2012 INTERNATIONAL WATER CONFERENCE®

CONFERENCE PROGRAM GUIDE

-The 73rd Annual IWC-

November 4-8, 2012
Crowne Plaza Riverwalk
San Antonio, TX USA

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CHAIRMAN'S WELCOME

Welcome to the 73rd Annual International Water Conference® (IWC). The Engineers' Society of Western Pennsylvania (ESWP), the IWC Advisory Council, and the IWC Executive Committee are very proud to provide the IWC as a very important source for up to date technical information and training on the most relevant topics in the industrial water and wastewater industry. Our conference will span multiple industries including power (both fossil and nuclear), oil and gas production and refining, mining operations, as well as many others. You will find our technical program filled with relevant topics such as wastewater treatment for the shale gas industry; produced water treatment for the oil and gas industry; selenium removal, fluidized gas desulfurization, and zero liquid discharge systems. We continue to provide excellent technical papers on topics such as ion exchange, cooling water treatment, recycle/reuse, membrane treatment, trace contaminant removal, instrumentation and monitoring, as well as modeling of water systems. We believe that our conference is the best water specific technical conference in the United States and are particularly proud of our format including peer review and prepared discussions for virtually every paper presented. We hope that you each learn something that helps you advance your career and our profession.

Scheduling of our technical program always considers avoidance of presenting similar topics in parallel sessions. However, with a large program and the varied interests of the attendees, it is impossible to eliminate conflicts for everybody. Therefore, all papers that are received by the due dates will be available for sale electronically on flash memory at the registration desk.

Our conference also offers the opportunity to attend many workshops, which provide Continuing Education Credits. These workshops are designed to span the needs of those looking for entry level, generalized training to highly specialized training for participants who may be more advanced in their water treatment knowledge. The workshops are held on Wednesday afternoon and Thursday. Registration for the workshops is open at the registration desk during the conference if you did not pre-register.

We have again sold out our Exhibit hall. The exhibits display the latest technological developments in water and wastewater treatment. Take advantage of this opportunity to meet directly with industry experts. Lunches and refreshments will be supplied in the exhibit hall and all conference registrants are welcome. We also encourage our participants to take advantage of the hospitality suites and vendor provided presentations that may be offered outside of the normal conference hours.

We are fortunate to have Mr. Venkee Sharma, President and CEO of Aquatech International Corp., 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 find Mr. Sharma's presentation to be both inspiring and informative.

We would also like to thank Mr. Robert Puente, J.D., for providing our welcome address. Mr. Puente is the President and CEO of the San Antonio Water System (SAWS) as well as a former member of the Texas State Legislature. Under the leadership of Mr. Puente, SAWS has maintained a distinguished record of regional and national recognition for its high level of performance. Under his direction, SAWS has won awards in the areas of protecting the environment (2011 Texas Environmental Excellence Award presented by Governor Rick Perry), exceptional utility performance (2010 Gold Award presented by the Association of Metropolitan Water Agencies), as well as exceedingly high ethical conduct

and civic responsibility (2010 Ethics in Business Award presented by the Ecumenical Center for Religion and Health and the UTSA College of Business).

Of course, a conference of this size does not get put together without the hard work of a lot of people. I want to especially thank the ESWP staff, Stephanie Mueller, Dave Teorsky, Michael Gaetano, and Cori Stellfox, for their hours of hard work. One of them will be at the registration desk during operating hours to answer any questions and provide any help that you might need.

Every Executive Committee member is a volunteer and has spent hours coordinating sessions, exhibits, workshops, and marketing to make sure the conference runs smoothly. Michael Ryder had the unenviable task of being our 2012 IWC Technical Program Chairperson. This is one of the most time consuming positions on the IWC Executive Committee. Colleen Layman was in responsible for coordinating the workshops this year. I want to thank Michael and Colleen for the fine job they did in putting together the 2012 IWC Technical Program and Workshops. Many other Executive Committee members also participated in planning and coordinating other aspects of this year's IWC. Please let them know your appreciation by thanking the Executive Committee members, noted by the Committee label on their name badge, for the efforts they put in to making this another successful IWC.

I would also like to thank the representatives of the Advisory Council companies that offer their expertise and advice to keep the conference current and interesting for all. The companies of the Advisory Council also sponsor various events like the coffee breaks, fellowship evenings, and other items that help make the conference better for all of us. Please thank the members of the Advisory Council for their efforts in helping to make the 2012 IWC a success. If you have any interest in becoming a member of the Advisory Council, please see a staff member at the registration desk.

And of course there are the many people involved in the conference as Session Chairs, Discussion Leaders, Authors, Discussers, and Workshop Presenters. They put in a lot of time and effort to make the IWC one of the best technical conferences for those in the business of water and wastewater treatment. This is our goal and what we strive to achieve every year. Thank you to all.

I hope that you enjoy this year's conference. I look forward to meeting many of you during our time in San Antonio. We also welcome your feedback as we use this information to make improvements in future conferences. The end of the 2012 IWC marks the beginning of the 2013 conference where we look forward to seeing you again in Orlando.

Dennis McBride
Fluor Fellow
Fluor Enterprises, Inc.
2012 IWC General Chairman

General Information

EXECUTIVE COMMITTEE

The International Water Conference® (IWC) is sponsored by the Engineers' Society of Western Pennsylvania (ESWP), a membership based, not-for-profit organization, located in Pittsburgh, PA. Learn more at www.eswp.com. The IWC is planned mainly through the volunteer efforts of these top industry professionals who make up the IWC Executive Committee and IWC Advisory Council Company representatives. ESWP extends a sincere thank you to the entire Executive Committee for their efforts in planning this year's conference. A very special thanks goes to the General Chair, Dennis McBride.

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General Information

IWC ADVISORY COUNCIL

The IWC Advisory Council is comprised of a group of companies that provide ongoing support for the planning of a successful conference. Membership is open to companies that have an interest in industrial water & wastewater treatment, and are willing to make a commitment to participate in two meetings thru the year to plan the IWC. In addition to promotional benefits for your firm, AC reps are entitled to one complimentary conference registration. For more information about the IWC, see any member of the IWC Advisory Council, IWC Executive Committee or contact the ESWP office.

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A special "Thank You" to all of our financial sponsors of the 2012 International Water Conference®, it is through the generous support of the following companies that we are able to present the following amenities and events during this year's IWC.

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GWI	www.globalwaterintel.com
Pollution Equipment News/ Rimbach Publishing Inc.	http://rimbach.com/RimPub/PEN/PEN.htm
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World of Chemicals	www.worldofchemicals.com

General Information

ABOUT THE IWC

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

As the preeminent international technical forum in the field, the IWC will bring together more than 600 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!

PREPARED DISCUSSIONS

Each Technical Paper presentation is followed by a Prepared Discussion, giving you a thoroughly considered, different perspective. Also, all presentations are followed by an open floor discussion where audience members and presenters can fully interact. The results: you can make better, more informed decisions.

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 $25 per 1GB flash drive with all the available papers. Also, you can find copies of previous years' IWC Proceedings for $55 per volume.

CONFERENCE PROCEEDINGS

All registered attendees (exc. Exhibit only) receive a CD containing the Official Conference Proceedings of the 73rd 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 2013 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.internationalwaterconference.org. For more information on how to become active in the IWC as an Exhibitor, Advisory Council Company, Executive Committee member, please contact Conference Manager Stephanie Mueller at 412-261-0710 ext. 13, or by e-mail at s.mueller@eswp.com

AMERICANS WITH DISABILITIES ACT

The International Water Conference® and the Engineers' Society of Western Pennsylvania (ESWP) 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

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. As such, 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 upon request.

ATTENDEE RECEPTIONS

To help you enjoy your stay in San Antonio during the 2012 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 invited to the Welcome Reception on Monday and Tuesday evenings in the Exhibit Hall. Luncheon buffets are also provided in the Exhibit Hall on Monday and Tuesday. 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.

SPOUSES WELCOME BREAKFAST

For spouses who are traveling with conference registrants, the IWC will host a Welcome Breakfast on Monday, November 5 at the Crowne Plaza Hotel. We will have a representative from the San Antonio Convention & Visitors Bureau present to discuss the many sites of the City, as well as special discounted event pricing of many of the best sites to see. You will also 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.

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

REGISTRATION LISTS

Registrations received prior to November 4, 2012 have been compiled in THE IWC REGISTRATION LIST, viewable at the Conference Registration Desk. An electronic version of the full Registration List will be available at the WesTech Web Spot computers, for a free download of the PDF version. This will be updated nightly throughout the conference. You may also visit the Registration Desk to receive the names of all registered attendees in both Excel and comma-delimited formats for a $25 fee.

CO-MEETINGS

- ASME Water Technologies Committee will meet on Wednesday, November 7 & Thursday, November 8 from 1:00 PM-5:00 PM.
- The ASME Executive Subcommittee will meet on Sunday, November 4 from 7:00 PM-9:00 PM.
- The Produced Water Task group will meet Tuesday, November 6 from 6:00 PM-10:00 PM.

All IWC Attendees are welcome!

General Information

2012 AWARDS OF DISTINCTION

The Annual Awards are presented at the opening Keynote Session on Monday, November 5 at 11:15 AM in San Antonio Ballroom. Please join us to celebrate the following achievements in the water treatment industry.

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 Dan Rice, DBR Consulting, Sault Ste. Marie, MI.

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 presentations in the field of power systems water technology that was presented at the 72nd Annual International Water Conference®. This year, we honor Dr. Kenneth Ogan of Advanced MicroLabs in Fort Collins, CO for the presentation IWC 11-17: "Monitoring of Trace Levels of Ions in the Steam Cycle by Microchip Capillary Electrophoresis".

JOSEPH A LEVENDUSKY SCHOLARSHIP

This Scholarship, with funding up to $7,000 per year, will be awarded to an undergraduate student in mechanical or chemical engineering. This year's scholarship winner is Corey Kientz, Seton Hall University, Clifton, NJ

INFO-SHARE SUITES

Veolia Water Solutions & Technologies

Date: Monday, November 5
Time: 7:00 AM-8:00 AM
Room: Executive Salon 5

Join Veolia Water Solutions & Technologies for Breakfast at 7 AM on Monday, November 5th, in Executive Salon 5 to learn more about Zero Discharge Desalination, one of our latest water treatment solutions. ZDD is a membrane-based brackish water desalination technology that achieves higher recovery than any alternative available in the marketplace.

Space is limited! Reserve your spot by emailing katherine.ardaugh@veoliawater.com or stop by Veolia Water Solutions & Technologies Booth 20 on Sunday evening to make your breakfast reservations!

Aquatech International Corporation

Date: Monday, November 5
Time: 9:00 PM- 12:00 Midnight
Room: Executive Salon 3

Join Aquatech to celebrate the IWC - Vegas Style. Try your luck at winning various prizes while enjoying drinks, appetizers, and desserts. Come and relax after the first day of the conference!

COOLING WATER - NEW DEVELOPMENTS IN MICROBIOLOGICAL TREATMENT

Date: Monday November 5
Time: 8:00 AM-11:00 AM
Room: Executive Salon 1

Cooling water system performance is a balance between corrosion, scaling / fouling and microbial growth. These concepts are closely interrelated and must be properly controlled to maintain overall system efficiencies. Microbial control, if left unchecked, will create biofilm, fouling, under deposit corrosion and various system concerns. The three excellent papers in this session provide insights into three different areas - overall microbial treatment program, the use of a novel, mild oxidant and new Legionella standard / risk management.

IWC Representative: Paul Puckorius, Puckorius & Associates, Inc., Arvada, CO
Session Chair: Ken Dunn, Ashland Water Technologies, Shrewsbury, MA
Discussion Leader: Don Holt, Ashland Water Technologies, Ajax, ON, Canada

Session Introduction: **8:00 AM**

Ken Dunn, Ashland Water Technologies, Shrewsbury, MA

IWC-12-01 **8:10 AM**

AN INTEGRATED APPROACH TO BIO-CONTROL IN COOLING SYSTEMS

Charles Ascolese, GE Water & Process Technologies, Trevose, PA

It is widely accepted that successful treatment of cooling water systems must address three key areas: corrosion, deposition and biology. A similar three-part concept is useful for classifying chemical methods of biological control as oxidizers, nonoxidizers or bio-dispersants. While chemical agents are often viewed as the primary tools of bio- control, their successful use depends on another set of three "tools":

- Selection
- Application
- Monitoring

Biocide selection, application and performance monitoring in aid of cooling water microbiological control are discussed along with developments that enhance performance of the chemical bio-control agents they support.

Discusser: Don Holt, Ashland Water Technologies, Ajax, ON, Canada ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12-02 **9:00 AM**

MIC (MICROBIOLOGICALLY INFLUENCED CORROSION) IN COOLING WATER SYSTEMS - WHAT THEY CAN DO? NEW DETECTION TECHNIQUES AND CONTROL METHODS

Paul Puckorius, Puckorius & Associates, Inc., Arvada, CO

This paper identifies and discusses the numerous MIC microorganisms found in these systems and their actions that cause deterioration of cooling tower water system materials of construction both metallic and nonmetal surfaces. Some have been difficult to detect which has resulted in the development of new testing techniques that will be discussed in case histories. Control of these MIC organisms requires specific biocides and application techniques which will be reviewed

Discusser: Dorothy Reynolds, GE Power & Water, Trevose, PA ..... 9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12- 03 **10:10 AM**

NEW LEGIONELLA STANDARDS: NO GOOD DEED GOES UNPUNISHED

Janet Stout, Special Pathogens Laboratory, Pittsburgh, PA; Arthur Freedman, Ph.D., Arthur Freedman Associates, Inc., Naperville, IL; Robert Cunningham, Arthur Freedman Associates, Inc., Trinity Center, CA

Legionnaires' disease, pneumonia caused by Legionella bacteria, increased by 217% between 2000 and 2009. Responding to this growing threat to public health, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) will issue a new standard - ASHRAE Standard 188: Prevention of Legionellosis Associated with Building Water Systems in spring 2012. The new standard will require that facility managers implement stronger safeguards through pro-active risk assessment and risk management practices. The ASHRAE Standard and a proposed standard from the Cooling Technology Institute, define a process to mitigate this threat. Elements of both proposed standards include Hazard Analysis and Critical Control Point (HACCP) methods.

It is likely that many building owner/operators and facilities engineers will be directed to implement expensive programs when fundamental steps in operation and water treatment practices would adequately address minimizing disease potential. A simple risk mitigation approach should consider low vs. high risk buildings and occupants. It should include a sensible schedule for testing Legionella to validate control and periodic review of water treatment practices. As with all other identified hazards in our environment, it is imperative that proper emphasis be placed on mitigation without allowing unreasonable fear to drive unnecessary expense.

We will review the following:

1. Placing the risk of infection in perspective
2. Assessment of risk in a given facility
3. Collection and interpretation of data
4. Establishing a program to provide on-going control of the hazard (Legionella)

Discusser: Loraine Huchler, MarTech Systems, Inc., Lawrenceville, NJ.....10:35 AM
Floor Discussion and Closur.....10:45 AM
Conclusion .....11:00 AM

INNOVATIVE SOLUTIONS & TECHNOLOGIES FOR MINE WATER

Date: Monday November 5
Time: 8:00 AM-11:00 AM
Room: Executive Salon 2

Mine operators are faced with more stringent discharge limits for their wastewater and are seeking innovative solutions and technologies to address some of the complex issues they are managing daily toward achieving improved environmental protection and sustainability. The speakers will present advanced treatment solutions and technologies for an acid rock drainage facility in Colorado, removal of selenium using fluidized bed bioreactors in the Eastern US and Northwest Canada, and a Zero Liquid Waste (ZLW) approach for coal mining operations in West Virginia.

IWC Representative: George Abrahim, Veolia Water, Pittsburgh, PA
Session Chair: Paul Pigeon, Golder Associates, Inc., Lakewood, CO
Discussion Leader: Jim Woods, WesTech Inc., Salt Lake City, UT

Session Introduction **8:00 AM**

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

IWC-12- 04 **8:10 AM**

INTEGRATION OF BENCH AND PILOT HIGH DENSITY SLUDGE (HDS) TREATMENT OF ACID ROCK DRAINAGE (ARD) INTO FULL-SCALE TREATMENT FACILITY DESIGN AT THE CENTRAL CITY/CLEAR CREEK SUPERFUND SITE NEAR BLACKHAWK, COLORADO

Neal Gallagher, Christopher Beck & Brian Huff, Golder Associates Inc., Lakewood, CO, Mary Boardman, Colorado Department of Public Health & Environment, Mike Holmes, U.S. Environmental Protection Agency Denver, CO

The OU4 high density sludge (HDS) water treatment plant (WTP) was designed to treat flows ranging 180 to 600 gpm from four separate sources of mining influenced wastewater (MIW) within the Central City/Clear Creek Superfund Site near Blackhawk, Colorado. Successful HDS treatment process parameters were defined through bench and pilot-scale testing. Variation in scaled test results provided insight into the advantages and disadvantages of scaled testing and incorporation of scaled test results into full-scale WTP design.

Discusser: Kashi Banerjee, Veolia Water, Moon Township, PA.....8:35 AM
Floor Discussion and Closure.....8:45 AM

IWC-12- 05 **9:00 AM**

ZERO LIQUID WASTE: A REGULATORY-DRIVEN APPROACH TO MINE WATER TREATMENT

Joseph Swearman, CONSOL Energy, Pittsburgh, PA

The coal mining industry is now faced with new regulatory requirements that limit the discharge of chlorides into receiving streams. In order to meet these new regulatory standards for treated mine water, CONSOL Energy and Veolia Water Solutions & Technologies has developed a Zero Liquid Waste (ZLW) approach for coal mining operations near Mannington, West Virginia. The centralized system will manage pretreated water collected from six sources at three mines. Advanced treatment technologies, including a proprietary reactor, chemical softening, reverse osmosis, evaporation and crystallization, are incorporated into the system design.

The advanced mine water treatment system, which is currently under construction, will generate clean water to be used in various energy endeavors or returned to the environment. Thanks to the brine management system and onsite landfill, no substantial liquid or solid waste from the treatment process will leave the CONSOL site.

CONSOL's Zero Liquid Waste facility will set the standard for environmental

compliance in the mining industry for many years to come. Our case study will describe the system requirements, ZLW design approach, and ongoing project challenges.
Discusser: Paul Togna, Environmental Operating Solutions, Inc., Bourne, MA ...9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12-06 **10:10 AM**

FLUIDIZED BED BIOREACTOR TECHNOLOGY: NEW OPTIONS FOR SELENIUM-CONTAINING MINING WATERS

David Enegess, Todd Webster Ph.D, & Sam Frisch, Envirogen Technologies, Inc., Kingwood, TX

Selenium-containing waters have come under increasing scrutiny and regulatory pressure in coal mining operations throughout North America and beyond. New advances in biologically-based Fluidized Bed Reactor (FBR) technology are offering coal mine operators' selenium treatment solutions that have been called best-in-class for both performance and cost. This paper will discuss sources of selenium in mining, seep and run-off waters, the selenium regulatory environment and physical-chemical issues related to treatment. It will review existing technology and go into detail on the fundamentals of FBR treatment and how it is applied to selenium-containing waters. The paper will review cost and operating advantages of plug-flow FBR technology compared to other fixed film reactor technologies for chemical consumption, footprint, operating, and equipment and installation costs. Data on FBR selenium treatment operations in both Appalachia and Northwest Canada will be presented, including a discussion of the impact of media selection on performance and cost and a 20-plus year history of the use of FBR systems in similar, non-coal mining applications. Finally, the real world operating requirements of these systems will be discussed, including strategies to handle both small ($<$200 gpm) outfalls and large, centralized treatment systems ($>$ 1000 gpm) using the FBR technology.
Discusser: Brent Means, Federal Office of Surface Mining, Pittsburgh, PA .....10:35 AM
Floor Discussion and Closure ..... 10:45 AM
Conclusion ..... 11:00 AM

IMPROVED WATER MONITORING AND MODELING FOR GREATER PLANT EFFICIENCY

Date: Monday November 5
Time: 8:00 AM-11:00 AM
Room: Executive Salon 4

Improving plant operating efficiency is a goal of any industrial plant. This session provides information on how to make these improvements through modeling techniques and improved monitoring of critical water treatment systems

IWC Representative: Wayne Bernahl, W. Bernahl Enterprises Ltd., Elmhurst, IL
Session Chair: David Gray, Mettler & Toledo, Bedford, MA
Discussion Leader: Jim Cairns, Thermo Fisher, Beverly, MA

Session Introduction: **8:00 AM**

David Gray, Mettler & Toledo, Bedford, MA

IWC-12-07 **8:10 AM**

SILICA AND SODIUM MEASUREMENTS TO MEET TODAY'S WATER QUALITY SPECIFICATIONS IN THE POWER GENERATION AND SEMICONDUCTOR INDUSTRY

Randy Turner, Swan Analytical USA, Wheeling, IL

In the production of high purity water, dissolved silica is known to be one of the first ions to breakthrough when the ion-exchanger resin approaches exhaustion. Much work has been done in the past couple of decades in measuring silica online. Continuous Silica monitoring after secondary mixed bed ion exchangers and secondary anion exchangers in the water demineralization process ensures consistent water purity. In the power industry, higher pressure boilers require lower contaminant levels; therefore, higher quality make-up requires silica concentrations in the low parts-per-billion range. Due to modern technologies in the semiconductor industry, the size of micro-chips has been reduced significantly, leading to higher quality requirements for water treatment. This trend of higher quality purified water also requires measurement of trace silica down to parts-per-trillion (ppt) level. It is also important to monitor the cation exchanger performance to ensure hardness in the form of calcium, magnesium, and sodium is removed to ensure water quality. This paper covers state-of-the-art technology used to accurately and reliably continuously monitor trace silica levels for the semiconductor industry and power industry. The paper also covers online monitoring of cation resin performance and exhaustion by means of modern sodium analyzers, to identify breakthrough of sodium and signal the need for regeneration or to identify the need to modify regeneration practices to reduce sodium slippage.

Discusser: Vickie Olson, Honeywell, Atlanta, GA ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12- 08 **9:00 AM**

PLANT OPTIMIZATION AND RELIABILITY WITH WATER TREATMENT SYSTEM MODELING

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

Due to diminishing supplies of fresh water being available to support industrial uses, end users are being required to implement water conservation practices to ever increasing levels. In order to properly evaluate and design a water system that is capable of meeting these stricter requirements, it is imperative that the water balance and water quality/chemistry are reviewed and analyzed for each unit to ensure proper operation and balance of the overall plant. However, water and water quality/chemistry balances are complicated by the vast interdependencies from and integration of different units in the plant.

