA.

STENNER PUMP COMPANY

Booth: 617
Contact: Stacy Nelson
Phone: 904-641-1666
Fax: 904-642-1012
E-mail: snelson@stenner.com
Web: www.stenner.com

Established in 1957, Stenner manufactures reliable peristaltic metering pumps for water treatment or injecting additives into a process. The variable speed SVP accepts a 4-20mA signal for automatic dosing with outputs in 1% increments. The Classic is a versatile electro-mechanical pump in adjustable or fixed models. All Stenner pumps are self-priming up to 25 ft and can run dry without damage. The patented pump head offers easy tube replacement. Visit the booth for hands-on demonstrations.

SUEZ

Booth: 101/103
Contact: Sylvie Roy
Phone: 804-756-8423
E-mail: sylvie.roy@degremont.com
Web: www.degremont-technologies.com

SUEZ is a global integrated group focused on the management of water and waste resources. On five continents, SUEZ supports municipalities and industries in the circular economy to maintain, optimize and secure the resources essential for our future. For industrial customers in North America, SUEZ provides a full line of integrated equipment solutions and services for raw water, high purity process water, waste water, and zero liquid discharge, available as single units of operation or complete, fully integrated systems.

SUMITOMO ELECTRIC INDUSTRIES, LTD.

Booth: 107
Contact: Takashi Harada
Phone: 647-546-5582
Fax: 416-368-5582
E-mail: takashi.haradi@beil.net
Web: http://global-sei.com

Sumitomo Electric offers two different technologies, MF/UF membrane and de-oiling filtration/adsorption unit, both suitable for industrial wastewater treatment including oil and gas applications. Membrane technology consists of robust MF/UF membrane of PTFE, having excellent thermal/chemical resistance and tolerance to high content of oil in feed water, exhibiting excellent filtration performance. De-oiling filtration/adsorption unit offers simple and cost effective solution to remove oil and suspended solids from about 500mg/L down to 50mg/L.

SWAN ANALYTICAL USA

Booth: 317
Contact: Dominic O'Donnell
Phone: 847-229-1290
Fax: 847-229-1320
E-mail: info@swan-analytical-usa.com
Web: www.swan-analytical-usa.com

Swan Analytical manufactures online continuous monitoring analytical instruments for high purity water, and potable water. Measurements include TOC, Conductivity/Resistivity, pH/ORP, trace D.O., trace sodium, trace silica, phosphate, nitrate, ammonium, hydrazine, chlorine, bromine, fluoride and turbidity. Swan's analyzers deliver high precision with ease of operation. Contact Bob Langie, bob.langie@swan-analytical-usa.com.

TAYLOR TECHNOLOGIES

Booth: 615
Contact: Chris Golden
Phone: 410-472-4340
Fax: 410-771-4291
E-mail: chris@taylortechnologies.com
Web: www.taylortechnologies.com

An ISO 9001:2008-certified manufacturer, Taylor Technologies has produced reliable, reasonably priced water-testing supplies for industrial water treaters since 1930. Offerings include the field-tested TTi® 3000 Colorimeter, as well as test kits, reagents, standard solutions, labware, and electronic meters. The TTi 3000 comes preprogrammed to test 30+ water quality parameter most encountered in commercial/industrial settings, lifetime free upgrades, and a 5-year warranty. Its portability and data-logging capabilities make this device suitable for field or laboratory use.

THERMAX, INC.

Booth: 504
Contact: Cindy Gresham
Phone: 856-630-2037
Fax: 813-436-5450
E-mail: cgresham@thermax-usa.com
Web: 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 Service offices, and 11 manufacturing facilities, 7 of which are in India and 4 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 Ion Exchange Resins for more than 35 years. TULSION is a premium brand and enjoys a global reputation in the field of water treatment and process application technologies.