This paper will discuss the various programming logic and codesin Excel and Visual Basic Application (VBA) that can be used to study the overall plant water and water quality/ chemistry balances and also the individual units in the plant. Through graphs and charts, the results from these balances can then be used to optimize the overall plant design and minimize the water consumption rate while maintaining plant operational reliability.

Discusser: Robert D. Bartholomew, Associate, Sheppard T. Powell Associates, LLC, Baltimore, MD ..... 9:25 AM

Floor Discussion and Closure ..... 9:35 AM

Break ..... 9:50 AM

IWC-12-09 **10:10 AM**

AN INTEGRATED APPROACH TO MEMBRANE PERFORMANCE MANAGEMENT USING A NEW AUTOMATION AND MONITORING TECHNOLOGY

Dejan Blagojevic, Anders Hallsby, Benjamin Bingjia Yao & JF Kong, Nalco, an Ecolab Company, Naperville, IL

Like a trickle that turns into a flood, small problems can grow into major disruptions that can affect your entire operation, process inefficiencies, machinery breakdowns, poor product quality, and environmental impacts that inevitable damage to your bottom line. Many membrane plants built in the last 5-10 years are equipped with PLC's that collect sensor data, and sometimes normalize it. Normalization of data is the practice of correcting for temperature and pressure effects on the performance of the system.

The ASTM (American Society of Testing Methods) has developed a method for standardizing data. These equations can be used as stand-alone software or with a digital control system (DCS) to monitor system performance.

One approach for improved operation that enables even smaller membrane installations to operate according to best practices is to provide remote monitoring and data analysis, including normalization, and rely on off-site experts to interpret the data and recommend actions to maintain optimal operation.

This presentation will review the successful implementation of new automation and monitoring technology that controls antiscalant, remotely monitors key operating parameters, and performs web based normalization and trending. Also included are web based optimization and maintenance tools, regular expert reviews of data, and 24/7 monitoring with recommendations to maintain in bounds operation.

Discusser: Peter Midgley, Degremont North America- Infilco, Dundas, ON Canada 10:35 AM

Floor Discussion and Closure ..... 10:45 AM

Conclusion ..... 11:00 AM

TRACE CONTAMINANTS

Date: Monday November 5
Time: 8:00 AM-11:00 AM
Room: San Antonio Ballroom

As water quality requirements become ever more stringent, the removal of trace (and not so trace) contaminants is increasingly important and topical. The Trace Contaminants session includes three diverse papers. The first paper touches on the problem of how to modify an existing treatment system to encompass a new contaminant (selenium) that was not considered in the original process design. The second paper presents a new dual purpose hybrid media that acts as a catalytic media in addition to its adsorbent properties. The third paper introduces a new and overlooked method to remove silica, a contaminant that is not easy to remove by it. All three papers introduce new and innovative solutions to removal of trace contaminants.

IWC Representative: Dan Rice, DBR Consulting, Sault Ste. Marie, MI
Session Chair: Peter Meyers, Resin Tech, Inc., West Berlin, NJ
Discussion Leader: Charles Guzelli, Severn Trent Services, Woodland Hills, CA

Session Introduction: **8:00 AM**

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

IWC-12-10 **8:10 AM**

MODIFYING AN EXISTING ARSENIC AND MERCURY PRETREATMENT PROCESS TO REMOVE SELENIUM

Ivan Cooper, Civil & Environmental Consultants, Charlotte, NC; Lee Josselyn, P.E., Golder Associates, Denver, CO; Gerry Gunning Joe Eck, Mark Condie, Interstate Brick, West Jordan, UT;

Golder Associates investigated and designed an arsenic and mercury pretreatment system to remove constituents from the brick making process scrubber blowdown at Interstate Brick in West Jordan, Utah. The technology involves co-precipitation of arsenic with ferric hydroxide, transferring arsenic to the solid phase. Tests showed that modifying the incoming water to a pH of 4 and adding ferric chloride at 100 mg/l with polymer addition/clarification reduced arsenic concentration from 0.5 mg/l to less than 0.01 mg/l. The sodium hydroxide allows a ferric hydroxide precipitate to form a co-precipitate with arsenic, removing metals from the wastewater. Golder then designed and constructed the pretreatment facility. In July, 2011, the district staff informed Interstate Brick that a new selenium discharge concentration was in effect, and required Interstate Brick to remove selenium from a discharge concentration of 0.5 2.0 mg/l to 0.149 mg/l. Golder performed additional testing using the various chemistries at varying concentrations to determine if selenium can be removed, while still removing the other constituents. Results at higher concentrations of ferric chloride were successful, but additional chemical costs produced concern. Full scale tests confirmed process changes that reduced effluent concentrations to meet the new permit limits while minimizing the increase of additional chemical usage of ferric chloride to the 250-300 mg/l range and tracked increased sludge production and operator time.

Discusser: Dave Malkmus, ResinTech, Inc., West Berlin, NJ ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12-11 **9:00 AM**

REVOLUTIONARY SILICA-BASED GRANULAR CATALYTIC MEDIA FOR THE REMOVAL OF IRON, MANGANESE AND ARSENIC FROM WATER

Richard Johnson, ITOCHU Chemicals America Inc., Houston, TX

The purpose of this paper is to provide designers and end-users of water treating equipment with information about a silica-based catalytic material known as DMI-65 (the media). The media boosts the oxidation processes in aqueous solutions (mainly water). The media is part of the broad category of products deriving their physical and chemical action from interaction of their metal oxide surface with water molecules and ions in solution.

In terms of solid surface interaction with water, we distinguish the term adsorption as attraction – interaction at solidsurface level and absorption as transport and retention of target ions through fine porosity inside the media. For this media interaction of water molecules and ions is initiated through adsorption. In other words this is oxidation – precipitation – filtration not ion exchange.

Operating in the presence of sodium hypochlorite the media acts as an oxidation catalyst so that any iron or manganese not initially oxidized will be oxidized in the presence of the media. Unlike other materials the media doesnot need to be periodically regenerated with potassium permanganate.

The media can be used in a pH range of 5.8 – 8.6. Recommended flow rates are based on the concentration of the iron and/or manganese in the raw water; but a good rule-of-thumb would be 2 – 10 gpm/ft2. The media will require occasional backwash and a free chlorine residual of 0.1 – 0.3 ppm in the effluent water. The media has been tested and certified by the Water Quality Association in accordance with the NSF 61 standards.

Discusser: H. Robert Goltz, DOW Chemical, Midland, MI ..... 9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12-12 **10:10 AM**

ENHANCED IRON CORROSION: A NEW WAY TO REMOVE DISSOLVED SILICA FROM WATER

Yongheng Huang, Phani Peddi, Hui Zeng, & Ci-Lai Tang Texas A&M University, College Station, TX

Dissolved silica is widely present in groundwater, surface water, and various industrial liquid streams. Many industrial processes require a water supply of low or free of dissolved silica. For decades, chemical coagulation-precipitation methods have been commonly used for dissolved silica removal. Despite many drawbacks of these methods, industry has not been able to find a more cost-effective alternative. In this study, we propose and explore a new way to remove dissolved silica from water. We use metallic iron as the main reagent to achieve effective dissolved silica removal through an artificially-enhanced iron corrosion process in a hybrid zero valent iron (hZVI) reactive system. We demonstrated through a long-term continuous-flow test on a bench-top hZVI treatment prototype with 20 L effective volume that dissolved silica of $>$200 mg/L as SiO2 could be consistently reduced to $<$ 2 mg/L at near-neutral and ambient temperature conditions and with a limited chemical consumption and waste sludge production. We discuss the potential mechanisms that trigger the rapid polymerization of dissolved silica in the hZVI system. The hZVI process, if commercialized, could provide a more cost-effective solution than conventional coagulation-precipitation processes to meet various dissolved silica treatment needs in reverse osmosis pretreatment, boiler water supply, and cooling water recycling applications.

Discusser: Dr. Donald Kirk, University of Toronto, Toronto, ON, Canada ..... 10:35 AM
Floor Discussion and Closure ..... 10:45 AM
Conclusion ..... 11:00 AM

Monday's Sessions

KEYNOTE SESSION

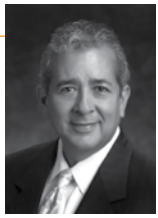
Date:	Monday, November 5
Time:	11:00 AM – 12:00 NOON
Room:	San Antonio Ballroom
Session Chair:	Dennis McBride, Fluor Enterprises, Greenville, SC

CHAIRMAN'S WELCOME

Dennis McBride, Fluor Enterprises, Greenville, SC

PRESENTATION OF ANNUAL AWARDS

WELCOME TO SAN ANTONIO



Robert R. Puente, J.D., President/CEO, San Antonio Water System

Robert R. Puente was appointed San Antonio Water System's President and CEO in November 2008 after a distinguished career in the Texas House of Representatives. As chief executive of one of the nation's largest utilities he provides leadership in delivering water and wastewater services to more that 1.3 million consumers, developing new water resources, continuing infrastructure upgrades throughout the community, and building regional partnerships.

As a member of the Texas State Legislature for 17 years, Puente is one of the policy pioneers of modern water supply management in Texas. He helped shape key regional water issues, beginning with the creation of the Edwards Aquifer Authority in 1993 and as Chairman of the House Natural Resources Committee from 2003-2008. In his final year in the House, he sponsored Senate Bill 3, which solidified Edwards Aquifer pumping permits and saved the region hundreds of millions of dollars.

Under Puente's leadership at San Antonio Water System, the utility updated San Antonio's Water Management Plan and has increased its water supply inventory by adding approximately 82,000 ac-ft of diverse supplies. The city will also add a groundwater desalination plant by 2016.

KEYNOTE PRESENTATION

Venkee Sharma, President and CEO

Venkee Sharma has been at the helm of Aquatech for 20 years. In this time, the company has transformed from a small, regional manufacturer of industrial water treatment equipment to a recognized and respected major player in global water industry: 2012 revenues are expected to be near $170 MM with over 700 employees in 6 major locations / subsidiaries worldwide.

A Chemical Engineer by education, Venkee has worked, at some point, in almost every skill area in the company. Under his leadership, Aquatech has grown to a global technology and services powerhouse, and arguably the largest private company in its space, completely self-financed through retained earnings under consistent ownership. He believes in humility, continuous improvement, under committing / over delivering, and quietly getting the job done. Focused on leading by example, he sets the bar for the rest of the Aquatech's employees. He is very growth oriented, but strives for balance with family values, an unassuming demeanor, and a fiscally conscious business approach.

Aquatech is a global leader in innovative water technology and services for the Industrial and infrastructure markets with a focus on solving water scarcity and Environmental challenges through desalination, water reuse, and zero liquid discharge.

21ST CENTURY WATER CHALLENGES: DESIGNING AND OPERATING ZLD PLANTS

Date: Monday November 5
Time: 1:30 PM-5:20 PM
Room: Executive Salon 1

Zero Liquid Discharge (ZLD) system is a system where no water leaves the boundary of the facility. In the recent times, regulations have become tough enough to make ZLD a feasible and economical option. However, it is inherently more complicated as it requires every drop of wastewater produced to be retreated, reused and eventually concentrated to solid waste. We will be discussing some of these challenges and remedies in this session.

IWC Representative: Kumar Sinha, Bechtel Power, Frederick, MD
Session Chair: Venus Kaur, Southern Edison Company, Westminister, CA
Discussion Leader: Rafique Janjua, Fluor Enterprises, Inc., Sugar Land, TX

Session Introduction 1:30 PM

Venus Kaur, Southern Edison Company, Westminister, CA

IWC-12-13 1:40 PM

NO EASY ANSWERS: ZLD IMPROVEMENT OPTIONS FOR A 720-MW POWER GENERATION FACILITY

Daniel Sampson, WorleyParsons, Vallejo, CA

The water treatment infrastructure for a relatively new 720-MW power generation facility includes a Zero Liquid Discharge (ZLD) system. The ZLD system receives cooling tower blowdown as the primary feedwater. The ZLD system allowed unrestricted power plant operation for the first three years following initial power plant commissioning, but ZLD system bottlenecks restricted plant operation and required a significant amount of off-site wastewater disposal in subsequent years.

The system as currently configured consists of a fairly typical power plant ZLD system with six basic processes: cold-lime softening, multimedia filtration, wastewater reverse osmosis, brine concentrator (BC), brine crystallizer (BXtal), belt filter press (BFP).

This paper examines the plant's ZLD system in detail, focusing on the following questions:
1. Why is the ZLD system a problem now when it wasn't a problem in the past?
2. What process improvements have been attempted in the past and with what results?
3. What options exist for eliminating or mitigating the ZLD process bottlenecks and at what cost?

The discussion answers these questions with the goal of providing a clear understanding where the plant is now, how it got here, where it can go in the future, and how much it will cost to get there.

Discusser: William Moore, Westech Engineering, Houston, TX ..... 2:05 PM
Floor Discussion and Closure ..... 2:15 PM

IWC-12-14 2:30 PM

A UNIQUE ALL MEMBRANE INTEGRATED MAKEUP AND ZERO LIQUID DISCHARGE SYSTEM

Stanley Karrs, Alan Knapp, & Kake Oswego Siemens Industries, Inc., Warrendale, PA

The growing trend to limit the use of fresh water while minimizing, if not totally eliminating the discharge of wastewater in the Power Industry has made the need to provide an integrated approach a critical factor. This Paper describes how the combination of off-site service and a wastewater design that combines precipitation with microfiltration was the solution for the Harry Allen Gas Turbine Combined Cycle power plant. The virtually all membrane design operates at an overall recovery of 95% while discharging a stream of wastewater to evaporation ponds and trucking solids off-site. The feedwater to the

plant is variable originating from three different water sources; while the wastewater is a combination of reverse osmosis concentrate, steam generator blowdown, evaporative cooler blowdown, wet surface air cooler blowdown, multimedia backwash water, oil/water separator wastes, and other service waste waters. This design overcomes many of the shortcomings of a conventional or a thermal approach which would have much higher capital and operating costs.

Discusser: Michele Migliavacca, Veolia Water Solutions & Technologies, Houston, TX 2:55 PM

Floor Discussion and Closure ..... 3:05 PM

Break ..... 3:20 PM

IWC-12-15 **3:40 PM**

TREATMENT OF COOLING TOWER BLOWDOWN WATER WITH MEMBRANES IN A ZERO LIQUID DISCHARGE POWER PLANT

Marvin Drake, Indiantown Cogeneration LP, Indiantown, FL; Ramraj Venkatadri, Ph.D., Spence Wise, & Narasimha Charan Pall Corporation, Port Washington NY; Gary Willer, NAES Corporation Indiantown, FL

Reuse of process and waste water in power plants has become increasingly important over the past decade. The Indiantown Cogeneration plant in Florida (360 MW capacity) has recently modified their zero liquid discharge scheme to incorporate the use of micro-filtration and reverse osmosis technology to treat the blowdown from their cooling tower.

There are three identified sources for make-up water at the plant- grey water, highly saline and moderately saline well water and highly organic surface water, or a combination of these waters. The filtered make up water is sent as feed to the cooling tower. Blowdown from the cooling tower was originally sent to two brine concentrators and the distillate from the brine concentrator was utilized as boiler feed water. The plant desired flexibility in the source of makeup water to the cooling tower. It was also desirable to replace the brine concentrators completely since they suffered from skin cracking problems, requiring expensive upgrades. The reduction of parasitic load by elimination of the brine concentrators was an attractive driver as well.

Extensive trials were conducted with a membrane system consisting of a hollow fiber microfiltration integrated with a reverse osmosis unit. The results are discussed in detail in the presentation. The membrane system allowed the brine concentrators to be completely replaced. The results demonstrated that the membrane system generated very high quality permeate that could be used as boiler feed. The reject of the RO system could be processed in the existing spray drier absorber system (dry scrubber), thereby implementing zero liquid discharge. The Integrated Membrane System was commissioned in 2011 and has been operating smoothly for over 8 months. Operating field data for the system is included in the presentation. Preliminary indications are that a return on investment would be achieved within three years.

Discusser: Joe Guida, Fluor Enterprises, Houston, TX..... 4:05 PM

Floor Discussion and Closure ..... 4:15 PM

IWC-12-16 **4:30 PM**

ZERO-LIQUID DISCHARGE SYSTEM AT PROGRESS ENERGY MAYO GENERATION STATION

Matthias Loewenberg, GEA Process Engineering Inc., Columbia, MD; Danny Johnson, P.E. & John Edelen, P.E., Duke Energy, Raleigh, NC

Progress Energy is currently installing a new Zero-Liquid Discharge treatment system for Flue-Gas Desulfurization Waste Water at their Mayo Generation Station in Roxboro NC. The system, designed and supplied by GEA Progress Engineering Inc., helps Progress Energy's continuous commitment to provide safe, reliable and environmental friendly energy generation. The Zero-Liquid Discharge addition to their existing FGD scrubber supports compliance with tight NPDES wastewater discharge regulations. The Partial Zero-Liquid Discharge system consists of proven falling film evaporator technology with a secondary forced circulation evaporator in order to reduce the FGD blow down volume significantly. The resulting concentrated brine will be mixed with Plant fly ash and disposed in a new on-site landfill. The distillate water will be used in the Plant systems, reducing the make-up water demand.

Numerous treatment options were considered for this facility, however ZLD was chosen based on multi-pollutant removal ability, proven technology, and cost. This paper will outline the methodology behind the selection of this Partial Zero-Liquid Discharge approach with respect to environmental compliance.

Discusser: Robert Bradley, Veolia Water Solutions & Technologies, Houston, TX 4:55 PM

Floor Discussion and Closure ..... 5:05 PM

Conclusion: ..... 5:20 PM

BOILERS – PRESERVING ONE OF YOUR GREATEST INVESTMENTS

Date: Monday November 5
Time: 1:30 PM-5:20 PM
Room: Executive Salon 2

The availability and safety of steam generators is of utmost importance to utilities and industry. Corrosion poses one of the greatest threats to this investment. Accurate process monitoring is key to mitigating corrosion. We will discuss sampling requirements and techniques to ensure accurate data is obtained. Mitigating corrosion requires vigilance. We will discuss techniques for minimizing oxygen ingress in the steam cycle, use of oxygen scavengers and their relation to flow accelerated corrosion (FAC), and modern filming amine options for boiler water conditioning.

IWC Representative: Debbie Bloom, Nalco, an Ecolab Company, Naperville, IL
Session Chair: Mike Preston, Black & Vetch, Overland Park, KS
Discussion Irvin Cotton, Arthur Freedman Associates, Newport, RI

Session Introduction **1:30 PM**

Mike Preston, Black & Vetch, Overland Park, KS

IWC-12-17 **1:40 PM**

PROPER SAMPLING MAKES A DIFFERENCE

David Daniels, M&M Engineering, Austin, TX

Steam cycle chemistry analysis begins with the sampling methods and ends with the analytical instruments used. Instruments that monitor a power plant's water and steam chemistry have made significant advances over the past few years in reliability and sensitivity. Properly conditioned and consistent flow is critical to accurate and reliable of these on-line measurements. A major contamination incident occurred due to a demineralizer malfunction. The slow response of the on-line instruments showed problems with the old sample panels. Following the incident the utility decided to installed new sample panels.

This paper discusses there experience in specifying, installing and using new sample panels and the change they saw in responding to any out of limit conditions. The net result has been more precise water and steam chemistry data and operators that now trust the instruments.

Discusser: Roger Light, DOW Chemical, Freeport, TX.....2:05 PM
Floor Discussion and Closure.....2:15 PM

IWC-12-18 **2:30 PM**

CONTROLLING CONDENSATE & FEEDWATER DISSOLVED OXYGEN & AIR INLEAKAGE (DO)

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

Low dissolved oxygen concentration limits in condensate systems (<10-20 ppb) and in many feedwater systems (1-2, 1-5, 1-10 ppb, 5-10 ppb) for many heat recovery steam generator (HRSG) units or conventional boilers can be difficult to maintain. This paper summarizes the causes and presents methods of controlling sources of dissolved oxygen into these systems.

Discusser: Ted Beardwood, Ashland Technologies, Ajax, ON, Canada.....2:55 PM
Floor Discussion and Closure.....3:05 PM
Break.....3:20 PM

IWC-12-19 **3:40 PM**

THE CONTINUING CRUSADE AGAINST OXYGEN SCAVENGER USE IN ALL-FERROUS STEAM GENERATORS

Brad Buecker, Kiewit Power Engineers, Lenexa, KS

Since 1986, flow accelerated corrosion and FAC-induced failures have occurred in many steam generators. Some of these failures have caused fatalities, which is the ultimate cost. The primary culprit in flow accelerated corrosion is use of oxygen scavengers, where the reducing environment they generate allows iron dissolution at flow disturbances. Yet, many power plant developers and owners, and A/E engineers, still specify oxygen scavenger feedsystems for new plants. Unless the condensate/feedwater system contains copper alloy feedwater heaters, oxygen scavengers should not be employed. This paper will review the fundamentals of FAC, and most importantly, will outline the chemical control methods that have supplanted oxygen scavenger treatment programs.

Discusser: Tony Banweg, Nalco, an Ecolab Company, Naperville, IL.....4:05 PM
Floor Discussion and Closure.....4:15 PM

IWC-12- 20 **4:30 PM**

MODERN FILM-FORMING BASED AMINES – AN INNOVATIVE EUROPEAN TECHNOLOGY FOR BOILER WATER TREATMENT

Wolfgang Hater, BK Giulini GmbH, Duesseldorf, Germany; Claude Digiaro, BK Giulini GmbH, Ludwigshafen Germany; Colin Frayne, Aquassurance, Inc., Macon, GA

Modern film-forming based amines for steam-cycle internal boiler water treatment are an innovative technology, now widely used in Europe, and providing superior ease of handling and high robustness versus traditional programs using oxygen scavengers and phosphate. These modern film-forming, amine-based products are internal treatments, and should not be confused with old-style octadecylamine chemistries used solely for condensate line corrosion control. These new amine chemistries are generally ready-to-dose, all-in-one formulations, and provide complete protection of the entire steam generator due to the volatility of the film-forming component. Significant water and energy savings can often be achieved thanks to a reduction of blow-down and improved heat transmission coefficients.

This paper gives a survey of the properties, technical advantages and recent studies on European film-forming amines, as well as a case study providing detailed information on achieved savings. In a complex system of four steam generators of different types, one of them being mainly in stand-by mode, the change from a conventional treatment program to film forming amine technology led to significant cost reduction that can be attributed to a marked improvement of condensate quality, enabling an increase in condensate return, a reduction in blow-down, and finally leading to a decrease in energy consumption.

Discusser: Anthony Rossi, General Electric, Trevose, PA ..... 4:55 PM
Floor Discussion and Closure ..... 5:05 PM
Conclusion ..... 5:20 PM

NOVEL PROCESSES FOR PRODUCED WATER TREATMENT

Date: Monday November 5
Time: 1:30 PM-5:20 PM
Room: Executive Salon 4

With maturity of existing reserves and ever expanding E&P activities, a large quantity of produced water is being generated worldwide. Today, treatment and management of produced water is key to maintain achieve production target while meeting environmental requirements. The session will cover an overview of produced water treatment approach for shale gas, oil sand, CBM, CSG, and offshore oil/ gas development fields. In addition it will cover technical options focusing on BTEX/light hydrocarbon removal from produced water, ion-exchange for softening in SAGD, and water quality criteria for polymer flood applications in EOR.

IWC Representative: Michael Sheedy, Eco-Tec Inc., Pickering, ON Canada
Session Chair: Sudhir Parab, ConocoPhillips Canada Limited, Calgary, AB Canada
Discussion Leader: Peter Midgley, Degremont NA, Dundas, ON Canada

Session Introduction **1:30 PM**

Sudhir Parab, ConocoPhillips Canada Limited, Calgary, AB Canada

IWC-12-21 **1:40 PM**

OVERVIEW OF PRODUCED WATER AND EOR WATER TREATMENT

Avijit Dey, Bechtel Corporation, Houston, TX

Produced water is mainly salty water trapped in the reservoir rock and brought up along with oil or gas during production. It can hold very minor amounts of chemicals added down-hole during production. These waters exist under high pressures and temperatures, and usually contain oil and metals. The treatment of produced water is a key component of the cost of producing oil and gas. The ability to efficiently and economically dispose of this water is vital to the success in the oil production business.

In this article, produced water treatment approach for shale gas, oil sand mining, oil sand SAGD, CBM, CSG, and offshore oil/ gas development fields shall be discussed. In addition, technical options for the EOR water treatment shall also be discussed.

Discusser: Peter Midgley, Degremont North America-Infilco, Dundas, ON Canada2:05 PM
Floor Discussion and Closure ..... 2:15 PM

IWC-12- 22 **2:30 PM**

OPTIMIZATION OF A WARM LIME SOFTENER NETWORK SYSTEM

Melonie Myszczyszyn, Canadian Natural Resources Limited, Calgary, AB Canada

A softening network of two or more warm lime softeners at a facility allows one to optimize the system components through comparison during operation. At the CNRL Wolf Lake facility, having two warm lime softeners (softener no 1 and softener no 2) to work with allowed various improvements to be determined over the years of 2000 to 2009. In the year 2000, the maximum capacity achieved by operations in each of softener no 1 and softener no 2 respectively was the following, 780 m3/hr. and 200 m3/hr. After various improvement implementations by year 2009, the maximum capacity achieved by operations in each of softener no 1 and softener no 2 respectively was, 1450 m3/hr. and 950 m3/hr. Key improvement areas were in the slurry systems water supply, piping, and mixers, sludge blowdown lines, sludge bed heights and sampling lines, turbine speeds and blades, system isolation valving, and chemical reaction laboratory testing. Studying and applying modifications in each of these improvement areas led to reduced phantom upsets, increased warm lime softener capacities, and overall chemical savings.

Discusser: Steve Portelance, Worley Parsons, Calgary, Canada.....2:55 PM
Floor Discussion and Closure.....3:05 PM
Break.....3:20 PM

IWC-12-23 **3:40 PM**

SAGD: PRODUCED WATER SOFTENING CHALLENGES FOR ION EXCHANGE RESIN (IER) TECHNOLOGY

Claude Gauthier, The Purolite Company, Burlington, ON Canada; Don Downey, The Purolite Company, Paris, ON Canada; Caroline Wilson Mussbachar, P. Eng,Laricina Energy, Calgary AB, Canada

This progress report discusses the many challenges and practical operating experience (OPEX) for Steam Assisted Gravity Drain (SAGD) Enhanced Oil Recovery (EOR) produced water softening applications. To meet this challenge high efficiency strong acid cation (SAC) and weak acid cation resins (WAC) utilizing SST shallow shell technology have demonstrated improved performance over standard ion exchange resins (IER). Pilot plant data, field performance data, regeneration elution and rinse profile curve data is presented. Practical lessons learned as to operational, equipment design deficiencies are outlined.

Discusser: Arun Mittal, Aquatech International Corp., Canonsburg, PA.....4:05 PM
Floor Discussion and Closure.....4:15 PM

IWC-12- 24 **4:30 PM**

RECOVERY OF BTEX AND LIGHT HYDROCARBONS FROM PRODUCED WATER

H. Robert Goltz & Aaron Johnson Dow Chemical, Midland, MI

BTEX and Light Hydrocarbons, measured as Gasoline Range Organics, Diesel Range Organics and Total Petroleum Hydrocarbons, can be present in produced water from oil and gas operations at varying levels. These components are partially soluble in water so they partition between the product phase and the water phase depending on their concentrations and type. These components are also semi-volatile so they will de-gas out of the water into the atmosphere creating an odor and air emission. Air permits may be required for storage tanks. The presence of benzene in these produced waters can also be of concern for disposal. Single use activated carbon could be used but is expensive. This paper will describe the use of a steam regenerable engineered media for recovery of BTEX and light hydrocarbons from gas and oil field produced water. The recovered hydrocarbons can be sold to defray part of the cost of the treatment.

Discusser: Peter Lamke, Golder Associates Inc., Lakewood, CO ..... 4:55 PM
Floor Discussion and Closure ..... 5:05 PM
Conclusion ..... 5:20 PM

CHALLENGES IN FGD WASTE WATER TREATMENT

Date: Monday November 5
Time: 1:30 PM-5:20 PM
Room: San Antonio Ballroom

This session reviews recent developments in Flue gas desulfurization system design, operation, and technology development which will provide insight and valuable information.

IWC Representative: Brad Wolf, Berkeley Research Group, LLC, Pittsburgh, PA
Session Chair: Pat Randall, Aquatech International Corp., Tampa, FL
Discussion Leader: Terry LaPrise, Aquatech International Corp., Tampa, FL

Session Introduction **1:30 PM**

Pat Randall, Aquatech International Corp., Tampa, FL

IWC-12-25 **1:40 PM**

FGD EVAPORATION PLANT OPERATIONS

J. Michael Marlett, Aquatech International Corp., Hartland, WI

Environmental quality remains a high priority in the power industry. These quality requirements result in the advancement of treatment techniques to provide plant discharges, air and water, to be minimized by reuse or of a quality that is either equal or higher in purity of the influents. Applications of existing technology are often employed but not validated with reports of performance. FGD wastewater treatment methods have centered mostly on physical and biological methods. Zero Liquid Discharge thermal solutions have been applied and are presently in use. The potential users and the EPA have yet to determine if thermal treatment techniques are the best available technology for this pollution source. This paper is a report on the operation of the plants in Italy that are operated and maintained by ENEL.. Five plants were installed at ENEL power plants in Italy. They have been operating for 4 years. How have they lived up to the expectations regarding expected operation? This paper is a report of the operation of the units at ENEL 4 years after their startup.

Floor Discussion ..... 2:05 PM

IWC-12- 26 **2:30 PM**

SELENITE AND SELENATE REMOVAL BY FUNCTIONALIZED ALUMINA ADSORPTION TECHNOLOGY

Nancy Sherwood, Rebecca Unkefer, Melissa Hayes, & Gina Sacco, MAR Systems Inc., Solon, OH

Selenium speciation presents unique challenges for removal to low ppb trace levels. The selenite oxyanion is much more readily removed from water by adsorption technology in flow-through column studies than the selenate oxyanion. Selenate removal however, is key to wastewater decontamination in the coal mine process and FGD scrubber water markets. The removal of both species is discussed as a function of water quality, pH and temperature. Water conditioning pretreatment options that improve selenate removal by adsorbent technology is discussed and treatment case histories providing selenium removal in coal mine process water ponds to very low levels of 1-2 ppb selenium are provided.

Discusser: William Kennedy, P.E., Duke Energy, Charlotte, N ..... 2:55 PM
Floor Discussion and Closure ..... 3:05 PM
Break ..... 3:20 PM

IWC-12-27 **3:40 PM**

ASH POND REPLACEMENT THERAPY

Thomas Higgins, CH2M HILL, Chantilly, VA; Dennis Fink,CH2M Hill, Oakland, CA; Dana French,CH2M Hill, Richmond Heights, MO

In this presentation, CH2M HILL will convey the following:

1. A review of the regulatory drivers pushing the elimination of pond-based flue gas desulfurization (FGD) wastewater and ash transport (sluicing) and disposal (pond-landfills) management. This review will include an overview of the treatment technologies being considered by EPA in setting Best Available Technology limits—physical/chemical treatment, biological treatment, and zero liquid discharge (ZLD).
2. Methods used for collecting, and typical data on, the following: flow and composition of wastewater streams; development of site-specific design bases; characterization of typical wastewater flows; reuse of wastewater to reduce discharges; and use of mass balance and chemistry modeling tools to evaluate reuse, treatment, and discharge strategies to meet these new limits.
3. Concepts on using existing evaporation (from cooling towers and FGD absorbers), or utilizing blowdown water for conditioning of flyash, and other water reuse and conservation measures to reduce the amount of wastewater requiring treatment.
4. Process "tips and tricks" and engineering concepts for ash-pond replacement systems, including provisions for water reuse or more stringent future effluent limitations.
5. Example ash pond replacement treatment systems, one of which was recently placed in service.

Discusser: William Moore, WesTech Inc., Houston, TX ..... 4:05 PM
Floor Discussion and Closure ..... 4:15 PM

IWC-12- 28 **4:30 PM**

REMOVAL OF SELENIUM FROM AQUEOUS WASTE STREAMS

Anna Casasus, Lucas Moore, Ph.D., Fredrick Vance, Ph.D., Vaishali Patel , Stephen Hurd, & Roderick Abinet, Kemira, Atlanta, GA

Selenium is a micronutrient that, while essential to life in low concentrations, is bioaccumulative, threatening aqueous biota and those higher in the food chain. Thus, the removal of selenium from wastewaters is a technical challenge that is increasingly gaining interest from a number of industries. As regulatory limits become more stringent, a solution that can consistently achieve low effluent levels is highly desirable. Kemira is developing technologies targeting the removal of selenium to trace concentrations from a number of aqueous streams resulting from coal processing and utilization. Research has focused on understanding and/or manipulating the effects of water matrix parameters, such as the species of selenium present, pH, and competing ion concentrations, among others. The objective is to develop technologies that will achieve high levels of selenium removal while minimizing the formation of a secondary waste, as well as the potential for leaching after disposal.

This paper will present an overview of the characterization of selenium present in wastewaters, since both the oxidation state of selenium and the pH play a key role in removal efficiencies. This is especially important in flue gasdesulfurization (FGD) streams where high sulfate levels can interfere, particularly with the removal of selenate, due to the similarities of the oxyanions. While greater than 90% removal has been demonstrated through optimization to date, work is ongoing to further improve the treatment to meet the stringent discharge limits in place or proposed in many areas.

Discusser: Angela Zagala, Nalco, An Ecolab Company, Cary, NC ..... 4:55 PM
Floor Discussion and Closure ..... 5:05 PM
Conclusion ..... 5:20 PM

WATER CONSERVATION, RECYCLE AND REUSE

Date: Tuesday November 6
Time: 8:00 AM-12:00 Noon
Room: Executive Salon 1

This session will focus on water conservation, recycling, and reuse. The topics to be discussed are the expansion of an RO plant which desalinates cooling water and mine drainage for use within a power station; a Water Conservation Tool for Natural Gas Combined Cycle Power Plants; a chemical treatment method and a filtration unit that provides reuse of wastewater at a laundry service; and a fluorescence-based method to detect sugar in reused boiler make-up water at a manufacturing facility.

IWC Representative: Steven Gagnon, AVANTech, Inc., Columbia, SC
Session Chair: Jonathan Shimko, Tetra Tech NUS, Pittsburgh, PA
Discussion Leader: Chip Westaby, Turner Designs Hydrocarbon Instruments, Fresno, CA

Session Introduction **8:00 AM**

Jonathan Shimko, Tetra Tech NUS, Pittsburgh, PA

IWC-12-29 **8:10 AM**

PRODUCING DEMINERALISED WATER FOR POWER GENERATION FROM DESALINATION OF CONCENTRATED COOLING

Water and Mine Drainage

Dheneshree Lalla & Mike van der Walt Eskom Holdings SOC Ltd., Johannesburg, Gueteng South Africa

South Africa, being a water scarce country, has driven the Zero Liquid Discharge philosophy further than eliminating the discharge of effluent, into maximizing recovery, recycle and re-use. Tutuka Power Station is one of the first in the Eskom's fleet to recover and treat, via desalination, its own concentrated cooling water as well as mine drainage from its tied colliery. Tutuka operates a dry ashing system and a wet open evaporative cooling system, the combination of which makes for challenging water management. To reduce final effluent production, the recovery on the existing RO plant must be increased from the current 87%. Expansion of the RO plant is currently underway to increase overall recovery to 97%, by concentrating the brine stream from a TDS of 22 000 ppm to a TDS of more than 105 000 ppm. Treating water of this TDS is a first for Eskom. Plant commissioning is scheduled for March 2012 The produced permeate is routed as feed to the ion exchange demineralized water production plant. Besides raw water intake reduction, benefits include increased ion exchange run time, reduced regenerations and reduced effluent production. Surplus permeate is used as Cooling Water make-up allowing increased cycles of concentration. The final brine will be disposed of in a 10 year evaporation pond while technologies for brine management reach maturity.

Discusser: Brian Clarke, Kiewit, Lenexa, KS ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12-30 **9:00 AM**

A WATER CONSERVATION TOOL FOR POWER GENERATORS

Gianna Cooley, Christina Peterson, Ph.D., CDM Smith, Houston, TX

Thermoelectric power providers are large users of water. A stable, high quality, water supply is a critical issue for many thermoelectric power generators. In 2011, the need for water conservation was brought to the forefront when Texas experienced the worst 1-year drought on record. During that time, the Electric Reliability Council of Texas (ERCOT) estimated almost 15% of its available generation capacity experienced historically low water levels that could strand intakes and/or result in unavailable or curtailed water rights/contracts.

Few specific tools have been developed to assist power generators with identifying water conservation best management practices (BMPs). To bridge that gap, CDM Smith developed the Water Conservation Tool (WCT) for Natural Gas Combined Cycle power plants. The WCT inputs largely focus on data related to the water balance around major processes. The model uses a process flow diagram with inputs for flows and Total Dissolved Solids (TDS) concentration. Outputs from the WCT include water use efficiency benchmarks and an inventory of applicable BMPs based on processes in use at the plant and the benchmark evaluation. BMPs are provided for potential reduction, recycle and reuse. Clients can then explore the reduction, recycle, and reuse options specific to their plant. The model can be easily updated for a variety of parameters. Out puts indicate efficiency of different process and BMPs specific to the plant.

This presentation will present a hypothetical case study for a natural gas combined cycle power generator. The presentation will present the typical approach to conducting a water conservation study and demonstrate the use of the WCT. The presentation will demonstrate the benefits of the tool which include the straightforward dashboard of benchmark data based on readily available information and the ability to quickly evaluate relevant water conservation BMPs for a facility.

Discusser: Ray Post, Chemtreat, Langhorn, PA....9:25 AM
Floor Discussion and Closure....9:35 AM
Break....9:50 AM

IWC-12-31 **10:10 AM**

PRETREATMENT AND REUSE OF WASTEWATER AT AN INDUSTRIAL LAUNDRY

Yakup Nurdogan, Bechtel National, Inc., Pueblo, CO

California Linen Rental Company (Cal-Linen) in Oakland, California, supplies laundered linens, clothing, and other washable items to small businesses in San Francisco Bay Area. Cal-Linen processes approximately 50,000 lb/day using nine automated 400-lb computerized washers. Cal-Linen purchases their water from the East Bay Municipal Utility District (EBMUD), which also provides wastewater services. Cal-Linen installed a wastewater pretreatment and clarification system in order to comply with the EBMUD™ fat-oil-grease (FOG) discharge limits. The pilot-scale demonstration tests proved that the method of magnesium coagulation at pH levels between 11.0-11.5 and anionic polymer flocculation was the best chemical treatment method for the dissolved air flotation (DAF) clarification of the treated wastewater. A multi-media filtration unit was also used after DAF to improve the FOG and total suspended solids (TSS) removal efficiencies. Magnesium chloride addition at 140-200 mg/L as Mg and 4-6 mg/L polymer addition made possible to reduce FOG by 98% and TSS by 85% using a DAF and filtration clarification system. Cal-Linen recycles up to 50% of its treated effluent after reducing FOG, hardness, and TSS in the effluent. Warm treated wastewater is recycled back to the hot water system, saving energy and up to 11 million gal of water per year. This paper will summarize the results of the bench- and pilot-scale treatability studies, which led to design of this award winning pretreatment plant. The operating experience of the full-scale wastewater treatment system will also be discussed.

Discusser: Jonathan Vorheis, CH2M Hill, San Antonio, TX....10:35 AM
Floor Discussion and Closure....10:45 AM

IWC-12-32 **11:00 AM**

DETECTION OF ORGANIC CONTAMINATION IN SUGAR PROCESS CONDENSATE STREAMS BY FLUORESCENCE

Christopher B. Wilson, Nalco, An Ecolab Company, Naperville, IL USA; Ling Liang, Nalco, an Ecolab Company, Shanghai, China; Manish Singh, Nalco, an Ecolab Company, Pune, India

During the sugar manufacturing process, vapor condensate is available from juice heaters, multiple effect evaporators, and vacuum pans, which are used for concentrating the sugar juice. The condensate typically contains few contaminants and has relatively high heat content, making it an ideal candidate for reuse as the feed water to the boilers. Occasionally, the condensate becomes contaminated with sugar from the process, resulting in "sugar shots". If a sugar shot is not detected in time and the contaminated condensate is returned to the boiler, sugar may break down into organic acids that may rapidly depress boiler water pH, and result in corrosion.

A fluorescence-based method was developed to provide real-time and on-line detection of sugar shots. This technology measures the naturally occurring organics in the juice that have fluorescent properties. With the specific excitation and emission wavelengths, the fluorescence based method can successfully detect low level concentrations of sugar in vapor condensate. In field applications, this technology outperformed other monitoring methods based on conductivity or wet chemistry in terms of sensitivity and reliability.

Discusser: Duane Germenis, Turner Designs Hydrocarbon Instruments, Fresna, CA 11:25 AM

Floor Discussion and Closure ..... 11:35 AM

Conclusion ..... 12:00 NOON

TREATMENT AND ANALYSIS TECHNOLOGIES FOR THE NUCLEAR RENAISSANCE

Date: Tuesday November 6
Time: 8:00 AM-12:00 Noon
Room: Executive Salon 2

Treatment and Analysis Technologies for the Nuclear Renaissance

Equipment at nuclear power plants is reaching the end of the design life which has created a nuclear renaissance due to major plant modifications and licenses for new construction. The four papers in this session will provide innovative analysis and treatment technologies useful for this nuclear renaissance including: treatment of wastewater at Fukushima, analysis of the chemistry and structure of oxides and deposits on steam generator tube surfaces, ion exchange filter paper and intelligent sensor technology for measurement of reactor water chemistry.

IWC Representative: Andrew Calderwood, Consultant, Pittsburgh, PA
Session Chair: Michele Funk, Bechtel Power Corporation, Frederick, MD
Discussion Leader: John M. Jevec, The Babcock & Wilcox Company, Barberton, OH

Session Introduction **8:00 AM**

Michele Funk, Bechtel Power Corporation, Frederick, MD

IWC-12-33 **8:10 AM**

EMERGENCY RESPONSE WASTEWATER PROCESSING AT FUKUSHIMA NUCLEAR PLANT

James Braun & Tracy Barker, AVANTech Incorporated, Columbia, SC

The Great East Japan Earthquake that took place on March 11, 2011 created a number of technical challenges at the Fukushima Daiichi Nuclear Plant. One of the primary challenges involved the treatment of highly contaminated radioactive wastewater. Avantech

Inc. developed a unique patent pending treatment system that addressed the numerous technical issues in an efficient and safe manner.

Our paper will address the development of the process from concept through detailed design, identify the lessons learned, and provide the results of the project. Specific design and operational parameters/benefits discussed in the paper include:
Selection of equipment to address radionuclide issues Unique method of solving the additional technical issues associated with Hydrogen Generation and Residual Heat Operational results, including chemistry, offsite discharges and waste generationResults show that the customized process has enabled the utility to recycle the wastewater for cooling and reuse. This technology had a direct benefit to nuclear facilities worldwide.
Discusser: Peter Meyers, ResinTech, West Berlin, NJ ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12- 34 **9:00 AM**

EFFECTS OF ZINC ADDITION ON STEAM GENERATOR TUBE SURFACE CHEMISTRY AND STRUCTURE

W.A. Byers,Ph.D., Arash Parsi, Ph.D. & Rachel DeVito, Westhinghouse Electric Company, Cranberry Township, PA

PWR operators have pursued zinc additions to the primary coolant to control radiation field build-up and to reduce primary water stress corrosion cracking. While zinc addition has been largely successful in achieving these goals, the effectiveness of zinc addition has varied from plant to plant. The cause for this variation is unknown.

An understanding of the mechanisms by which zinc addition improves corrosion and radiation field build-up would be helpful for optimizing zinc addition and for predicting the effectiveness of zinc addition at plants which are considering initiation of a zinc addition program. Several mechanisms have been presented in the scientific literature. Information on the chemistry and structure of the oxides and deposits on steam generator surfaces is needed to decide the extent to which different mechanisms operate. However, little plant data is available.