TRISEP CORPORATION

Booth: 306
Contact: Lyndsey Wiles
Phone: 805-964-8003
Fax: 805-964-1235
E-mail: sales@trisep.com
Web: www.trisep.com

TriSep Corporation is a specialty membrane manufacturer focused on delivering customized products to solve unmet customer needs. To meet a wide range of water purification and process application requirements, TriSep offers a variety of reverse osmosis, nanofiltration, ultrafiltration, and microfiltration membranes. TriSep manufactures spiral wound membrane elements, flat sheet membranes, and support chemicals while utilizing a technical sales team to offer customers exceptional service.

TURNER DESIGNS HYDROCARBON INSTRUMENTS, INC.

Booth: 300
Contact: Chip Westaby
Phone: 559-253-1414
E-mail: sales@oilinwatermonitors.com
Web: www.oilinwatermonitors.com

Turner Designs Hydrocarbon Instruments, Inc. is the worldwide leader in the application of field portable, laboratory and inherently low maintenance on-line continuous process monitors for measuring and monitoring hydrocarbons in water. We are in the exclusive business of making laboratory, field portable and on-line instruments based in UV fluorescence technology. Our staff of experts understands customer needs, problems and applications for monitoring petroleum hydrocarbons in water. Customer satisfaction is our first priority. We unparalleled in fluorescence (UVF) expertise for the measurement of hydrocarbons in water and soil. Our customers enjoy the benefits of our worldwide exposure, product development and distribution network. We have more UVF instruments in service for oil in water measurement than all UVF competition combined.

U.S. WATER SERVICES

Booth: 305
Contact: Jeff Carlson
Phone: 815-209-6492
Fax: 763-553-0613
E-mail: jcarlson@uswaterservices.com
Web: www.uswaterservices.com

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

UNIVAR

Booth: 106
Contact: John Fulcher
Phone: 855-888-8648
E-mail: WaterTreatment@univar.com
Web: www.univar.com

Univar is a leading global distributor of specialty and basic chemicals from a global network of premier suppliers. With a broad portfolio of products and innovative services, and deep technical and market expertise, Univar connects customers' with the tailored solutions they need through one of the most extensive distribution networks in the world. Univar is Chemistry Delivered.

UNIVERSITY OF WISCONSIN- MADISON

Booth: 210
Contact: Lee DeBaillie
Phone: 608-262-2329
Fax: 608-263-3160
E-mail: debaillie@wisc.edu
Web: www.epd.wisc.edu

The University of Wisconsin-Madison offers online master's degree programs and continuing education courses focusing on a variety of topics, including water resources. In the fall of 2015, UW-Madison launched an online degree in Environmental Engineering, adding to its top-ranked line-up of graduate programs that includeSustainable Systems Engineering and Engineering Management. In addition, UW-Madison has offered professional development courses in water resources, drinking water, stormwater and wastewater for over 60 years.

HONEYWELL UOP

Booth: 310
Contact: Jim Gassen
Phone: 847-391-2924
E-mail: James.Gassen@Honeywell.com
Web: www.uop.com

For 100 years, Honeywell UOP has been a leading contributor to the innovation and development of contaminant removal solutions that help our customers meet performance requirements and promote operational efficiency. With more than 40 years of experience in the water treatment industry, Honeywell UOP provides total solutions that meet customers' industrial wastewater treatment needs and successfully removes impurities such as radionuclides, heavy metals and organics from a wide range of waste and groundwater streams.

USP TECHNOLOGIES (FORMERLY U.S. PEROXIDE)

Booth: 309
Contact: Kristin Mills
Phone: 877-346-4262
Fax: 404-352-6077
E-mail: info@usptechnologies.com
Web: www.usptechnologies.com

USP Technologies (formally US Peroxide) is a leading provider of 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. Utilizing a collaborative problem solving approach, our objective is to deliver sustainable and efficient program results that meet the highest standards of environmental stewardship. USP Technologies – Solutions for a clean environment.