This paper will present a review of steam generator tube surface information which is available, along with the results of new steam generator tube surface analyses. Auger electron spectroscopy, scanning/transmission electron microscopy, and scanning electron microscopy have been used to characterize steam generator tubes before and after zinc addition. The results indicate that a surface blocking mechanism may be one of the dominant mechanisms by which zinc affects surface corrosion.
Discusser: Venus Kaur, Southern California Edison, Westminister, CA ..... 9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:40 AM

IWC-12-35 **10:10 AM**

NANODEX™ FILTER PAPERS

Peter A. Yarnell, Graver Technologies, LLC, Glasgow, DE

Ion exchange filter papers have been utilized in the nuclear power industry for analytical measurements for some years. Both anion and cation, filter papers are currently employed in nuclear plants to analyze aqueous streams such as reactor coolant, condensate demineralizer feed and effluent, and stator cooling water. The most common cationic contaminants are corrosion products such as copper, nickel, zinc, chromium, cobalt, and iron. The anion filter papers capture contaminants such as chloride, sulfate, and particularly iodide. In some cases, the contaminants are radionuclides such as Cr51, Co58, Co60, and I131. These filter papers accurately quantify ionic species at low levels (ppb or even ppt). Moreover, the large surface area of the filter paper offers rapid kinetics.

Graver Technologies developed second generation ion exchange filter papers that offer higher ion exchange capacity while retaining the benefits of the current commercial ion exchange filter papers used in US nuclear plants.

These ion exchange filter papers have undergone a battery of tests as part of the qualification process, including measurements for exchange capacity, hydraulic performance, physical dimensions, permeability and porosity characteristics, stability, and residual contaminants. In each case, comparisons have been made to existing commercial ion exchange filter papers.

Beta site trials with both the anion and cation developmental filter papers are underway in both US and European nuclear power plants. The results of these trials, as well as any commercial plant data, will be presented in the paper.

Discusser: Terry Heller, Purolite, Bala Cynwyd, PA ..... 10:35 AM
Floor Discussion and Closure ..... 10:45 AM

IWC-12-36 **11:00 AM**

INTELLIGENT SENSOR TECHNOLOGY FOR POWER PLANT LIQUID ANALYTICS

David Gray & Kirk Buecher, Mettler-Toledo Thornton, Inc., Bedford, MA

Analytical measurements on water in power plants provide fundamental information needed to purify makeup water, minimize corrosion and deposition in the cycle and meet environmental requirements for wastewater discharge. The separation of conductivity, pH, ORP and dissolved oxygen sensors from their instrumentation by significant distances has compromised performance and reliability of these measurements for decades. Weak sensor signals, noisy electrical environments through which their cables must pass, and various kinds of miss-match between sensor and instrument contributed to reduced reliability and accuracy. In addition, efficient sensor maintenance has been hindered by variable conditions within and around the sensor.

Maintenance may take the approach, "fix it after it breaks" which allows system upset with potential corrosion and/or deposition in very high cost components of the plant. Alternatively, it may take the preventive approach, "fix it before it breaks" which often represents unnecessary maintenance. Preventive maintenance usually entails a large margin of safety in calibrating, cleaning and rejuvenating sensors more often than necessary. This leads to greater maintenance expense in materials and labor. With intelligent sensors, there is a third approach with predictive maintenance that can boost efficiency significantly.

Discusser: Jeanette Shoemaker, Betchel Power, Frederick, MD ..... 11:25 AM
Floor Discussion and Closure ..... 11:35 AM
Conclusion ..... 12:00 NOON

UNLOCKING CORROSION AND SCALE DEPOSITION MECHANISMS BY DETERMINATION OF KEY PRODUCED WATER ELEMENTAL IONS: OXYGEN, ORGANIC MATTER, AND SILICA: ASME WATER SUBCOMMITTEE PANEL SESSION

Date: Tuesday November 6
Time: 8:00 AM-12:00 Noon
Room: Executive Salon 4

This ASME sponsored Open Floor Panel discussion session will relay current techniques and insight on advancements and ways to detect oxygen, characterize organic matter, transport silica, and discuss controlling silica deposition in produced water piping and boiler systems in thermal enhanced recovery processes. Understanding and knowing what amounts of contaminants like oxygen, organics, and silica are Key to determining and mitigating the mechanisms controlling the corrosion and deposition rates within produced water boiler systems. The papers presented in this panel session, will spark debate on corrosion and deposition within EOR boilers and lead to group discussions on whether to scale or not within the boiler piping or to transport ions through the boiler and into the downstream

IWC Representative: Debbie Bloom, Nalco, an Ecolab Company, Naperville, IL
Session Chair: Melonie Myszczszyn, Canadian Natural Resources Limited, Calgary, AB Canada
Discussion Leader: Rudy Tamayo, Husky Energy, Calgary, AB Canada

Session Introduction **8:00 AM**

Melonie Myszczszyn, Canadian Natural Resources Limited, Calgary, AB Canada

IWC-12-37 **8:10 AM**

MONITORING PPB LEVELS OF DISSOLVED OXYGEN IN SAGD PILOT FACILITIES
Glenn Weagle & Ron Maltman Champion Technologies, Sherwood Park, AB Canada
SAGD Pilot facilities often acquire their water supply for steam generation from various sources. These water sources can be quite variable; therefore quality assays are very important. Low ppb concentrations of dissolved oxygen had not been as easy to assay in the field. Field test equipment has been expensive and difficult to maintain. New sensing technology using fluorescence decay now permits reliable dissolved oxygen measurement and data logging that is unaffected by the water quality, even high solids and opacity. Membrane based dissolved oxygen meters frequently fail in these conditions and cannot be trusted to data log dissolved oxygen trends. These dissolved oxygen trends have provided crucial data permitting â€œon the fly correction such that serious oxygen related issues can be prevented like corrosion. In one facility using trucked in raw water dissolved oxygen levels would fluctuate from 5 ppb to 500 ppb in less than 1 hour after each unloaded water truck. In another facility it was thought that pre-conditioned, softened deaerated water had acceptable dissolved oxygen levels when it was determined not to be the case. In another facility, 103 ppb oxygen loss across a heat exchanger from active corrosion was detected. In this presentation numerous case studies will be used to outline where dissolved oxygen measurement assisted in facility operations, preventing costly maintenance and loss of equipment. With current technology these accurate and reliable dissolved oxygen determination are possible for any facility.

IWC-12-38 **8:35 AM**

ADVANCES IN THE CHARACTERIZATION OF DISSOLVED ORGANIC MATTER IN SAGD PRODUCED WATER

David Pernitsky, Suncor Energy, Inc., Calgary, AB Canada; Subir Bhattacharjee, University of Alberta, Edmonton, AB Canada; Matthew Peterson & Anthony Ku,GE Global Research,Niskayuna, NY

Steam Assisted Gravity Drainage (SAGD) is a widely used process for in-situ recovery of bitumen from Oilsands, and requires the treatment of large volumes of produced water, which is then recycled as boiler feed water. One of the fundamental prerequisites for the development of new water treatment technologies is a thorough understanding of the physico-chemical characteristics of SAGD produced water. This paper describes recent laboratory work done to chemically characterize the dissolved organic matter (DOM) present in SAGD produced water samples taken from an operating facility. Samples were analyzed by excitation-emission matrix spectroscopy (EEMs), diffused reflectance FTIR, and two-dimensional gas chromatography/time-of-flight mass spectroscopy techniques. Sequential membrane filtration was used to determine molecular weight distributions. A resin fractionation technique was also used to separate SAGD DOM into hydrophobic and hydrophilic acid, base, and neutral fractions. The results of these complementary analyses indicate that SAGD DOM consisted predominantly of low molecular weight compounds, with hydrophobic acids representing the largest fraction. These hydrophobic acids were found to exhibit signatures that resemble humic-like substances more closely than the naphthenic acids typically found in Oilsands process affected waters. Phenols, carboxylic acids, thiophenes, and sulfones were also present in significant concentrations. Implications for treatment and fouling prevention will also be discussed.

IWC-12-39 **9:00 AM**

SILICATE SCALE INHIBITOR USE IN ONCE-THROUGH STEAM GENERATORS IN THE SAGD INDUSTRY

Edward Van Doorn, Baker Hughes Inc., Calgary, AB Canada; Rene Belanger, P. Eng.,Baker Hughes, Inc.,Edmonton, AB Canada

One of the current silicate scale control strategies in OTSG operations is to precipitate silica with magnesium oxide in either warm or hot lime processes, reducing the silica concentration in the feed water to less than 50 mg/L. Inhibition of silicate scale during steam production in an OTSG has been proven in both laboratory and industrial applications. In the presence of the silicate scale inhibitors, feed water containing in excess of 250 mg/L silica can be used in an OTSG producing 80% steam quality, resulting in blowdown silica concentrations in excess of 1000 mg/L, without any evidence of scale formation. Eliminating the use of warm and hot process softeners with the application of silicate scale inhibitors will result in substantial savings in both capital and operating costs.

IWC-12-40 **9:25 AM**

SILICATE DEPOSIT CONTROL IN STEAM-ASSISTED GRAVITY DRAINAGE (SAGD) AND PRODUCED WATER APPLICATIONS

Corbin Ralph, Carol Batton, & John Hoots, Ph.D, Nalco, an Ecolab Company, Naperville, IL

Silicate-based deposits are prevalent in many produced water (SAGD, steam flood, and related) plant unit operations. Type and structure of silica deposits may range from amorphous silica to silica salts. These silicate deposits are often complex mixtures containing hardness ions (calcium, magnesium, and others), iron and alkaline metal ions (sodium, lithium, and others). Amorphous silica along with iron salts and organic-based foulants may also be incorporated into deposits. Presence of silica/silicate deposits can

significantly reduce system efficiency, increase operating/maintenance costs, reduce productivity and in some cases lead to overheating/failure of equipment. Steam generators and evaporators are especially prone to silicate deposits due to operation at elevated temperatures, high level of silica/hardness in feedwater and increased cycles of concentration. Preventing silicate-based deposits or removing those deposits after they have formed helps reduce system problems and cost of operation. This paper describes type of deposits encountered, as well as development process for new silicate inhibitor treatment and system cleaning chemistries. Laboratory testing methods and results are discussed. Based on lab studies of new silica inhibitor chemistries, results show significant ability to maintain thermal efficiency and run length can be extended by 4-fold or more prior to onset of significant deposition. Outcome of field trial testing and application challenges overcome is also described. As existing operational needs are met, new requirements, and harsher conditions (poorer water quality, higher cycles of concentration and higher % of recycled water) are encountered. Most recent operating results as well as methods to help overcome new challenges are summarized.

Break ..... 9:50 AM
Panel Discussion ..... 10:10 AM
Conclusion ..... 12:00 NOON

PILOT AND FULL SCALE OPERATING EXPERIENCES FOR FGD WASTEWATER TREATMENT

Date: Tuesday November 6
Time: 8:00 AM-12:00 Noon
Room: San Antonio Ballroom

Pilot and Full Scale Operating Experiences for FGD Wastewater Treatment

The unique combination of constituents found in FGD wastewater streams present challenges to both equipment process suppliers and plant operations. Existing receiving stream discharge limits and upcoming regulations regarding FGD wastewater have encouraged the industry to develop creative technologies for wastewater management. This session will review pilot and full scale FGD wastewater treatment technology experiences designed for reduction of nitrates, boron, nutrients, selenium and total dissolved solids from FGD wastewater.

IWC Representative: Colleen Layman, HDR Inc., Harpers Ferry, WV
Session Chair: Patricia Scroggin, Burns & McDonnell, Kansas City, MO
Discussion Leader: Ashwin Thakkar, Aquatech International Corp., Canonsburg, PA

Session Introduction **8:00 AM**

Patricia Scroggin, Burns & McDonnell, Kansas City, MO

IWC-12-41 **8:10 AM**

DESIGN AND START-UP OF A FULL-SCALE BIOLOGICAL SELENIUIM REMOVAL SYSTEM FOR FLUE GAS DESULFURIZATION (FGD) WASTEWATER FROM A POWER GENERATING STATION

Antonio Lau, & Michael Pudvay, P.E., Infilco Degremont, Inc., Richmond, VA ;John Bradberry, P.E.; Ray D'Alesandro; Steve Frank; Anthony Garaventa & Shelley Wojciechowski, GenOn,New Florence, PA; Harry McNamee, P.E. & Robert Bernstein, URS Corporation, Princeton, NJ; Enos Stover; Ross Stover & Chris Campana, Stover & Associates, Inc. Stillwater, OK

This paper describes the design, start-up and commissioning of a full-scale biological treatment system that was installed at a coal-fired power generating station to remove selenium and nitrates from a Flue Gas Desulfurization (FGD) blowdown stream. The new patented iBIO® wastewater treatment (WWT) system was first pilot tested and it is based

on a suspended growth continuous-stirred-tank anaerobic reactor that has been seeded with a source of commonly available anaerobic microorganisms which were subsequently acclimated to remove selenium from the FGD wastewater. This new innovative WWT system was integrated into the power station's existing WWT unit to provide the additional selenium removal capability from the wastewater.

This demonstrated biological selenium removal treatment system provides a robust and cost-effective alternate technology to coal-fired utilities that use FGD wet scrubbers to control their sulfur oxide (SOx) emissions and also need to consistently meet the more stringent low-level selenium effluent permit limits.

Discusser: Josh R. Prusakiewicz, HDR Inc, Ann Arbor, MI ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12- 42 **9:00 AM**

START-UP AND OPERATION OF A FULL SCALE, NO LIQUID DISCHARGE BORON REMOVAL PROCESS FOR FGD WASTE WATER

H Robert Goltz & Chris Eicher The Dow Chemical Company, Midland, MI; Michael Pudvay, Infilco Degremont, Richmond, VA

Boron can be present in the wastewater of FGD scrubbers and must be removed. Dow Water & Process Solutions and Infilco Degremont, Inc. have developed an end-of-pipe system to remove boron contamination down to required discharge limits. This report will present the results of a successful plant start-up and operations.

Discusser: Herman Nebrig, Southern Co., Birmingham, AL ..... 9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12-43 **10:10 AM**

A PILOT DEMONSTRATION OF SPRAY DRYER EVAPORATION AS A METHOD TO TREAT POWER PLANT FGD WASTEWATER

Jason (Xinjun) Teng, Southern Company, Birmingham, AL Robert Strange, Southern Research Institute, Birmingham, AL; Bruce Easom, Easom Consulting, Groton, MA

The United States Environmental Protection Agency (USEPA) is expected to limit the concentrations of species including selenium and mercury allowed to be discharged in wastewater from wet flue gas desulfurization (FGD) units. One treatment option is spray drying evaporation, a Zero Liquid Discharge (ZLD) technology. In this process, FGD wastewater droplets are sprayed concurrently with hot flue gases and the dried solids are collected using an electrostatic precipitator (ESP) or baghouse.

A pilot scale test was conducted at plant Gadsden of Southern Company to demonstrate this technology. The droplet mass mean diameter was adjusted to 40Â¿m during the test. A thermal model was established. The model showed that to evaporate 200 gpm FGD wastewater with 40,000ppm chloride, with an inlet and outlet gas temperatures of 620°F and 400°F, the required flue gas flow was estimated to be 0.95Ã—106 acfm. Data illuminated that mercury in the FGD wastewater did not evaporate back to the flue gas. Instead, all the mercury deposited in the solids.

Addition of active carbon could further remove the mercury from flue gas. Around 99% of the chloride in the wastewater was crystallized, and the left 1% was evaporated into the flue gas. An increased baghouse pressure drop was observed during the test.

Discusser: Greg Mandigo, Aquatech International Corporation, Milwaukee, WI 10:35 AM
Floor Discussion and Closure ..... 10:45 AM

IWC-12-44 **11:00 AM**

CONSTRUCTED WETLAND TREATMENT SYSTEM FOR FGD WASTEWATER TREATMENT - PILOT PROJECT FINAL RESULTS

Christopher Snider Maria Squillace, Dennis Haag, & Katie Bland Burns & McDonnell, Kansas City, MO; Andrew Rietcheck & Jared Morrison, Westar Energy, Inc. Topeka, KS

Constructed wetland treatment systems use natural biological processes to reduce the concentrations of constituents in the wastewater and have demonstrated promise for the treatment of FGD wastewater. However, limited industry and academic research has been conducted and very few full scale applications have been undertaken. Constructed wetland treatment systems have been used effectively for the treatment of other industrial and municipal wastewaters but widespread use in the power generation sector has not yet developed due to lack of research and project experience.

A major power producer has decided to undertake a constructed wetland treatment system pilot project to evaluate the technology. The constructed wetland, currently in operation, is approximately 2 acres in size and treats approximately 7 percent of the plant FGD wastewater stream. The initial Pilot results were presented at the IWC 2010 Conference. This presentation will cover the final Pilot results and will explain the decision making process implemented when faced with the decision to build the full scale constructed wetland treatment system within a critical time frame.

Discusser: Diane Martini, Sargent & Lundy, LLC, Chicago, IL.....11:25 AM
Floor Discussion and Closure.....11:35 AM
Conclusion ..... 12:00 NOON

REVERSE OSMOSIS MEMBRANE ISSUES: NEW DIRECTIONS IN PRETREATMENT

Date: Tuesday November 6
Time: 1:30 PM-5:20 PM
Room: Executive Salon 1

Reverse Osmosis Membrane Issues: New Directions in Pretreatment

Reverse osmosis (RO) membrane fouling and scaling is the bane of existence for virtually all RO systems. Fouling and scaling cost RO users time and materials to address the consequences of these issues. Biofouling and scaling are issues that will continue to grow in importance as RO is used to treat ever more challenging waters. Pretreatment is one key to minimizing fouling and scaling. This session's papers address new directions in RO pretreatment to minimize biofouling and scaling while operating on challenging streams such as wastewater for recycle, and describe the use of membrane filtration (ultrafiltration), equipment (Ultraviolet Light) and chemicals (biocides) for general

IWC Representative: Dennis McBride, Fluor Enterprises, Greenville, SC
Session Chair: Jane Kucera, Nalco, an Ecolab Company, Naperville, IL
Discussion Leader: Jeff Tate, Agape Water, Harleysville, PA

Session Introduction: **1:30 PM**

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

IWC-12-45 **1:40 PM**

DEVELOPMENT OF A PHOSPHOROUS-FREE RO ANTISCALANT FOR WASTE WATER RECYCLING APPLICATIONS

Deepak Musale, Nalco, An Ecolab Company, Naperville, IL; Ana Urmenyi, Nalco Netherlands BV,Oegstgeest, South Holland, The Netherlands;Benjamin Bingjia Yao,Nalco China, Shanghai, P.R.C.; Harshada Lohokare,Nalco Water India Ltd., Pune, India

Due to water shortage in many parts of the world, industrial water users are increasingly recycling their wastewater after various treatments including reverse osmosis

(RO), which yields the water quality that is suitable for many purposes within industrial plants. However, due to complex composition of wastewater in many industries, the RO systems used in the waste water recycling are commonly fouled with heavy metal (e.g. iron and Manganese) precipitates and colloids such as gel silica. Antiscalants are normally used to alleviate such fouling; however, gel silica is not controlled effectively by most commercial RO antiscalants. Secondly, the higher phosphorous levels in RO reject, caused by phosphorous-based antiscalants, do not meet the stringent discharge limits in certain regions. This trend suggests the need for a RO antiscalant that will not only be phosphorous-free but also effective towards controlling Fe, Mn and gel Silica fouling in addition to common mineral salt scaling, to allow for cost effective and environmentally sustainable water recycling. To address the above industry need, - a new phosphorous-free RO antiscalant was developed, which has functionality to inhibit the common mineral salt scale as well as to disperse heavy metal salts and gel foulants such as colloidal silica. After development and evaluation in laboratory, this product was field tested along with phosphorous-based antiscalant in two water recycling RO plants for several months. Both trials showed same or better performance of new phosphorous-free antiscalant than currently used phosphorous-based antiscalant, for Fe, Mn and gel silica fouling control. The results from these trials will be presented in this paper.

Discusser: Mo Malki, American Water Chemicals, Inc., Tampa, FL.....2:05 PM
Floor Discussion and Closure.....2:15 PM

IWC-12-46 **2:30 PM**

A NOVEL APPOACH TO CONTROL MICROBIAL FOULING OF REVERSE OSMOSIS MEMBRANES

William Collentro, Consultant, Plymouth, MA

Microbial fouling of reverse osmosis membranes is associated with loss of product water flow, increase in feed water pressure, and increase in product water microbial levels. Membrane fouling can be reduced by reducing the total viable bacteria level in reverse osmosis system feed water. Inline ultraviolet treatment of feed water, subsequent to reverse osmosis unit waste recycles can significantly reduce total viable bacteria to levels that are not detectable in a 100 ml sample. Ultraviolet radiation at a wave length of 184.7 nanometers produces both highly oxidative ozone and the hydroxyl radical capable of rapid inactivation of bacteria. The 184.7 nanometer technology can be "mixed" with classical 254 nanometer wave length technology to protect thin-film composite membranes from oxidation. Pilot and operating data will be provided to demonstrate the effectiveness of the technology.

Discusser: Dale Wynkoop, Veolia Water (Crown Solutions), Vandalia, OH.....2:55 PM
Floor Discussion and Closure.....3:05 PM
Break.....3:20 PM

IWC-12-47 **3:40 PM**

CONTROL OF BIOFOULING OF REVERSE OSMOSIS MEMBRANE SYSTEMS WITH A BIOCIDE

Paul Schook, The Dow Chemical Company, Buffalo Grove, IL; Katariina Majamaa, Dow Water and Process Solutions,Tarragona, Spain; Peter Sehn, Dow Water and Process Solutions,Rheinmuenster, Germany; Rhonda Vance-Moeser, Dow Water and Process Solutions, Midland, MI; Rashmi Patwardhan, Ph.D., Dow Microbial Control Buffalo Grove, IL; Nanette Hermsen, Dow Water and Process Solutions Edina, MN; Jim Summerfield, Dow Microbial Control Buffalo Grove, IL

Reverse Osmosis (RO) membrane purified water is used in many industrial applications such as rinsing of electronic components, specialty chemical manufacturing, and for boiler water. Biofouling is a common phenomenon observed in these membrane-based systems

and results in reduced productivity, increased operational cost, and reduced quality of the produced water. Dibromo nitrilopropionamide (DBNPA) - a fast-acting, non-oxidizing, cost effective biocide has consistently shown efficacy in on-line and off-line cleaning of RO membranes producing water for industrial purposes. Two case studies demonstrating efficacy of this biocide for cleaning RO membranes in industrial applications will be presented. Recent studies have also shown that DBNPA is a suitable biocide for off-line cleaning of RO membranes producing potable water provided that certain guidelines are followed. When DBNPA is used to clean membranes producing potable water, the RO-filtered water must meet local regulatory guidelines and limits for drinking water.

Studies have demonstrated that RO membranes treated off-line with DBNPA and subsequently rinsed properly and appropriately monitored can meet these stringent regulatory requirements in most regions. Currently, efforts are ongoing in several global regions to register DBNPA for off-line cleaning of the RO membranes producing municipal water.

Discusser: Ken Pandya, AWTS, Inc., Plano, TX.....4:05 PM
Floor Discussion and Closure.....4:15 PM

IWC-12-48 4:30 PM

INCREASING WATER SYSTEM EFFICIENCY WITH ULTRAFILTRATION PRE-TREATMENT IN INDUSTRIAL APPLICATIONS

Katariina Majamaa, Javier Suarez, & Eduard Gasia, Dow Chemical Ibrica, S.L., Tarragona, Catalonia, Spain

A reference list of ten recent integrated UF-RO installations in industrial applications spanning the globe is presented. These plants not only range in geographic location, but also in size, industry segment and type of initial feed water. A detailed focus on the design and operational aspects of two plants is provided. Experience from these plants can be leveraged to new projects.

Further increasing the attractiveness of UF, recent module developments include a simplified module construction allowing a water production increase of 30% while keeping energy consumption and plant footprint constant. On a plant design aspect, a new, streamlined compact skid solution is presented to simplify the engineering effort and lower UF skid CAPEX cost. An economic analysis was carried out with a refined cost model and various system design concepts comparing the CAPEX and OPEX reduction impact of new high active area UF modules and pre-engineered skids in the total UF-RO water system cost compared to conventional pretreatment.

Discusser: Nandan T. Vani, D.Sc. PE, Bechtel Corporation, Houston, TX.....4:55 PM
Floor Discussion and Closure.....5:05 PM
Conclusion.....5:20 PM

REFINERY WASTEWATER

Date: Tuesday November 6
Time: 1:30 PM-5:20 PM
Room: Executive Salon 2

Refinery Wastewater

The refining industry is faced with ever increasing and demanding environmental regulations to protect the environment. Wastewater from the refining process contains hazardous hydrocarbons, phenol, amines, ammonia nitrogen, selenium, BTEX compounds, heavy metals, total dissolved solids and other hazardous compounds. Reuse of treated wastewater effluent is gaining momentum not only to comply with the complex regulatory requirements cost effectively but also to relieve the demand on the scarce raw water supply. This session presents cutting edge trends in technology such as use of new polymer treatment program for selenium removal, use of macro porous polymer extraction to remove dispersed and dissolved hydrocarbons, wet air oxidation treatment of spent caustic, and wastewater characterization and operational methods to resolve hindered settling in wastewater

IWC Representative: Jim Dromgoole, Fort Bend Services, Stafford, TX
Session Chair: Ramesh Kalluri, Kalluri Group, Inc., Houston, TX
Discussion Leader: Arun Mittal, Aquatech International Corp., Canonsburg,PA

Session Introduction — 1:30 PM

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

IWC-12-49 — 1:40 PM

SELENIUM REMOVAL FROM REFINERY WASTEWATER USING A NEW POLYMER TREATMENT PROGRAM

Daniel Schwarz & Jitendra Shah Nalco, an Ecolab Company, Naperville, IL; Tina Syvret, Nalco, an Ecolab Company, Sugar Land, TX

Selenium is naturally occurring in crude oil and is a contaminant in the wastewater stream when the crude oil is refined to useable product. Although present in all living matter, high levels can be toxic to aquatic life and plant discharge limits are controlled. The refining industry is currently experiencing, or is anticipating a reduction in the discharge limits for selenium in their wastewater effluent streams yet there are no treatments that can cost-effectively and reliably remove selenium from a wide array of refinery effluents. Although there are sites that have found methods that work to varying degrees of success, these methods are specific to individual processes, and no general method has been developed.

Nalco has developed a widely applicable technology that is both cost effective and capable of achieving 80-95% selenium removal in most refinery waste streams. The main objective was to develop a chemical treatment program that would take advantage of the reducing environment of refinery sour water stripper effluent where most selenium is in the Se+2, selenite state and not the difficult to remove Se+6, selenate state.

The new treatment uses a very small amount of an iron complex to aid in the binding of the selenium which is subsequently removed with the addition of a metal precipitating agent. The decreased quantity of chemicals dosed has resulted in significantly lower sludge production and disposal costs.

Discusser: John Christiansen, CDM Smith, Houston, TX ..... 2:05 PM
Floor Discussion and Closure ..... 2:15 PM

IWC-12-50 **2:30 PM**

CHARACTERIZATION OF TWO GULF-AREA REFINERY SECONDARY WASTEWATER TREATMENT PLANTS TO RESOLVE HINDERED SETTLING ISSUES

David Pecina, David Mason, & S. Smith General Electric, The Woodlands, Texas

In this study, two similar Gulf-area oil refinery secondary wastewater treatment plants were characterized chemically, operationally, and microbiologically in an effort to resolve chronic hindered settling issues present at one location but not at the other location over a 12 month period. Fluorescence in situ Hybridization (FISH) for single cell identification using 16S RNA-targeted oligonucleotides, epifluorescence microscopy, and standard phase microscopy were used in the analysis of microbial flocs and identification of filamentous bacteria and in qualitative assessments of major nitrifying and denitrifying bacteria present in each of the systems. Chemical analysis of influent wastewater was also performed at both sites at one time point to determine the total organic carbon (TOC), chemical oxygen demand (COD), and organics present using ion-chromatography (IC), gas chromatography/liquid chromatography (GC/MS), liquid chromatography high resolution mass spectrometry (LC/MS). Chemical analysis showed the influent stream in the problem system to contain comparatively higher amounts of TOC, COD, and organic acid concentrations. Additionally, the problem system was found to contain high amounts of denitrifying bacteria (Azoarcus and Thaeura) and filamentous bacteria (Type 1701 (Class Betaproteobacteria) and Nostocoida limicola™)). Operational differences were also observed in MCRT and F/M ratios between each of these systems. Operational adjustments will be made at the problem system with additional considerations of chemical control measures to reduce the abundance of filamentous bacteria. This study will continue to follow the microbiological community and operational conditions in the problem system until it is stable.

Discusser: Frank Castaldi, Ph.D., Golder Associates, Lakewood, CO.....2:55 PM
Floor Discussion and Closure.....3:05 PM
Break.....3:20 PM

IWC-12-51 **3:40 PM**

WET AIR OXIDATION TREATMENT OF SPENT CAUSTIC IN PETROLEUM REFINERIES

Bryan Kumfer & Mark Clark, Siemens Industry, Inc., Rothschild, WI

Spent caustic streams from refineries typically have a high chemical oxygen demand (20 - 500 g/L) and contain chemicals that are hazardous, inhibitory, and/or biorefactory. The potential chemicals in the spent caustic wastewater include reduced sulfur compounds such as sulfides and mercaptans as well as organic species such as the sodium salts of naphthenic and cresylic acids. Due to the types of chemicals contained in the spent caustic, the spent caustic wastewaters can be environmentally hazardous and difficult to treat with conventional biological treatment. Wet air oxidation can be used as a treatment process in order to significantly reducing the chemical oxygen demand while producing a biodegradable effluent. In wet air oxidation, temperatures ranging from 130 to 260 °C and their corresponding pressures (150 PSI to 1200 PSI) are used for the treatment of a variety of spent caustic streams. The operating temperature and associated pressure are based on the mixture of contaminants and treatment requirements for the spent caustic stream. Lab and field data will be presented to show the effectiveness of wet air oxidation followed by biological polishing for treating spent caustic wastewater.

Discusser: Jeff Easton, P.E., WesTech, Salt Lake City, UT.....4:05 PM
Floor Discussion and Closure.....4:15 PM

	EXECUTIVE SALON 1	EXECUTIVE SALON 2	EXECUTIVE SALON 4	SAN ANTONIO BR
SUNDAY, NOVEMBER 4				
5:00-7:00 PM	GET ACQUAINTED RECEPTION IN THE EXHIBIT HALL - TEXAS BALLROOM			
MONDAY, NOVEMBER 5				
8:00-11:00 AM	COOLING WATER	INNOVATIVE SOLUTIONS FOR MINE WATER	IMPROVED WATER MONITORING	TRACE CONTAMINENTS
11:00 AM-12:00 NOON	KEYNOTE SESSION IN SAN ANTONIO BALLROOM, 3RD FLOOR			
12:00 NOON-1:30 PM	EXHIBIT HALL LUNCHEON IN THE EXHIBIT HALL - TEXAS BALLROOM, 2ND FLOOR			
1:30 PM-5:20 PM	ZLD PLANTS	BOILERS- PRESERVING YOUR INVESTMENT	PRODUCED WATER	FGD WASTEWATER TREATMENT
5:00-7:00 PM	RECEPTION IN THE EXHIBIT HALL - TEXAS BALLROOM, 2ND FLOOR			
TUESDAY, NOVEMBER 6				
8:00 AM-12:00 NOON	WATER CONSERVATION, RECYCLE, & REUSE	TREATMENT FOR NUCLEAR RENAISSANCE	ASME: UNLOCKING CORROSION & SCALE DEPOSITION	PILOT AND FULL SCALE FGD WASTEWATER

	EXECUTIVE SALON 1	EXECUTIVE SALON 2	EXECUTIVE SALON 4	SAN ANTONIO BR
TUESDAY, NOVEMBER 6				
12:00 NOON-1:30 PM	EXHIBIT HALL LUNCHEON IN THE EXHIBIT HALL - TEXAS BALLROOM, 2ND FLOOR			
1:30 PM-5:20 PM	REVERSE OSMOSIS MEMBRANE ISSUES	REFINERY WASTEWATER	TREATMENT OF WATER FROM OIL AND GAS DEVELOPMENT	FGD WASTEWATER CHEMISTRY AND TREATMENT
4:30-6:00 PM	RECEPTION IN THE EXHIBIT HALL - TEXAS BALLROOM, 2ND FLOOR			
WEDNESDAY, NOVEMBER 7				
8:00 AM-12:00 NOON	ION EXCHANGE	DBOM SERVICES UF MEMBRANE FAILURE BOILER CLEANING	FRAC WATER ANALYSIS	ADDRESSING WATER TREATMENT AT POWER PLANTS
1:00-5:00 PM	CONTINUING EDUCATION WORKSHOPS - SEE PAGES 59-62			
THIURSDAY, NOVEMBER 8				
8:00 AM-5:00 PM	CONTINUING EDUCATION WORKSHOPS - SEE PAGES 59-62			

IWC-12- 52 **4:30 PM**

TOXIC DISSOLVED AND DISPERSED HYDROCARBONS REMOVAL AND REUSE IN THE OIL & GAS INDUSTRY, GAS / CONDENSATE / SHALE GAS PRODUCED WATER, REFINERY PROCESS WATER AND GROUNDWATER WITH THE MACRO POROUS POLYMER EXTRACTION TECHNOLOGY

Dick Meijer, Veolia MPP Systems/Veolia Water, Ede, Gelderland The Netherlands; Kenneth Severing, Whittier Filtration, Veolia Water Solutions & Technologies, Brea, CA

Environmental legislation worldwide is aiming at a good balance between the extend of environmental protection and spending capital on water treatment systems with the associated carbon food print. There is a clear trend to move from integral discharge parameters like BOD, COD, AOX etc. to more risk based approaches, like the Environmental Impact Factor introduced in Norway in the beginning of this decade. In risk based approaches a division is made between harmful and non-harmful constituents present in the water. Technologies specifically removing the harmful part are searched for to aim at an optimal balance between capital costs and environmental protection. Macro Porous Polymer Extraction is such a technology that specifically removes the toxic non polar hydrocarbons from water. A real life experience on the disastrous effect of unknown toxic content on the bio treatment confirming the Environmental Impact model will be presented. More than 35 units have been installed in the past years and applied in the various areas of the oil & gas industry. Examples are given of onshore shale gas produced water, refinery process/waste water, groundwater and offshore gas/condensate produced water on platforms and future floating LNG plants. Constituents that are removed are among others, dissolved and dispersed oil (aliphatics), BTEX, Poly Aromatic Hydrocarbons (PAHs), MTBE, THT (Tetra Hydro Tiophene, an odorant used in natural gas for leak detection). Recently it has been discovered that $>$ 80% of mercury is removed from produced water raising the possibility to extend scope the technology. Finally the reduction of the Environmental Impact Factor with MPPE will be illustrated versus other technologies. The Macro Porous Polymer Extraction (MPPE) technology from Veolia Water is able to remove dissolved and dispersed hydrocarbons with 99.9999% if needed. The MPPE technology is basically a liquid/liquid extraction process where the extraction liquid is immobilized in a macro porous polymer. In addition it allows the practically pure separated hydrocarbons to be completely used as a product. No other "waste"stream is created.

Discusser: Randy Harney, Fluor Enterprises, Aliso Viejo, CA ..... 4:55 PM
Floor Discussion and Closure ..... 5:05 PM
Conclusion ..... 5:20 PM

TREATMENT OF WATER FROM UNCONVENTIONAL OIL AND GAS DEVELOPMENT

Date: Tuesday November 6
Time: 1:30 PM-5:20 PM
Room: Executive Salon 4

Treatment of Water from Unconventional Oil and Gas Development

The US energy landscape is being revolutionized by the development of unconventional oil and gas fields throughout the US. One of the challenges with this development is the treatment of the flowback and produced water for reuse or disposal. This session will address 4 different innovative technologies that are being applied for treatment and recycle of this water.

IWC Representative: John Lucey, Heckmann Corp., Pittsburgh, PA
Session Chair: John Schubert, HDR, Inc., Sarsota, FL
Discussion Leader: Jerry Penland, Chester Engineers, Moon Township, PA

Session Introduction 1:30 PM

John Schubert, HDR, Inc., Sarsota, FL

IWC-12-53 1:40 PM

VSEP SOLUTION FOR FRAC FLOWBACK WATER RECYCLING

Mark Galimberti, New Logic Research - VSEP, State College, PA

The short conclusion is that the VSep Nano filtration stage produces clear water permeates (about 95+% recovery) that are still laden with disassociated salts. The concentrate produced in this stage contains about 35% total solids of which about 30% is volatile. Thus the Nano filtration stage is removing suspended solids, colloids, organic materials, and some salts. The concentrate produced can be further thickened and conditioned such that it can be disposed in a landfill as a residual waste.

Our flowback treatment strategy is to produce a reusable water that when blended with fresh water to frac another well will have a low Langelier Saturation Index indicating minimum potential for scaling in the well and formation.

The disassociated salts will then be returned to the well rather than precipitated and removed from the flowback at great expense and disposed in a landfill or deep well.

Discusser: Bob Holt, GE, Moraga, CA.....2:05 PM
Floor Discussion and Closure.....2:15 PM

IWC-12-54 2:30 PM

FIELD OPERATION RESULTS FOR TREATMENT OF FRAC WATER WITH AQUATECH'S MOVAP, MOBILE INDUSTRIAL DISTILLATION

Charles Kozora & Robert Bealko Aquatech International Corp., Canonsburg, PA

In early 2011, Aquatech's MoVap unit was put into operation to treat differing combinations of drill fluid, Frac Flowback and Production brine received from multiple gas well pads and producers. During operation, the quantity and quality operating data was monitored using composite sampling for feed water, distillate and concentrate. The unit delivered the designed capacity and treated water quality at the rated power consumption. The distillate generated was reused while the concentrate was shipped to a disposal well.

The unit was operated on varying feed rates and varying TDS in the feed wastewater and its impact on the distillate quality was noted. The feed wastewater TDS was varied from 40,000 ppm TDS to 96,000 ppm TDS and minimal variation in distillate quality was observed. All along the feed TDS range, the distillate quality stayed on average between 70 ppm to 125 ppm.

Discusser: John Schubert, HDR, Inc., Sarasota, FL.....2:55 PM
Floor Discussion and Closure.....3:05 PM
Break.....3:20 PM

IWC-12-55 **3:40 PM**

CLO2 FOR TREATMENT OF FRAC WATER: A GUIDE TO ITS SAFE USE

Greg Simpson, NRCCA, Grapevine, TX

With the recent focus on horizontal drilling for oil and gas production, there has been a corresponding increase in the need for large volumes of water for the hydraulic fracturing process. This high demand has resulted in the need to reuse the flowback and produced water as much as possible.Treatment of flowback and produced water is required to make it more suitable as a fracturing fluid. Chlorine dioxide (ClO2) has been identified as the treatment chemical of choice for hydraulic fracturing applications because of its rather unique properties. These include its ability to dial-in the desired level of bacterial inactivation, to oxidize sulfides, and to oxidize iron and other metals to an insoluble floc. As a result, a number of groups have begun to use ClO2 to treat flowback and produced water. Most of these are relative late comers to ClO2 and have decided rather than to contract with or hire people who have extensive expertise with ClO2, to use ClO2 as if it were just another chemical used in the oil patch, which it is most certainly not, as some of these groups have learned the hard way. And it is not only newer, relatively small startups which have learned this lesson, but some very large companies have also added ClO2 to its product mix. And when safety or performance issues arise, the tendency of the applicator has generally been to blame ClO2.

One important purpose of this paper is to provide a brief overview of ClO2, specifically why it is considered the only true green biocide by many working in the oil patch today. Another main purpose is to discuss the safety aspects of ClO2. Specifically, the properties and safety issues of gaseous ClO2, aqueous solutions, and aqueous sodium chlorite are discussed. Finally, a general look at the equipment which is used for generation and the various safety interlocks which may or may not be recommended by various generator manufacturers as essential components of a generation system are presented and discussed.

Discusser: Josh Prusakiewicz, HDR, Inc., Ann Arbor, MI.....4:05 PM
Floor Discussion and Closure.....4:15 PM

IWC-12-56 **4:30 PM**

SHALE GAS PRODUCED WATER PRETREATMENT FOR BARIUM AND RADIUM REMOVAL

James Silva, Hope Matis, William Kostedt, IV,& Vicki Watkins GE Global Research, Niskayuna, NY

A GE survey of 6 shale gas wells in Pennsylvania and a DEC survey of 13 shale gas wells in New York show that much of the Marcellus flowback and produced (frac) water contains significant concentrations of barium and naturally occurring radioactive materials (NORM), particularly radium. Although up to 95% of Marcellus frac water has been reused for subsequent hydrofracturing activities, this practice is not sustainable. For example, when the price of natural gas decreases, the rate of hydrofracturing slows and the demand for source water decreases.

However, the supply of produced water from existing wells continues, and can exceed the demand for source water blendstock. Rather than trucking excess produced water into Ohio for deep-well injection, 80-95% may be recovered as distilled water by a combination of evaporation (which may be done in the field with mobile evaporators) and crystallization of a NaCl product (which is more suitable for centralized facilities). The NaCl product must pass TCLP with respect to barium in order to be salable or disposable

in a RCRA-D landfill. We evaluated six pretreatment processes to remove barium and radium from Marcellus produced water: ion exchange, nanofiltration, sulfate precipitation, lime-soda precipitation, a modified lime-soda process, and adsorption onto a proprietary sorbent. This work describes the materials and disposal costs for each process and shows laboratory validation results for two down selected pretreatment processes.

Discusser: James Beninati, HDR, Inc., Raleigh, NC ..... 4:55 PM
Floor Discussion and Closure ..... 5:05 PM
Conclusion ..... 5:20 PM

FGD WASTEWATER CHEMISTRY AND TREATMENT

Date: Tuesday November 6
Time: 1:30 PM-5:20 PM
Room: San Antonio Ballroom

FGD blowdown streams continue to be complex wastewaters that require innovative methods of measurement and treatment. Without a true understanding of the blowdown chemistry, it can be difficult to pin point the proper treatment process. Once a treatment process is identified, balancing water within the facility becomes a challenge.

IWC Representative: Manoj Sharma, Aquatech International Corp., Canonsburg,PA
Session Chair: Thomas Lawry, HDR, Inc., Pittsburgh, PA
Discussion Leader: Joe Janeczko, Ashland Water Technologies, Shrewbury, MA

Session Introduction **1:30 PM**

Thomas Lawry, HDR, Inc., Pittsburgh, PA

IWC-12-57 **1:40 PM**

CHEMISTRY OF FGD BLOWDOWN

Thomas Higgins, Kristen Jenkins, & Laura Reid, CH2M HILL, Chantilly, VA

In the past, zero liquid discharge has been used for wastewater management in the power industry primarily on cooling tower blowdown, and in locations where water is scarce or there were limited options for discharging the wastewater. As limits for metals are lowered and new parameters are being regulated, the complexity and cost of treatment to meet these low limits and add on treatment technology has made zero liquid discharge a more viable option. TDS of Cooling tower blowdown is primarily sodium chloride, which is relatively straightforward to treat.

Sodium chloride is abundant in nature and streams containing high concentrations exist (like seawater) and can be concentrated to a high level given the high solubility of sodium chloride in water. FGD blowdown consists mainly as calcium and magnesium salts of chloride and sulfate, with chloride levels varying depending on the metallurgy of the scrubber. Chloride levels can vary from 3,000 to 35,000 mg/L. The characteristics of the blowdown will vary depending on the chloride concentration which drives the number of times the water can be concentrated. The magnesium to calcium ratio of the limestone will drive the amount of magnesium in solution. The sulfur to chlorine ratio of the coal will determine whether the blowdown will be dominated by sulfate or chloride. A coal high in chloride combined with a high calcium limestone will produce a blowdown high in calcium and chloride and low in magnesium and sulfate. A high sulfur coal and high magnesium limestone will produce a low calcium, high magnesium sulfate and chloride blowdown. Concentration of FGD scrubber blowdown produces a stream that is primarily calcium and magnesium chloride. This presentation will discuss the water chemistry associated with concentrating and crystallizing FGD blowdown, and present a commercial model used in the evaluation.