VEOLIA WATER TECHNOLOGIES

Booth: 500
Contact: Renee Look
Phone: 919-653-3917
E-mail: renee.look@veolia.com
Web: www.veoliawaterstna.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.

WATERCOLOR MANAGEMENT

Booth: 512
Contact: Karen Seals
Phone: 256-260-0412
Fax: 256-355-3070
E-mail: info@watercolormanagement.com
Web: www.watercolormanagement.com

WaterColor Management (WCM) is the original insurance organization that has provided unwavering support to companies and professionals in the water treatment industry since 1986. WaterColor now offers the broadest-available insurance coverages which are specifically designed for water treaters, manufacturers, suppliers and consultants industry in partnership with an A++ XV rated company.

WATERS EQUIPMENT CO.

Booth: 204
Contact: Rob Lemke
Phone: 262-567-7256
Fax: 262-567-4523
E-mail: sales@sentry-equip.com
Web: www.sentry-equip.com

With proven sampling expertise since 1924, Sentry® products and services provide the power generation industry with the critical insights to optimize process control and protect plant assets. We deliver true representative sampling and analysis techniques to customers around the globe, empowering them to accurately monitor and measure processes for improved production efficiency, output and safety. With complete steam and water analysis systems and water chemistry services, we are determined to tackle any application, anywhere.

WATERTECTONICS

Booth: 506
Contact: TJ Mothersbaugh
Phone: 425-349-4200
Fax: 425-349-4890
E-mail: tj.mothersbaugh@watertectonics.com
Web: www.watertectonics.com/

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

WESTECH ENGINEERING, INC.

Booth: 501
Contact: Jimmy Woods
Phone: 801-265-1000
Fax: 801-265-1080
E-mail: jwoods@westech-inc.com
Web: www.westech-inc.com

For cooling water, hydrofracturing, mine water, raw water pretreatment, and industrial wastewater treatment, WesTech is your independent source for reliable industrial and municipal process treatment equipment designed, engineered, and built for long lasting efficiencies. For new plants, design build, and retrofits, WesTech offers the process, manufacturing and project management experience required. Employee-owned since 1973 and ISO 9001 certified, WesTech provides reliable treatment process systems for myriad liquid-solids separation challenges.