Discusser: Ray Post, ChemTreat, Langhorne, PA ..... 2:05 PM
Floor Discussion and Closure ..... 2:15 PM

IWC-12-58 **2:30 PM**

EXTENDING THE LINEAR DYNAMIC RANGE FOR MEASUREMENTS OF SELENIUM IN COMPLEX FLUE GAS DESULFURIZATION WATER SYSTEMS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY

Fredrick Vance, Ph.D.; Frank Kero, Ph.D.; Lucas Moore, Ph.D.; Anna Casasus; Olaronke Olubajo; Jeff Malson; Kemira, Altanta, GA

The efficacy of novel treatment formulations that aim to sequester, precipitate or encapsulate anthropogenic pollutants like selenium (Se) from a bulk environmental matrix has been determined by inductively coupled plasma mass spectrometry (ICP-MS). This analytical challenge associated with a linear dynamic range from untreated ppm levels to treated ppb levels is compounded by variable measurement interferences during process. Strategies to mitigate this issue via offline sample preparation methods (e.g. microwave digestion, solid phase extraction) and the optimization of online resolution elements (e.g. optimization of the octopole collision cell parameters and the evaluation of quadrupole mass spectrometer scan modes) will be discussed. The limitations of linearity (i.e. accuracy, precision, detection limits, matrix equivalency to calibration standards, recovery) for this analytical method have been demonstrated for field samples collected from flue gas desulfurization (FGD) waters. A two way ANOVA design of experiment was employed to evaluate sources of variability in measurement. A review of post-data treatment correction equations will also be presented.

Discusser: James Beninati, HDR Inc., Raleigh, NC ..... 2:55 PM
Floor Discussion and Closure ..... 3:05 PM
Break ..... 3:20 PM

IWC-12-59 **3:40 PM**

PILOT-SCALE DEMONSTRATION OF THE HZVI PROCESS FOR TREATING FGD WASTEWATER

Yongheng Huang, Phani Peddi,& Hui Zeng, Texas A&M University, College Station, TX; Xinjun Teng, Southern Company, Birmingham, AL

The hybrid zero-valent-iron (hZVI) process is a novel chemical treatment process that has shown great potential in previous laboratory and field bench-scale tests for removing selenium, mercury, and nutrients from the flue-gas-desulfurization wastewater. In this study, a pilot-scale demonstration was conducted to continuously treat 1-2 gpm of the FGD wastewater at a coal-fired power plant for five months. Results show that the hZVI process could simultaneously reduce selenate-Se from 1-3 ppm to $<$ 10 ppb and mercury from over 100 ppb to $<$ 10 ppt, in compliance with new stringent effluent discharge limits planned by the U.S.EPA for Se and Hg. Moreover, the process efficiently removed a broad spectrum of heavy metals such as As(III), As(V), Cr(VI), Cd(II), Pb(II) and Cu(II) from ppm to near or sub-ppb level. A 3-stage hZVI reactor with a combined hydraulic retention time of 8-12 h was sufficient for Se treatment and a single stage for Hg and other heavy metals. The process had a competitive economics and consumed $\sim$0.3 kg ZVI per 1 m3 FGD wastewater treated at a cost of about $0.6/m3. Solid waste production and energy consumption, estimated at

Discusser: Ganesh Kamatkar, Aquatech International Corp., Canonsburg, PA..... 4:05 PM
Floor Discussion and Closure ..... 4:15 PM

IWC-12-60 **4:30 PM**

SULFATE DISCHARGE CONSIDERATIONS FOR FGD SYSTEM DESIG

Diane Martini, Sargent & Lundy, LLC, Chicago, IL; Bertil Valenkamph, Nipsco,Valparaiso, IN

Sulfate and TDS are becoming critical issues in surface water quality. A utility in Indiana with sulfate discharge limit was required to install an FGD system. There were concerns that the FGD blowdown could increase the sulfate discharge from the plant beyond the discharge limit. The plant was also has water withdrawal limits and water return requirements to maintain the river level. Working with the sulfate mass balance through the plant, and in cooperation with the FGD vendor, a water balance was developed that maximized the use of plant cooling tower blow down as makeup to the FGD process. The paper will describe how cooling tower blow down and limited amounts of fresh service water were employed to optimize the water balance such that the total sulfate mass discharge from the facility will be reduced after the FGD system comes on line.

Discusser: Katie Bland, Burns & McDonnell, Kansas City, MO ..... 4:55 PM
Floor Discussion and Closure ..... 5:05 PM
Conclusion ..... 5:20 PM

ION EXCHANGE – MORE THAN JUST DEMINERALIZING

Date: Wednesday November 7
Time: 8:00 AM-12:00 Noon
Room: Executive Salon 1

Ion Exchange – More than Just Demineralizing

"Ion exchange professionals have had to make substantial changes to how the product can be applied. Not only does IEX face the challenges of alternate technologies, but we are constantly faced environmental concerns and reduction of recourses (water and chemicals). The papers in this year's session are presented by "out of the box" thinkers that not only answer some the challenges above, but give us new insight in how to re-apply an mature technology."

IWC Representative: Jim Sabzali, Aldex Chemical Company Ltd., Granby, QC Canada
Session Chair: Don Downey, Purolite Company, Paris, ON Canada
Discussion Leader: William Tuck, Anderson Water Systems, Inc., Dundas, ON Canada

Session Introduction **8:00 AM**

Don Downey, Purolite Company, Paris, ON Canada

IWC-12-61 **8:10 AM**

PERCHLORATE SPECIFIC RESIN REGENERATION: "AN ALTERNATIVE APPROACH TO SINGLE USE RESIN DISPOSAL"

Charles Drewry, Calgon Carbon Corporation, Fischer, TX; Rohan Seneviratne & Timothy Knowlton, Calgon Carbon Corporation, Pittsburgh, PA

Ion Exchange Resins, particularly Perchlorate Specific Resins, have become the standard for the treatment of perchlorate contaminated groundwater. Perchlorate Specific Resins are used almost exclusively because they provide the lowest treatment cost and the best overall performance. However, this approach can be rather costly. The ion exchange resin is the bulk of the cost of the overall process with it typically accounting for 60%-90% of the treatment costs. With petroleum being a major component of resin cost, this leaves the resin market hostage to the fluctuations of the petroleum commodity market. Once the resin is saturated with perchlorate, the resin is either disposed of as hazardous or non-hazardous waste. Disposal of the resin is the preferred method because the resin regeneration process for perchlorate specific resins was not available. An alternative approach to the resin disposal has been developed that recycles the exhausted resin. Calgon Carbon Corporation (CCC), a pioneer in the perchlorate remediation market, has licensed technology from Oak Ridge National Laboratories for the regeneration of perchlo rate specific resins, and has been working to bring it to a commercial scale. CCC first established the technique on a laboratory and pilot scale, then a demonstration commercial scale, and now CCC is ready to implement a full-scale commercial regeneration service. This will allow for clients to recycle resin at a significant cost savings versus virgin resin pricing, while still receiving a product that performs as well as the virgin resin.

Discusser: James Dromgoole, Fort Bend Services, Stafford, TX.....8:35 AM
Floor Discussion and Closure.....8:45 AM

IWC-12-62 **9:00 AM**

SULFATE REMOVAL TO INCREASE COOLING WATER RE-USE

David Kratochvil & Max Nodwell BioteQ Environmental Technologies, Inc., Vancouver, BC Canada

Rising concern about water quality and the availability of clean water supplies is placing sulfate under increasing scrutiny from both regulators and operators in the power industry. Regulators around the world have been adopting stricter sulfate discharge limits ranging from 250 to 1,000 mg/L, depending on the receiving body. The removal of

sulfate, which contributes to the reduction of Total Dissolved Solids (TDS) and salinity, will mitigate concerns of sulfate™ adverse effects on human health, agricultural and the environment. Sulfate is a concern for power generators due to the potential for gypsum scale formation in the cooling water system. Cooling is the most water intensive activity in power generation, and water quality is critical for the safe, reliable and efficient operation of the power plant. Gypsum scaling may occur, as cooling water is recycled, creating cycles of concentration on the dissolved salts. The scaling of process equipment can lead to operational challenges, impact productivity and result in higher operating costs. A novel technology based on ion exchange has been developed to remove sulfate to compliant levels for both environmental discharge and process re-use. This ion exchange technology maximizes water recovery (up to 99%) for re-use, eliminates brine waste and can operate in the presence of solids without the need for pre-treatment. This paper profiles application of this technology.

Discusser: William Tuck, Anderson Water Systems, Inc., Dundas, ON Canada ...9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12-63 **10:10 AM**

ARSENIC REMOVAL BY NANO PARTICLES OF IRON PREPARED ON POLYMER SUBSTRATE BY NOVEL TECHNIQUE

Atul Bhagwat, Sandip Deshmukh, Sanjay Mehendale, Ph.D., & Renu Saraph, Ion Exchange Global, India

Iron oxide and manganese dioxide are widely used to removal pollutant from ground water due to its surface activity and adsorption capacity. In this studies nano particles of iron is developed insitu on polymer substrate by novel technique and found to be selective for arsneic without affecting the water quality. The static arsenic adsorption capacity is found 37-42mg/g for various pH and TDS levels. The effect of pH, temperature, contact time and initial concentration of solution were investigated in order to explain adsorption reactions and kinetics of media. The results showed by arsenic was adsorbed effectively. Adsorption isotherms data fitted in freundlich isotherm and adsorption kineric followed langergren pseuto order rate of equation. The kinetic of adsorption is found to be off second order with intraparticle diffusion as a rate of determine step. The extent of adsorption depends on surgace loading, pH and TDS. The optimum adsorption of arsenic is occurred at pH 7.5-8.5. The media is found effective for fix bed opertion with minimum contact time and can reduce the arsenic level $<$10ppb on consitant basis.

Discusser: James Sabzali, Aldex Chemical Company Ltd., Granby, QC Canada 10:35 AM
Floor Discussion and Closure ..... 10:45 AM

IWC-12-64 **11:00 AM**

REMOVAL OF TRACE CONTAMINANTS BY ION EXCHANGE

Peter Meyers, ResinTech Inc, West Berlin, NJ

The removal of any trace contaminant by ion exchange depends as much or more on the other ions that surround the trace than on the concentration of the trace itself. This fundamental principal is true, no matter if the trace contaminant is highly preferred (such as uranium or perchlorate) or not preferred at all (such as fluoride or nitrite).

The reason why this is true is the concentration difference between the ion exchange resin and the water being treated. This paper discusses the mathematics behind this principal and how it is applied to some of the more common trace contaminants found in water supplies.

Discusser: George Crits, Consultant, Ardmore, PA..... 11:25 AM
Floor Discussion and Closure ..... 11:35 AM
Conclusion ..... 12:00 NOON

DBOM SERVICES, UF MEMBRANE FAILURE, HIGH RATE CLARIFICATION NUTRIENT REMOVAL AND BOILER CLEANING

Date: Wednesday November 7
Time: 8:00 AM- 12:00 Noon
Room: Executive Salon 2

DBOM Services, UF Membrane Failure, High Rate Clarification Nutrient Removal and Boiler Cleaning Detection & repair of UF membrane failure. Chemically Enhanced High Rate Settling (CEHRS) technology in dual use mode, low flow rate in dry weather for nutrient removal and high flow rate in wet weather. Benefits of choosing a "Design, Build, Operate & Maintain" approach for new Water/Wastewater Treatment plant. Step by step review of developing and implementing a boiler chemical cleaning.

IWC Representative: Mike Gottlieb, ResinTech,Inc. West Berlin, NJ
Session Chair: Larry Gottlieb, ResinTech, Inc. West Berlin, NJ
Discussion Leader: Dave Malkmus, ResinTech, Inc. West Berlin, NJ

Session Introduction **8:00 AM**

Larry Gottlieb, ResinTech, Inc. West Berlin, NJ

IWC-12-65 **8:10 AM**

DESIGN, BUILD, OPERATE & MAINTAIN (DBOM) – WATER/WASTEWATER TREATMENT EQUIPMENT & SERVICES

Steven Gagnon & Troy Gill, Avantech Inc, Columbia, SC; Paul Wright, River Bend Nuclear Plant, St. Francisville, LA

In tough, economical time, many companies have limited on capital equipment purchased and plant manpower has been cut to the maximum possible. Company are scrambling for funding to support much needed projects and chief among these issues, but often less discussed, is water. Investment for infrastructure has become a hot topic in the United States – it is widely acknowledged among opinion leaders, and government and utility industry experts. To counter these problems, many companies have gone from purchasing capital equipment to provided equipment required a outsource agreement. There are many leases and outsourcing agreement available depending on client's criteria and financing available. This paper shall deal with a company that has addressed their needs by entering into DBO&M contract.In June of 1986, River Bend Nuclear Station (owned by Entergy Gulf States, Inc) in St. Franksville, LA became the second nuclear power plant to produce electricity in Louisiana. River Ben received a power upgrade of 52 megawatts in 2003 and currently generates 978 megawatts of electricity, approximately 10% of the total energy demand of Louisiana. This nuclear facility has evaluated different financial options and selected a Build Operated Own & Maintain (DBO&M) lease agreement for their radwaste system and makeup water treatment system from a water treatment Original Equipment Manufacturer (OEM). For these DBO&M projects, the ownership of the equipment remains with the OEM but the clients has a buyout option. The OEM has provided the equipment, operating services, and commodities such as chemicals, resin and membranes for this facility. A DBO&M scheme makes cent when the projects required involves large amounts of finance with a long payback period and plant manpower is limited or certain expertise are required to resolve operating problem.

This paper provides details on the equipment selection, reviews overall process and payback and is an example specifically about the design/build/operate (DBO&M) approach and how it works.

Discusser: Doug Kellogg, Seimens, Rockford, IL ..... 8:35 AM
Floor Discussion and Closure ..... 8:45 AM

IWC-12-66 **9:00 AM**

COMPARATIVE MS2 BACTERIOPHAGE CHALLENGE TESTING OF INTACT AND COMPROMISED ULTRAFILTRATION MODULES

Daryl Gisch, The Dow Chemical Company, Midland, MI

When utilizing pressurized Ultrafiltration (pUF) for pathogen removal, an on-going concern is how effective a compromised module will perform. This work looked at comparative MS2 bacteriophage challenge testing of five commercial DOW SFD-2880 pUF modules both intact and after being compromised by a single "cut-fiber." Such "impaired" membrane integrity reflects a "worse-case" yet a most "probable defect" for a hollow fiber type module. The findings from this work study showed the compromised "cut-fiber" modules still demonstrated an average of 2.4 LRV for MS2 and the direct integrity by pressure decay testing readily detected a single comprised fiber in a bundle of ten thousand. Further applying the Dow recommended "pinning and plugging" to repair a fiber break will not only be easily measured by pressure decay testing but can also be measure in an improved LRV for MS2.

Discusser: David Franciamone, Pall Corporation, Ellicott City, MD ..... 9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12-67 **10:10 AM**

CHEMICAL CLEANING OF BOILERS

Kenneth Hansen, The Babcock and Wilcox Company, Barberton, OH

As a major boiler manufacturer, The Babcock and Wilcox Company has provided assistance with numerous chemical cleanings, both pre-operational and operating boilers. A cleaning on an operating boiler is determined with the use of a tube sample and deposit analysis. Therefore, the proper solvents and cleaning procedure can be identified. The usage of this solvent can be confirmed by performing a chemical cleaning solvent test. Also, the type of boiler and its circulation will have an influence on the type of chemical cleaning required. In addition, the existence of copper or organics within the deposit will influence the solvent determination. Therefore, the type of cleaning and solvent used for a given cleaning can be critical. The implementation of the results of this analysis in a timely manner is crucial in enabling sufficient time to perform the chemical cleaning properly during a scheduled outage.

Discusser: Glenn Matys, Chemtreat, Ottawa, ON Canada ..... 10:35 AM
Floor Discussion and Closure ..... 10:45 AM

IWC-12-68 **11:00 AM**

A SUSTAINABLE, ENERGY-EFFICIENT AND LOW CARBON FOOTPRINT MBBR PROCESS FOR AMMONIA REMOVAL

Li An, Veolia Water Systems, Moon Twp., PA

The MBBR ammonia removal process works on the principle of partial nitritation of the ammonia, followed by autotrophic removal of the nitrogen through the Anammox process. The Anammox bacteria oxidize ammonia to nitrogen gas with nitrite as an electron acceptor under anoxic conditions. Due to the unique capabilities of this organism, the need for energy and an external carbon source is reduced. Compared to conventional nitrification/ denitrification processes, 60% of the oxygen consumption is saved and less CO2 is emitted. By combining Anammox process with an MBBR fixed-film reactor, Veolia's Anita-MOX technology brings high-rate ammonia removal to the treatment of water rich in ammonia and poor in carbon source, providing a more stable process in a smaller footprint. The Anammox bacteria require a specific set of growing conditions and are very slow to replicate. The AnoxKaldnes™ carrier media can be used to provide

the necessary environment for both the aerobic and anoxic conditions necessary for the Anammox process to occur. The combination of the bacterial oxidation process with MBBR allows the start-up time to be cut in half or more. This novel process can remove more than 80% ammonia in practice. It can be used to treat water with a relatively high ammonia concentration, low C/N ratio and relatively high temperature (> 20°C), such as reject water from sludge digestion in municipal wastewater treatment plants. Industrial applications include landfill leachate treatment, ammonia polishing after anaerobic treatment, and many more.

Discusser: Sam Frisch, Envirogen, Kingwood, TX ..... 11:25 AM
Floor Discussion and Closure ..... 11:35 AM
Conclusion ..... 12:00 NOON

FRAC WATER ANALYSIS, TREATMENT AND REUSE

Date: Wednesday November 7
Time: 8:00 AM- 12:00 Noon
Room: Executive Salon 4

While hydraulic fracturing is an effective way to extract natural gas from shale, it is also a very water-intensive process. Often the water used and disposed contains a complex mixture of chemical additives and naturally occurring compounds, and must be transported long distances, generating high transportation costs. The expense of these transportation costs, along with limited water availability and industry regulations have driven innovations in analysis, treatment methods, reuse, and source water development. The papers presented in this session focus on the handling of flowback and produced water, addressing the analysis and characterization of this water, resource recovery methods, onsite methods for treatment and reuse, and the impacts of using alternate water sources, such as acid mine drainage, in fracturing applications.

IWC Representative: Manoj Sharma, Aquatech International Corp., Canonsburg, PA
Session Chair: Scott Quinlan, GAI Consultants, Homestead, PA
Discussion Leader: Brent Means, Office of Surface Mining, Harrisburg, PA

Session Introduction **8:00 AM**

Scott Quinlan, GAI Consultants, Homestead, PA

IWC-12-69 **8:10 AM**

OPPORTUNITIES FOR ON-SITE TREATMENT, MONITORING AND REUSE OF ACID MINE AND PRODUCED WATER IN OIL AND GAS SHALE

Timothy Keizer, Jason Burney, Ph.D., Nalco, Naperville, IL ;Jarod Limka, Joon Min, Young J Eum, BKT Co., Ltd., Anaheim, CA

Hydraulic fracturing is an incredibly water intensive process that is used to release gas and oil from tight shale formations. Water needs for the hydraulic fracturing of one well can range in excess of 5 million gallons of fresh or treated water. The large demand for water on a well pad can significantly complicate sourcing and logistics for gas companies. Millions of gallons of water need to be procured and trucked or piped to well sites that are often in remote, hard to reach areas. Transportation costs alone can exceed $1 million dollars for a single well. As such, locating an alternate source of water or reuse of produced water that could be accessed on site is very desirable. Acid Mine Drainage (AMD) and some surface waters could be accessed on site but can contain high amounts of sulfate, which will have an undesired reaction with Barium and Strontium present in the Shale formation. Likewise, sulfate metabolized by bacteria could sour the gas. Explorations of mobile and non-traditional treatment methods are being piloted. The viability and pilot testing of treatment such as BKT Co., Ltd™ anti-fouling FMX system

membrane technology and on-line monitoring will be discussed.
Discusser: Charles Kozora, Aquatech International Corp., Canonsburg, PA.....8:35 AM
Floor Discussion and Closure.....8:45 AM

IWC-12-71 **9:00 AM**

ON-SITE FIELD ANALYSIS OF HYDRAULIC FRACTURING FLOWBACK AND PRODUCED WATERS

Scott Tucker, Hach Company, Loveland, CO

Analyzing matrices with high total dissolved solids is difficult for any methodology, especially ones where on-site field analysis is critical. Flowback and produced waters are a complex mixture of chemical additives and naturally occurring compounds from the wellbore that require an innovative development approach. Hach's application team modified current methods to precisely analyze these difficult matrices by eliminating chemical interferences with reagent additions and altering sample volumes. These new hydraulic fracturing methods are used on Hach's current colorimetric, titration and electrochemistry platforms. The new methods have simple step-by-step procedures that allow the operator to select the sample concentration range of LR, MR, and HR for the colorimetric and sample volume for the titrametric methods; making it easy to analyze extremely high analyte concentration ranges. Hach was invited to upstate New York to perform on-site testing on produced water from the Herkimer Shale. The purpose of this visit was to analyze and characterize the produced water sample with the new methods. Hach tested many parameters during this visit; validating that Hach's modified procedures are effective and reliable for on-site analysis on these difficult matrices.
Discusser: Chip Westaby, Turner Designs Hydrocarbon Instruments, Fresno, CA . 9:25 AM
Floor Discussion and Closure.....9:35 AM
Break.....9:50 AM

IWC-12-72 10:10 AM

SEQUENTIAL PRECIPITATION - FRACTIONAL CRYSTALLIZATION TREATMENT OF MARCELLUS SHALE FLOWBACK AND PRODUCTION WASTEWATERS

Timothy Keister, James Sleigh, & Megan Briody, ProChemTech International, Inc., Brockway, PA

The patent pending Sequential Precipitation - Fractional Crystallization Process for resource recovery of Marcellus gas shale hydrofracture flowback and production wastewaters will be detailed. Data will be presented covering untreated wastewater analytical results and treatability data with specifications for the recovered commodity products.
Discusser: Jonathan Shimko, Tetra Tech NUS, Pittsburgh, PA.....10:35 AM
Floor Discussion and Closure.....10:45 AM
Conclusion.....11:00 AM

ADDRESSING WATER TREATMENT CHALLENGES AT POWER PLANTS

Date: Wednesday November 7
Time: 8:00 AM- 12:00 Noon
Room: San Antonio Ballroom

Water is the lifeblood of a power plant, not only in the steam-condensate cycle, but also for cooling. The U.S. EPA is in the process of revising the effluent limitations guidelines and standards (ELGs) for the steam electric power generating point source category. This session will address reliable sources of cooling water, technologies which can be used to achieve those anticipated ELGs and techniques which can be applied to optimize recycle/reuse systems.

IWC Representative: John Lucey, Heckmann Corp., Pittsburgh, PA
Session Chair: Gregg Poppe, DOW, Edina, MN
Discussion Leader: Greg Osen, AVANTech, Columbia, SC

Session Introduction **8:00 AM**

Gregg Poppe, DOW, Edina, MN

IWC-12-73 **8:10 AM**

DECIPHERING THE CHOICES IN TREATMENT REQUIRED TO MEET EPA EFFLUENT LIMITATION GUIDELINES AT COAL-FIRED GENERATING STATIONS

James Harwood GE Power & Water, Oakville, ON Canada; Lanny Weimer, GE Power & Water, Ellicott City, MD

In 2009, US EPA under authority of the Clean Water Act has elected to proceed with rulemaking in the form of revised Effluent Limitation Guidelines (ELG's) for the steam electrical power generating industry. Draft ELGs are scheduled for public release in July 2012 with final release scheduled for 2014. The standards will redefine the wastewater management requirements for many coal-fired power plants. The ELG's are based on best available technologies with a consideration for economic impacts. As a result, utilities will need to navigate through a host of different technological approaches and considerations in order to achieve expected limits for constituents such as selenium, mercury, boron and total dissolved solids (TDS) among others. These standards will be implemented through the National Pollutant Discharge Elimination System (NPDES) permit limits. For many utilities, tighter

NPDES limits will result in the implementation of treatment solutions for flue gas desulfurization (FGD) and ash handling streams. Utilities, consulting engineers and treatment technology providers will be required to work together to evaluate, select, procure, construct and commission new treatment facilities. At the same time, careful consideration must be given to the challenges faced in implementing solutions in these applications. Implications due to dynamic water qualities, variable fuel sources, and technology capabilities, concurrent implementation of other air and water controls, and vendor and consultant experience in this space must all be analyzed. This paper will examine the decisions faced by facilities as they navigate through these choices in order to successfully and economically meet these new requirements in the changing environment

Discusser: Charles Meurer, P.E., Stanley Consultants, Inc., Muscatine, IA.....8:35 AM
Floor Discussion and Closure.....8:45 AM

IWC-12-74 9:00 AM

USING RECLAIMED MUNICIPAL WASTEWATER FOR POWER PLANT COOLING AND PROCESS WATER SYSTEMS

Michael Wilson, CH2M Hill, Boston, MA ; Larry Schimmoller and Kevin Lambert, CH2M Hill, Englewood, CO; Joseph Nattress, CH2M Hill, Philadelphia, PA; Charlie Nichols, CH2M Hill, Atlanta, GA

The reclamation of treated municipal wastewater for power plant cooling water systems is a complex and sensitive decision process due to many often conflicting factors. The U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) determined that alternative sources of water for use at power plants which included reclaimed water are an innovative source of cooling water for electric generating facilities (Feeley 2005). The design of these industrial cooling water systems presents several challenges to the water reuse professional and may include combinations of wastewater biological process design, elements of physical chemical treatment and industrial high purity water systems. The use of reclaimed water by power plants for cooling water systems is an important sustainability principal and is becoming more prevalent watersheds due to stresses being placed on habitat, potable water systems and consumptive use. This in fact is a triple bottom line advantage since reclaimed water that is recycled for power production is the definitive example of the energy-water nexus. This paper presents the design basis of a 7 mgd reclaimed municipal water treatment plant for an East Coast Power facility. The biological and physical chemical treatment processes will be reviewed including methods of meeting cooling and process water quality objectives for carbonaceous biochemical oxygen demand, total suspended solids, ammonia removal, iron and manganese removal, chlorine residual and pH control systems and value chain associated with the economic factors.

Discusser: Jim Braun, AVANTech, Inc., Columbia, SC ..... 9:25 AM
Floor Discussion and Closure ..... 9:35 AM
Break ..... 9:50 AM

IWC-12-75 10:10 AM

CONSERVING GALLONS AND KILOWATTS: CHALLENGES OF TODAY'S SOLAR POWER PLANTS- EPC PERSPECTIVE

Jeanette Shoemaker, Christopher Huth,& Kumar Sinha, Bechtel Power Corp., Frederick, MD

With the increasing restrictions on CO2 emissions, renewable based power plants utilizing solar power are emerging as an effective way to increase the renewable portfolio for utility power. For example in California, the utilities' current renewable portfolios must increase from 20% to 33% by 2020. This drive has made renewable power considerably more desirable; however, fresh water availability and optimal solar irradiation are generally two mutually exclusive local characteristics that make designing these plants challenging. Not only is fresh water scarce at the desert locations that these solar plants wi! ll be located, but options for disposal of wastewater can be very limited as well. These factors have pushed the design of these plants to walk a fine balance between conserving and reusing water to the greatest extent practical and reducing parasitic electrical loads. This paper will address the challenges associated with developing solar power plant designs that optimize house electrical load while minimizing water footprint. Through the implementation of operational water management techniques and optimized water treatment processes, water usage can be reduced to manageable levels. Utilizing systems that recover and recycle wastewater, the system can be further optimized to reduce the overall water footprint. Case studies will be presented for multiple sites detailing the individual optimization required based on the water quality provided. Lessons learned during plant

siting and permitting will be provided to give light to the current issues associated with wastewater disposal in these areas and utilization of evaporation ponds. In addition, new technologies and design philosophies will be discussed to guide the reader through the difficulties of determining the right mix of sacrificing low initial capital cost, optimizing water usage, minimizing operating cost and minimizing parasitic electrical load.
Discusser: John Lucey, Heckmann, Inc., Moon Township, PA .....10:35 AM
Floor Discussion and Closure.....10:45 AM

IWC-12-76 **11:00 AM**

MITIGATING RISK WHILE WINNING THE WAR AGAINST DESTRUCTIVE FRESHWATER MUSSELS

Sarahann Rackl (Dow), Carolyn Link, Bridget Gruber, Sara Meehan, Frances Lucy, Ph.D., Marrone Bio Innovations, Davis, CA

Throughout North America and Europe, zebra and quagga mussels are crippling industrial and commercial operations by restricting water intake in heat exchangers, condensers, and cooling systems, and by damaging infrastructure and equipment. United States Congressional researchers estimated that zebra mussels alone cost the power industry $3.1 billion during 1993–1999, and had more than a $5 billion impact on industries, businesses, and communities during the same period. Unfortunately, the battle against these invasive, destructive mussels' rages on intensified by their unrelenting spread and complicated by increasing regulatory pressure to limit the use of dangerous chemicals in service water systems. Today, facility operators are faced with what appear to be conflicting goals—controlling mussels while managing shell debris, and achieving a high level of efficacy without harming the environment or putting the facility or employees at risk. This presentation shows the results of mussel control studies at power facilities in North America and Europe, including a U.S. Bureau of Reclamation project. These studies indicate that a recently approved molluscicide called Zequanox® can control zebra and quagga mussel populations without harming humans, infrastructure, non-target species, or the environment. The presentation reviews various treatment methods and addresses the advantages of controlling mussel populations at different life stages, highlighting the tradeoffs between application frequency and shell debris management. Finally, this presentation previews the studies to be conducted in 2012.
Discusser: Vincent A. Como, P.E., Black & Veatch, Overland Park, KS .....11:25 AM
Floor Discussion and Closure.....11:35 AM
Conclusion ..... 12:00 NOON

Workshops

CONTINUING EDUCATION WORKSHOPS

This year's workshops will cover relevant topics such as Water and Wastewater Treatment for Natural Gas, Frac Water, Reverse Osmosis, Ion-Exchange Technology and a special package of 3 basic water treatment courses. The 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 4 professional development hours (PDHs) and a certificate of completion. Advance registration and a separate fee of $250 is required. All workshops are scheduled based on minimum reservations; please inquire at the conference registration desk about the current status of any of the workshops. Discounts are given for multiple registrations.

W1 TREATMENT OF WATER FOR STEAM GENERATION IN SAGD ENHANCED OIL RECOVERY PLANTS

Date: Wednesday November 7
Time: 1:00 PM-5:00 PM

"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. We will look at the different requirements imposed on system choices for wet steam generation in once-through generators as opposed to "dry" steam generation in water tube power boilers.

Instructor: Robert Holloway, Holloway Associates Etobicoke, ON Canada

W2 WATER TREATMENT 101

Date: Wednesday November 7
Time: 1:00 PM-5:00 PM

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

Instructor: Dennis McBride, Fluor Enterprises Greenville, SC

W3 ELECTRODEIONIZATION (EDI) PRESENTS

Wednesday November 7
Time: 1:00 PM-5:00 PM

Electro-deionization (EDI) is a time proven process which combines semi-impermeable membrane technology with ion-exchange media to provide high efficiency self-regenerated demineralized water without chemicals. This workshop will explore the design and operation of EDI modules from different manufacturers of EDI membranes. A 100 gpm feed water source shall be provided, EDI projections from different EDI membranes manufacturer will be presented their design and effluent water quality will be evaluated

complete with discussions on the advantages of system will be presented.
The program shall also provide a simplified EDI P&ID print of the system designed and presented complete with recommended membrane data collection parameters, cleaning protocol, review of a typical autopsy report and the system operating cost. This workshop provides one stop shopping for all your EDI needs.
Instructor: Jim Braun, AVANTech Columbia, SC

W4 WATER & WASTEWATER TREATMENT FOR NATURAL GAS DEVELOPMENT

Date: Wednesday November 7
Time: 1:00 PM-5:00 PM

This course reviews the geologic conditions associated with shale gas plays, describes the hydrofracturing process, including chemical and mechanical aspects of hydrofracturing. The workshop identifies wastewater characteristics for flowback and produced water, and provides insight into water quality requirements for hydrofracturing. Significant time is spent on wastewater treatment options for flowback and produced water, with areas of emphasis including treatment for recycle and evaporation/crystallization options. The economics of water supply and wastewater treatment are identified.
Instructor: John Schubert, HDR Engineering Sarasota, FL

W5 HRSG AND HIGH PRESSURE (ABOVE 900 PSIG/60 BAR) BOILER WATER TREATMENT AND OPERATION

Date: Wednesday November 7
Time: 1:00 PM-5:00 PM

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.
Instructor: David Daniels, Mechanical and Materials Engineering Austin, TX

W6 REVERSE OSMOSIS – BACK TO BASICS

Date: Thursday November 8
Time: 8:00 AM- 12:00 Noon

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.
Instructor: Jane Kucera, Nalco Company Naperville, IL

W7 THERMAL ZERO LIQUID DISCHARGE PROCESSES

Date: Thursday November 8
Time: 8:00 AM-12: 000 Noon

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.
Instructor: Michael Marlett, Aqua-Chem ICD Hartland, WI

Workshops

W8 INDUSTRIAL BOILER WATER TREATMENT (UP TO 1800 PSIG/120 BAR)

Date: Thursday November 8
Time: 8:00 AM-12: 00 Noon

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.

Instructor: James Robinson, GE Betz Trevose, PA

W9 INTRODUCTION TO COOLING TOWER WATER SYSTEMS AND HOW TO DEVELOP A COOLING TOWER WATER TREATMENT PROGRAM

Date: Thursday November 8
Time: 8:00 AM-12: 000 Noon

This work shop 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.

Instructor: Paul Puckorius, Puckorius & Associates, Inc., Arvada, CO

W10 ION EXCHANGE TECHNOLOGY AND PRACTICAL OPERATING PRACTICES

Date: Thursday November 8
Time: 1:00 PM-5:00 PM

This workshop provides a detailed review of the various ion exchange processes for softening and demineralizing water as well as preparation for boilers, cooling, and process applications. A section on how to evaluate systems, their resin, operation, and water quality of ion exchange units is an excellent troubleshooting and informative portion of this workshop. A review of the different 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.

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

W11 WATER TREATMENT 201

Date: Thursday November 8
Time: 1:00 PM-5:00 PM

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.

Instructor: Kumar Sinha, Bechtel Power Corporation Fredrick, MD

W12 CLEANING AND TROUBLESHOOTING OF REVERSE OSMOSIS SYSTEMS

Date: Thursday November 8
Time: 1:00 PM-5:00 PM

Effective cleaning of reverse osmosis systems is dependent on several key parameters. These key parameters include RO system design, membrane selection, cleaning skid design, operation, membrane chemicals and cleaning procedures. Information on these key parameters and their impact on effective cleaning will be discussed in detail. Troubleshooting is necessary when cleaning does not restore the RO performance or when performance problems occur during the start-up/commissioning of new RO membrane elements.

Different methods are discussed that can be used to identify and locate the performance problem in the RO system. Guidelines on the interpretation of results generated by these tools will be provided. Case studies of 2 plants will be presented. This workshop is designed for RO system operators and designers to gather information, ask questions, and solve problems in a workshop environment.

Instructor: Jantje Johnson, Orangeboat Eden Prairie, MN

W13 COOLING WATER TREATMENT PROGRAMS AND GUIDELINES WHEN SWITCHING FROM FRESH TO REUSE WATER MAKEUP

Date: Thursday November 8
Time: 1:00 PM-5:00 PM

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.

Instructor: Paul Puckorius, Puckorius and Associates, Inc. Arvada, CO

WATER RESEARCH FOCUS AREAS

- Wastewater treatment
- Zero liquid discharge
- Cooling water
- Moisture recovery
- Solid landfill
- Advanced cooling
- Waste characterization

SOUTHERN RESEARCH
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Exhibitors

2012 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 and outside the Texas Ballroom as well as in Directors 1 & 2 located nearby the Texas Ballroom. The Exhibit Hall hours of operation are:

- Sunday, November 4 from 5:00 PM-7:00 PM
- Monday November 5 from 11:30 AM- 2:00 PM and 4:30 PM-7:00 PM
- Tuesday November 6 from 11:30 AM – 2:00 PM and 4:30 PM-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 2012 IWC Exhibitors is provided below. On the following pages, you will find a detailed description of these Exhibitors, including contact information and company description.

1 & 2 Degremont North America
3 Graver Water Systems/ Ecodyne Water
4 Zequanox by MBI
5 SWAN Analytical USA
6 Golder Associates, Inc.
7 Schreiber, LLC
8 Ashland Water Technologies
9 Parkson Corporation
10 LANXESS Sybron Chemicals Inc.
11 Chemtrac Systems, Inc.
12 U.S. Water Services
13 Baker Hughes
14 SAMCO Technologies, Inc
15 CHEMetrics, Inc.
16 SolarBee, Inc.
17 & 18 GE Power & Water
19 Environmental Operating Solutions
20 Veolia Water Solutions & Technologies
21 Illinois Water Technologies
22 Honeywell
23 AVANTech Inc.
24 Avista Technologies, Inc.
25 WesTech Engineering Inc.
26 Johnson March Systems, Inc.
27 Pall Corporation
28 Purolite Company
29 DOW Water & Process Solutions
30 Nalco, An Ecolab Company
31 Sentry Equipment Corp.
32 Professional Water Technologies
33 Process Solutions Inc. / MicrOclor
34 Thermax Inc.
35 Aquatech International Corp.
36 LMI/ Milton Roy
37 Global Chem-feed Solutions
38 Mettler Toledo Thornton and Ingold
39 Diamond V
40 French Creek Software, Inc.
41 Mitsubishi Electric Automation, Inc.
42 MAR Systems Inc.
43 QUA Group LLC
44 ChemTreat, Inc.
45 Severn Trent Water Purification, Inc.
46 Eco-Tec Inc.
47 Justeq LLC
48 Ovivo USA, LLC
49 Industrial Analytics Corp.
50 CEDA International Corporation
51 Champion Technologies
52 Bowen Engineering Corporation
53 Waters Equipment Co.
55 OrangeBoat
56 Chemical Publishing Company
57 Kemira Water Solutions Inc.
58 Astral Industrial (Fluidra USA)
59 ResinTech, Inc.
60 Aggreko, LLC
61 WorleyParsons
62 Genesys International
63 WaterTectonics
64 Turner Designs
65 Hach
66 Duraflow LLC
67 BWA Water Additives
68 U S Peroxide
69 Cortec Corporation
70 MPW Industrial Services
71 KASELCO, LLC
72 Sterilex
73 GEA Process Engineering
74 Southern Research Institute

Exhibitors

AGGREKO, LLC

Booth: 60
Contact: Billy Childers
Phone: 405-224-2182
Email: billy.childers@aggreko.com
Web: www.aggreko.com

Aggreko is the leader in rental power, temperature control, and 100% oil- free compressed air systems. We provide 24/7 availability and service from 50 locations nationwide. We help customers in many industries improve and safeguard their operations by solving problems, creating opportunities, and reducing risk. For more information, please visit www.aggreko.com/northamerica.

AQUATECH INTERNATIONAL CORP.

Booth: 35
Contact: Patrick Randall
Phone: 724-746-5300
Email: randallp@aquatech.com
Web: www.aquatech.com

Established in 1981, Aquatech International Corporation is a global leader in water purification technology for industrial and infrastructure markets with a focus on desalination, water reuse, and zero liquid discharge. Aquatech's product groups include Raw Water Treatment, Ion Exchange, Membrane Processes (UF/RO/MBR), Thermal Desalination (MED/MSF), Wastewater/Effluent Treatment and Zero Liquid Discharge.

ASHLAND WATER TECHNOLOGIES

Booth: 8
Contact: Kenneth Dunn
Phone: 508-341-0841
Email: kmdunn@ashland.com
Web: www.ashland.com

For nearly 100 years, Ashland Water Technologies has been a leading provider of a wide array of innovative process and water treatment specialty chemicals. Our extensive global expertise, on-site management approach and seasoned team of application experts enable us to partner with you to deliver high-value solutions. Combined with our commitment to environmentally sustainable initiatives, we work with you to protect our world for future generations. At the core of every Ashland water treatment program is our technologically advanced specialty chemicals and equipment that ensure your water and energy use is efficient, your system reliability is maximized and your capital assets are not compromised. To ensure optimum chemical feed without interruption under constantly changing conditions, Ashland's automated OnGuard™ monitoring systems, controllers and data management software are recommended to ensure trouble-free operations.

ASTRAL INDUSTRIAL (FLUIDRA USA)

Booth: 58
Contact: F. Keith Laguaite, P.E.
Phone: 904-607-4416
Email: klaguaite@fluidra.us
Web: www.astralpoolusa.com/

Astral Industrial, a Fluidra company, manufactures FRP pressure vessels from 36" to 118" diameter and 100 psi pressure rating, in our Jacksonville, FL plant. Polyester and vinyl ester resins provide the ultimate corrosion resistance and have internals that are hydraulically balanced to provide superb flow during filtration and backwashing.

Exhibitors

AVANTECH INC.

Booth: 23
Contact: James Braun
Phone: 803-622-5426
Email: jbraun@avantechinc.com
Web: www.avantechinc.com

AVANTech, Inc. is a comprehensive industrial water treatment solutions provider. Our extensive experience in engineering process systems enables us to create integrated solutions that can dramatically improve operations in industrial, commercial, power, and nuclear power

AVISTA TECHNOLOGIES, INC.

Booth: 24
Contact: Tim Kirk, P.E.
Phone: 979-260-9091
Email: tkirk@avistatech.com
Web: www.avistatech.com

Avista Technologies provides specialty chemicals for membrane separation systems including reverse osmosis (RO), microfiltration (MF) and ultrafiltration (UF). Products include NSF certified RoQuest coagulants and Vitec antiscalants, membrane cleaners and EPA Registered RoCide biocides. Avista also provides off-site cleaning and laboratory services including: membrane autopsies, cleaning studies, foulant analyses, and coagulant and antiscalant recommendations from site-specific water samples.

BAKER HUGHES PROCESS AND PIPELINE SERVICES

Booth: 13
Contact: Stewart Emmerson
Phone: 832-519-2060
Email: stewart.emmerson@bjservices.com
Web: www.bjservices.com

Pre-commissioning and turnaround services. Chemical cleaning, boiler and pipe systems. Flowmac flushing of lube and hydraulic systems. Air and nitrogen drying. Accelerated cooldown processes with N2 and Co2. Laboratory and development facilities.

BOWEN ENGINEERING CORPORATION

Booth: 52
Contact: Michael Soller
Phone: 317-842-2616
Email: msoller@bowenengineering.com
Web: www.bownengineering.com

Bowen is a self-performing, employee owned, general contractor focused on water, wastewater and power construction. Headquartered in Indiana, Bowen is working throughout the Central and Eastern United States. As a leading design-builder in the country, our ability to listen and collaborate with our partners and clients has made us their contractor of choice. Let's fix it together.

Exhibitors

BWA WATER ADDITIVES

Booth: 67
Contact: Melissa Goeren
Phone: 678-802-3026
Email: Americas@wateradditives.com
Web: www.wateradditives.com

BWA Water Additives is a leading global provider of sustainable specialty chemical solutions for industrial water treatment, desalination, and oilfield industries. Our brands: Belclene®, Belcor®, Belgard®, BromiCide®, Bellasol®, Belsperse®, Bellacide® and Flocon® are recognized worldwide for the highest quality and superior technical performance.

CEDA INTERNATIONAL CORPORATION

Booth: 50
Contact: Joseph O'Neil
Phone: 403-253-3233
Email: joneil@cedagroup.com
Web: www.cedagroup.com

CEDA International Corporation has evolved into one of the most diverse providers of industrial and specialty services in the world. The company offers well over 130 services to help clients manage refineries, upgraders, oil sands plants, chemical plants and other industrial facilities.

CHAMPION TECHNOLOGIES

Booth: 51
Contact: Sam Ihli
Phone: 337-302-3013
Email: info@champ-tech.com
Web: www.champ-tech.com

Chemtech is a specialty chemical and engineering service division of Champion Technologies, Inc., providing a full line of industrial water treatment chemicals and field engineering services. Champion Technologies is the fastest growing specialty chemical company, having one of the largest teams of research scientists and technologists dedicated to the oil, gas, refining, chemical and power industries. With over 50 years of specialty chemical experience, our commitment to research and development has produced a broad scope of high-performance technology and expertise around the world.

CHEMETRICS, INC.

Booth: 15
Contact: Bob Hruska
Phone: 800-356-3072
Email: info@chemetrics.com
Web: www.chemetrics.com

CHEMetrics manufactures water analysis test kits and instruments for over 50 essential parameters. Available tests include dissolved oxygen, nitrite, iron, phosphate, etc. The kits and instruments utilize self-filling reagent ampoules that simplify and speed water quality testing and are ideal for field and lab use. CHEMetrics offers personalized customer support that is a phone call or an email away.

Exhibitors

CHEMICAL PUBLISHING COMPANY

Booth: 56
Contact: Ben Carr
Phone: 888-439-3976
Email: info@chemical-publishing.com
Web: www.chemical-publishing.com

Founded in 1934 in New York City, Chemical Publishing Company has consistently provided the best in applied science and reference publications. Our Water Technology authors include, Colin Frayne, James McCoy, Donald R. Baker and Natarajan Manivasakam.