WIGEN WATER TECHNOLOGIES

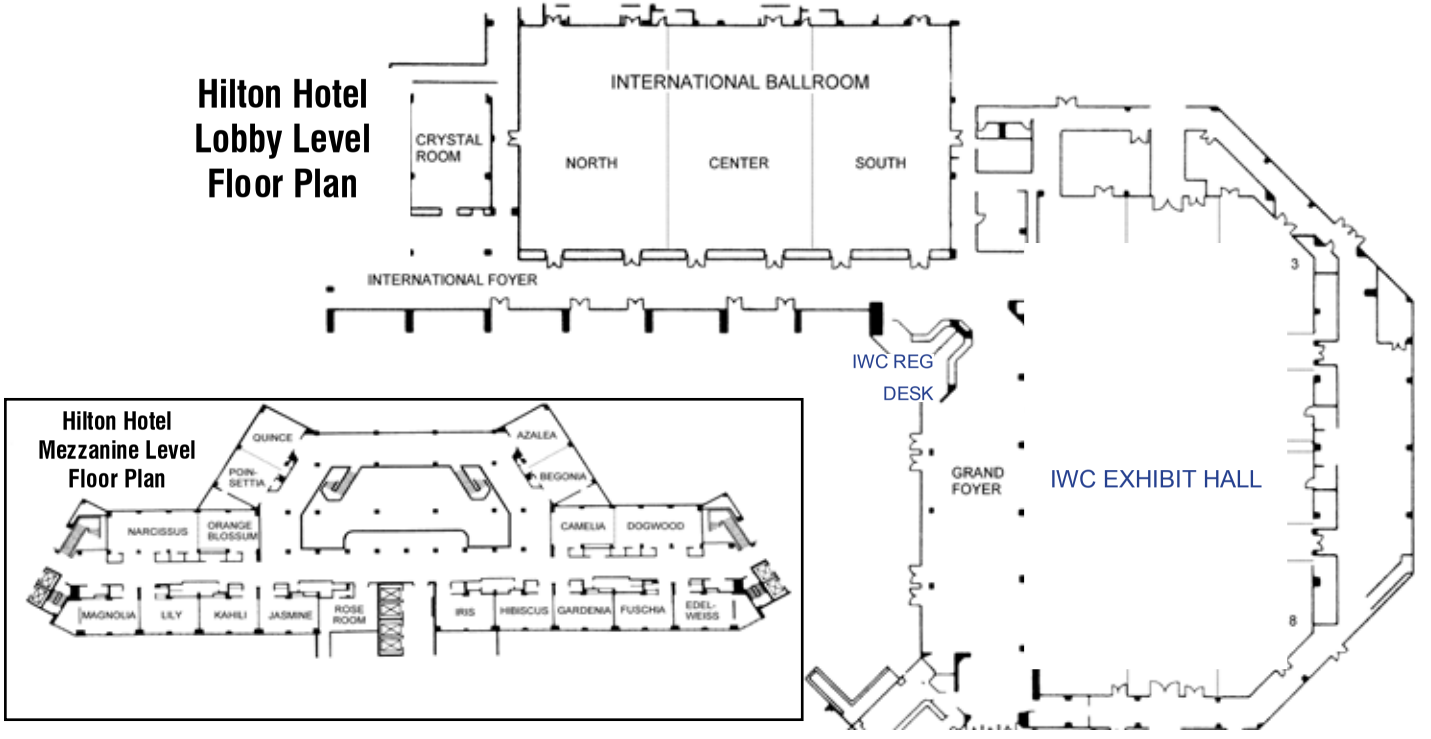
Booth: 513/515
Contact: Wigen Water Technologies
Phone: 952-448-4884
E-mail: steve.mcsherry@wigen.com
Web: www.wigen.com

Wigen Water Technologies® has become a leading OEM of custom water treatment systems, specializing in application-specific, cost-effective and reliable solutions for industrial, municipal and ultrapure clients. Our products include a variety of state-of-the-art technologies, designed to meet each client's needs. From primary filtration to distribution and recycling, Wigen has the capability to tackle the most complex water treatment challenges.

WUNDERLICH - MALEC ENGINEERING, INC.

Booth: 102
Contact: Brad Spindler
Phone: 920-241-0935
E-mail: brad.spindler@wmeng.com
Web: www.wmeng.com

Wunderlich-Malec Engineering Inc. (WM) formed the Industrial Water Business Unit to provide turn-key engineered water solutions using innovative technology from design through maintenance and operations delivered at the client's lowest Total Cost of Ownership. WM supplies custom engineered, modular clean water solutions from a single source to meet the increasing demand for clean water. The Industrial Water Business is based in Green Bay, WI and focused on servicing water and wastewater customers in the United States, Latin America, Middle East, and Asia utilizing WM's extensive twenty-two (22) offices and 270 plus employee engineering resources.


Hilton Hotel
Lobby Level
Floor Plan
INTERNATIONAL BALLROOM
CRYSTAL ROOM
NORTH
CENTER
SOUTH
INTERNATIONAL FOYER
IWC REG DESK
GRAND FOYER
IWC EXHIBIT HALL
3
8
Hilton Hotel
Mezzanine Level
Floor Plan
QUINCE
AZALEA
POIN-SETTIA
BEGONIA
NARCISSUS
ORANGE BLOSSUM
CAMELIA
DOGWOOD
MAGNOLIA
LILY
KAHILI
JASMINE
ROSE ROOM
IRIS
HIBISCUS
GARDENIA
FUSCHIA
EDEL-WEISS