CHEMTRAC SYSTEMS, INC.

Booth: 11
Contact: Robert Bryant
Phone: 770-449-6233
Email: chemtrac@chemtrac.com
Web: www.chemtrac.com

Chemtrac Systems, Inc. designs and manufacturers instrumentation for coagulation/clarification/filtration/disinfection optimization, as well as for steam/condensate monitoring. Chemtrac is a global leader in providing streaming current monitoring technology for coagulant feed control, and offers online particle counters and particle monitors for continuous filter performance evaluation. The particle counters/monitors are also used in the steam generation cycle for corrosion product transport monitoring, condenser leak detection, and steam purity monitoring. Chemtrac also provides analyzers for chlorine, ozone, turbidity, and organics monitoring.

CHEMTREAT, INC.

Booth: 44
Contact: Ray Post
Phone: 804-627-2369
Email: rayp@chemtreat.com
Web: www.chemtreat.com

ChemTreat, Inc. is the nation's largest and fastest growing specialty chemical company dedicated solely to industrial water treatment. For the best products and world-class service, you've come to the right place. We have over 500 associates working throughout North and South America, the Caribbean, and some areas of Asia/Pacific regions. Our entrepreneurial spirit not only helps drive our company's success, but also carries over into our customer's facilities. We help our customers' facilities. We help our customers save millions of dollars

CORTEC CORPORATION

Booth: 69
Contact: Cortec Corporation
Phone: 651-429-1100
Email: productinfo@cortecvci.com
Web: www.cortecvci.com

Cortec® Corporation (St. Paul, Minnesota) is trusted globally to provide environmentally friendly, corrosion protection with its VpCI® and MCI® Technologies for Metalworking, Electronics, Water Treatment, Oil & Gas, Packaging, Construction, and other industries. Certified ISO 9001:2008/14001:2004/17025:2005

Exhibitors

DEGREMONT NORTH AMERICA

Booth: 1 & 2
Contact: Peter Midgley
Phone: 289-244-7600
Email: peter.midgley@degremont.com
Web: www.degremont-technologies.com

Degremont NA - The world's most respected leader in:

- Zero Liquid Discharge
- Boiler Feed Water Treatment
- Clarification
- Wastewater Treatment
- Heavy Metals Removal
- Biological Treatment

Your single source supplier for custom designed, engineered, manufactured and commissioned industrial water treatment systems. Degremont - The most trusted name in the Water & Wastewater Treatment industry.

DIAMOND V

Booth: 39
Contact: Michael Spacil
Phone: 800-373-7234
Email: mspacil@diamondv.com
Web: www.diamondv.com

Diamond V®, headquartered in Cedar Rapids, Iowa, USA, is a bioscience company specializing in fermentation technology. The Company manufactures all-natural nutritional products that optimize microbial efficiency. Since 1943, Diamond V® has been committed to advancing nutrition and health in the animal industry and has expanded to human nutrition and, more recently, water and soil remediation. Our commitment to innovation, technology and quality has earned Diamond V® a global reputation of trust and reliability. We help our customers succeed by sharing knowledge, innovation and capability. The benefit is real because the Diamond V® investment and commitment is real. As the global population continues to grow, and the demand for fresh water increases, water quality is crucial. AquaSmart™, a new product innovation from Diamond V®, can aid in the effort to treat many wastewaters and provide cleaner, safer discharge for many industries.

DOW WATER & PROCESS SOLUTIONS

Booth: 29
Contact: DOW Customer Information Group
Phone: 800-447-4369
Email: custinfogrp@dow.com
Web: www.dowwaterandprocess.com

Dow Water & Process Solutions offers a broad portfolio of ion exchange resins, reverse osmosis membranes, ultrafiltration membranes and electrodeionization products, with strong positions in a number of areas, including industrial applications. More information about Dow Water & Process Solutions can be found at www.dowwaterandprocess.com.

DURAFLOW LLC

Booth: 66
Contact: Bill Matheson
Phone: 978-851-0447
Email: billmatheson@duraflow.biz
Web: www.duraflow.biz/

Duraflow manufactures Tubular, Crossflow, Microfiltration Membrane filters in their in Tewksbury, MA facility. These membrane modules are the key components of water and wastewater treatment systems built by Duraflow's trained and authorized OEM manufacturers. These systems are mostly for either recycling industrial wastewater or for prefiltration processes in front of Reverse Osmosis systems. Duraflow membrane modules are recognized as the perfect pretreatment to RO.

ECO-TEC INC.

Booth: 46
Contact: Michael Sheedy
Phone: 905-427-0077
Email: msheedy@eco-tec.com
Web: www.eco-tec.com

Eco-Tec develops designs and manufactures innovative water treatment systems particularly adapted to boiler feed, condensate polishing and produced water treatment. Featured products are Spectrum Micro Media filtration and Recoflo®/RecoPur® short, packed-bed ion exchangers.

ENVIRONMENTAL OPERATING SOLUTIONS, INC.

Booth: 19
Contact: Michael Starr
Phone: 508-743-8440
Email: mstarr@eosenvironmental.com
Web: www.eosenvironmental.com

Environmental Operating Solutions, Inc. (EOSi) provides green chemicals and technical services for biological contaminant removal applications in water and wastewater treatment systems. The company's agriculturally-derived products provide a non-hazardous and environmentally sustainable alternative to methanol or other chemicals. The company's MicroCT line of products (MicroCm®, MicroCg® and MicroCglycerinT) address contaminants including nitrogen, phosphorous, selenium and perchlorate. MicroCT products are also used as BOD supplements to sustain biomass during maintenance at industrial wastewater facilities and establish biomass for new plant startups. EOSi currently provides more than 400 wastewater treatment plants with a safer, more effective, and environmentally sustainable solution compared with methanol and other carbon sources. In addition, EOSi offers highly specialized technical expertise and support to help plant engineers and operators optimize the use of its products and achieve their effluent performance objectives. EOSi is also engaged in research and development efforts focused on bringing the next generation of biological contaminant removal solutions to the market. EOSi was established in 2003 and is based in Bourne, Massachusetts.

Exhibitors

FRENCH CREEK SOFTWARE, INC.

Booth: 40
Contact: Robert Ferguson
Phone: 610-935-8337
Email: robferguson@frenchcreeksoftware.com
Web: www.frenchcreeksoftware.com

French Creek develops and markets scale and corrosion software tools for water treatment professionals. Standard packages include industry standard WaterCycle® for cooling, hyd-RO-dose™ for membrane systems, WatSim™ for potable, MineSAT™ for mining and waste water, DownHole SAT for oil field. Private label available. Windows DLLs and UNIX libraries available for controllers, web apps, and in-house applications.

GE POWER & WATER

Booth: 17 & 18
Contact: Kyle Wendel
Phone: 425-828-2400
Email: Kyle.Wendel@ge.com
Web: www.gewater.com

With operations in 130 countries and employing nearly 8000 worldwide, GE Power & Water, 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.

GEA PROCESS ENGINEERING

Booth: 73
Contact: Matthias Loewenberg
Phone: 732-223-1167
Email: Matthias.Loewenberg@gea.com
Web: www.niroinc.com

GEA Process Engineering is a full-service engineering company dedicated to supplying evaporation, crystallization, membrane filtration, and drying process technology and systems. GEA Process Engineering designs, fabricates, and tests systems for power, mining, chemical, pharmaceutical, biotech, food, and beverage industries, as well as environmental applications.

GENESYS INTERNATIONAL

Booth: 62
Contact: Ursula Annunziata
Phone: 952-949-6535
Email: uannunziata@genesysro.com
Web: www.genesysamericas.com

Genesys North America specializes in high performance membrane chemicals and services for reverse osmosis and nanofiltration systems. The membrane chemicals include anti-scalants and cleaning chemicals. The products and expertise of Genesys North America allow customers to reduce the total cost of their RO/NF operation.

Exhibitors

GLOBAL CHEM-FEED SOLUTIONS

Booth: 37
Contact: William (Bill) Herbert Sr
Phone: 215-675-2777 X100
Email: williamh@globalchem-feed.com
Web: 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 Plants, Hydrocarbon Petrochemical Plants and other Heavy Industrial Manufacturing Facilities. Custom skid mounted chemical dosing systems are engineered for the injection of chemicals into boiler water, cooling water, and waste water systems as well as other process applications. Fugitive dust suppression systems are designed and fabricated for material handling and storage pile applications. Treatment points include unloading, crushing, transfer, load out and reclaim.

GOLDER ASSOCIATES, INC.

Booth: 6
Contact: Paul Pigeon
Phone: 303-980-0540
Email: ppigeon@golder.com
Web: www.golder.com

Golder Associates is an employee-owned, global group of companies specializing in ground engineering and environmental services. From offices worldwide, our employees work with clients who want to manage their environmental and engineering activities in a technically sound, economically viable and socially responsible manner.

GRAVER WATER SYSTEMS/ ECODYNE WATER

Booth: 3
Contact: Robert Applegate
Phone: 908-516-1404
Email: rapple@graver.com
Web: www.graver.com

Graver Water Systems, LLC designs and manufacturers water and wastewater treatment equipment and systems. Graver's engineers are knowledgeable in pretreatment, degasification, hot lime softening, boiler make-up, condensate polishing, wastewater treatment, cooling water treatment, and oil/water separation for industrial plants and electric utilities on a global basis.

HACH

Booth: 65
Contact: Pam Carlson
Phone: 970-663-1377
Email: pcarlson@hach.com
Web: www.hach.com

Hach Company manufactures and distributes analytical instruments and reagents used to test the quality of water and other liquids. Hach systems are designed to simplify analysis, and offer:

- Complete, easy-to-follow methods
- High-quality prepared reagents
- Accurate portable, laboratory and online instrumentation
- Life-time technical support

Exhibitors

HONEYWELL

Booth: 22
Contact: Vickie Oslon
Phone: 623-203-8623
Email: vickie.oslon@honeywell.com
Web: www.honeywell.process.com

Honeywell is a leading supplier of process control instrumentation. The NEW DirectLine™ Sensor Module is a unique architecture for analytical measurements. The DirectLine™ sensor modules save time with installation, wiring, and calibration.

ILLINOIS WATER TECHNOLOGIES

Booth: 21
Contact: Paul Byrd
Phone: 815-636-8884
Email: paulb@illinoiswatertech.com
Web: www.illinoiswatertech.com

Illinois Water Technologies is an independent service and retrofit provider of water treatment equipment. We also stock ion exchange-resin, filter media and provide custom replacement parts as well as common vendor supplied components.Our customers enjoy 24-hour availability, commitment to service, and cost savings that IWTech brings to the marketplace

INDUSTRIAL ANALYTICS CORP.

Booth: 49
Contact: Nick Afragola
Phone: 203-245-0380
Email: nafragola-iac@sbcglobal.net
Web: www.industrialanalyticscorp.us

Industrial Analytics Corporation, a US company, has been an integral participant in power plant water chemistry since 1990. Unique and user friendly water quality instrumentation are produced at our facility. Current parameters include sodium (manual and auto-cal versions), dissolved oxygen (response from air saturation to less than 10 ppb in under 5 minutes), silica (single and multi-stream, two reagent and three reagent packages), and pH via differential conductivity.

JOHNSON MARCH SYSTEMS, INC.

Booth: 26
Contact: John Sands
Phone: 215-364-2500
Email: john.sands@johnsonmarch.com
Web: www.johnsonmarch.com

Johnson March Systems is a custom designer and manufacturer of Chemical Dosing Systems, Steam and Water Sampling Panels, Chlorination Systems (Electrolytic, Gaseous, Purchased Hypochlorite), Ammonia Feed Systems, ASME Pressure Vessels, Specialty Skid Mounted Packages, and Dust Suppression Systems. JMSI is ISO9001-2008 certified by Underwriters Laboratories. JMSI has a full staff of Mechanical, Chemical, Electrical, Instrumentation and Civil Engineers.

Exhibitors

JUSTEQ LLC

Booth: 47
Contact: Justin Shim
Phone: 847-656-8626
Email: justeq@gmail.com
Web: www.justeq.com

Justqe produces and markets the newest industrial water treatment biocide, Justeq07. Justeq07 is effective, economical and convenient. The production growth of this biocide is the fastest among the industrial water treatment biocides.

KASELCO, LLC

Booth: 71
Contact: Douglas Herber
Phone: 361-594-2596
Email: kaselsosales@kaselco.com
Web: www.kaselco.com

KASELCO has been a leader in the water solutions industry since 1996. We specialize in our own patented electrocoagulation systems, manufactured in the USA. EC has many benefits over other treatment systems including the reduction of operating costs and the ability to create stable waste without the addition of chemicals.

KEMIRA WATER SOLUTIONS INC.

Booth: 57
Contact: Peter DeMartine
Phone: 704-361-2436
Email: peter.demartine@kemira.com
Web: www.kemira.com

Kemira is a global water chemistry company offering water quality and quantity management to improve our customers' energy, water, and raw material efficiency. Our solutions are widely used in industrial applications including: paper, oil & gas, mining, food & beverage, construction, and other selected industries as well as municipal water and wastewater

LANXESS SYBRON CHEMICALS INC.

Booth: 10
Contact: Edward Nace
Phone: edward.nace@lanxess.com
Email: 800-678-0020
Web: www.Lanxess.com

LANXESS Sybron Chemicals Inc offers the most technically advanced ion exchange resins today. We have over 60 years of experience in ion exchange, developing essential products, processes and application technology. We offer a full range of products that cover water treatment, the food industry, catalysis/ chemical processes and many other specialty markets. The products are sold world-wide under the brand name Lewatit and Ionac.

Exhibitors

LMI/ MILTON ROY

Booth: 36
Contact: Kurt Gabel
Phone: 215-441-0800
Email: Kurt.Gabel@miltonroy.com
Web: www.miltonroy-americas.com

Milton Roy is a global leader in fluid control and metering pump technologies, offering a broad range of pneumatic, hydraulic actuated, solenoid driven metering and centrifugal pumps and accessories that provide cost-effective reliable pumping solutions for chemical dosing and water removal to meet a wide range of industry needs.

MAR SYSTEMS INC.

Booth: 42
Contact: Anothy Lammers
Phone: 440-505-0962
Email: tlammers@marsystemsinc.com
Web: www.marsystesinc.com

MAR Systems is an Ohio-based company that was established in 2005. Our firm has developed a FASTER, CHEAPER, GREENER solution for the removal of heavy metal contaminants from water. As a result of the increasing presence of hazardous metal contaminants found in water, MAR Systems has developed patented, proprietary processes that remove mercury, selenium, arsenic and other metals from water through its Sorbster media.

METTLER TOLEDO THORNTON AND INGOLD

Booth: 38
Contact: Peggy Banarhall
Phone: 781-301-8822
Email: peggy.banarhall@mt.com
Web: www.mt.com

Mettler-Toledo Thornton, a global leader in high purity water measurement, provides in line industrial monitoring instrumentation for the key parameters measured in cycle chemistry, stator cooling, cooling towers, scrubbers, wastewater & makeup water treatments. Thornton's innovative, reliable sensors and transmitter monitor Conductivity (and Cation conductivity), pH, ORP, TOC, Sodium, Silica, Dissolved Oxygen and

MITSUBISHI ELECTRIC AUTOMATION, INC.

Booth: 41
Contact: Ed Ladd
Phone: 512-693-1451
Email: ed.ladd@meau.com
Web: www.meau.com

Building on Mitsubishi Electric's tradition of technological leadership and innovation for more than 75 years, the company merged three existing automation product business units to form Mitsubishi Electric Automation, Inc. on January 1, 1997. Under the leadership of Mr. Yuji Kajikawa, president and CEO, the sole mission of Mitsubishi Electric Automation, Inc, is to support the automation needs of North and Latin American customers with combined sales, marketing, service, engineering and manufacturing resources. This focused approach is being completed through a facility located in Vernon Hills, IL where all aspects of automation support can be maintained, including manufacturing, engineering, training, customer service, repair, sales and warehousing functions.

MPW INDUSTRIAL SERVICES

Booth: 70
Contact: Ryan Cullins
Phone: 740-345-2431
Email: rcullins@mpwservices.com
Web: www.mpwservices.com

MPW is the leading service provider of integrated technology-based Industrial Cleaning, Facility Management, Water Purification and Container Management in North America. MPW partners with customers to enhance operational efficiencies improve reliability and minimize costs. Qualified, highly trained personnel respond to your needs, delivering services with the highest ethical standards and commitment to safety. Since 1972, MPW has been providing rapid response, making MPWa pioneer in quality and

NALCO, AN ECOLAB COMPANY

Booth: 30
Contact: Debbie Bloom
Phone: 630-305-2264
Email: dbloom@nalco.com
Web: www.nalco.com

Nalco provides essential expertise for water, energy and air. We help our customers reduce energy, water and other natural resource consumption, enhance air quality, minimize environmental releases and improve productivity and end products while boosting their bottom line. Together our comprehensive solutions contribute to the sustainable development of customer operations. Nalco is a member of the Dow Jones Sustainability World Index. More than 11,500 Nalco employees operate in 130 countries supported by a comprehensive network of manufacturing facilities, sales offices and research centers to serve a broad range of end markets. For more information visit www.nalco.com.

ORANGEBOAT

Booth: 55
Contact Jantje Johnson
Phone: 952-956-4352
Email: jantje@orangeboatsupport.com
Web: www.orangeboatsupport.com

OrangeBoat is a unique, niche service provider that works exclusively to close short-term gaps in technical support and solve specific performance problems in membrane-based water treatment systems for engineering companies, equipment suppliers, membrane manufacturers, membrane chemical suppliers, and end-users.

OVIVO USA, LLC

Booth: 48
Contact: Claire Madson
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Email: Claire.Madson@ovivowater.com
Web: www.ovivowater.com

Ovivo is a worldwide leading Solution and Equipment provider to the Industrial Water market. Ovivo offers the complete solutions, including mechanical, chemical and biological solutions for the plant Raw Water Intake, Pure Water supply, and Wastewater Treatment needs. Ovivo (formally known as Eimco Water Technologies) with the acquisitions of Christ Water (2010) and Brackett Green (2005) now offers complete flow sheet and full equipment spectrum to serve clients globally. Equipment includes; Cooling Water

Intake screening, Boiler Makeup Water (Reverse Osmosis, DeIonize, Ion exchange and Ultra Filtration), Condenser Protection system (Automatic Tube Cleaning and on-line Debris Filter), Condensate Polishing, Wastewater Treatment (Clarifiers, DAF, MBR, MBBR)

PALL CORPORATION

Booth: 27
Contact: Spence Wise
Phone: 888-873-7255
Email: spence_wise@pall.com
Web: www.pall.com

Pall Corporation is a world leader in filtration, separation, and purification providing Total Fluid Management solutions to meet the needs of our customers, and make their operations more cost-efficient. Pall proprietary materials are at the heart of these capabilities. Pall technologies are supported by ISO 14001 certification of our facilities.

PARKSON CORPORATION

Booth: 9
Contact: Al Loncar
Phone: 888-PARKSON
Email: technology@parkson.com
Web: www.parkson.com

Parkson Corporation is a supplier of innovative, cost effective solutions for potable water, process water, and industrial and municipal wastewater treatment. Since 1971, Parkson has Provided its Customers with Superior, Cost-Effective Components and Systems For Water and Wastewater Treatment.

PROCESS SOLUTIONS INC. / MICROCLOR

Booth: 33
Contact: Thomas Mooney
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Email: tomooney@4psi.net
Web: www.4psi.net

MicrOclor established in 2003 is dedicated in providing cost effective disinfection solutions to municipal water and wastewater facilities and industrial process water and wastewater facilities. The MicrOclor team has over 130 years of combined electro-chlorination experience that has driven the development of a more robust yet simpler technology for generating bleach on site.

PROFESSIONAL WATER TECHNOLOGIES

Booth: 32
Contact: David Russell
Phone: 760-639-4400
Email: david.russell@pwtchemicals.com
Web: www.h2oinnovation.com/www.pwtchemcials.com

Professional Water Technologies synthesizes specialty pretreatment chemicals for RO and NF membrane processes. They provide complete membrane forensics autopsy services including biological and microscopic analysis, and element or membrane characterization capabilities. PWT also has a complete line of membrane cleaners for inorganics, silica, colloids, biological, and other specialty applications, as well as the FilteRx line of organic and inorganic filter aids for coagulation/flocculation.

Exhibitors

PUROLITE COMPANY

Booth: 28
Contact: Don Downey
Phone: 800-343-1500
Email: info@puroliteusa.com
Web: www.Purolite.com

"Purolite's focus is the development, manufacture, marketing and support of resins for Ion-Exchange, Adsorbents, Catalysts, and Special Applications. With our market-leading team of field experts, global manufacturing capability and record of innovative research, Purolite® offers the most

QUA GROUP LLC

Booth: 43
Contact: Joe Slivia
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Email: silviaj@quagroup.com
Web: www.quagroup.com

QUA is a manufacturer of advanced membrane products for water, wastewater, and water reuse applications. Extensive R&D activities for over a decade have resulted in a range of cutting edge membrane products. These products are sold and serviced through a network of qualified equipment manufacturers around the world.

RESINTECH, INC.

Booth: 59
Contact: Michael Gottlieb
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Email: ixresin@resintech.com
Website: 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

SAMCO TECHNOLOGIES, INC

Booth: 14
Contact: Robert Bellitto
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Web: www.samcotech.com

Skid mounted integrated turn-key solutions for pure/ultra pure/waste water and process filtration-separation. Innovative minimum waste/high yield water management and recovery solutions for produced water, boiler feed, condensate polishing, brine concentration/crystallization and Zero Liquid Discharge (ZLD). Exclusive licensee of Rohm & Haas Advanced Amberpack Deionization (ADI) technology.

SCHREIBER, LLC

Booth: 7
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Web: www.schreiberwater.com

Serving Industrial & Municipal markets since 1979, Schreiber Corporation 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: 31
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Web: www.sentry-equip.com

Sentry Equipment Corp. is a leading manufacturer of sample handling and sample conditioning components that enable safe, simple and repeatable samples (water/steam, gas, liquid, slurry and solids) for power generation and process industries worldwide. Complemented by the most preferred multi-vendor services organization, AquatiPro™ provides the expertise to help you gain maximum uptime of all your water quality instrumentation.

SEVERN TRENT WATER PURIFICATION, INC.

Booth: 45
Contact: Charles Guzelli
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Email: info@severntrentservices.com
Web: www.severntrentservices.com

Severn Trent Services is a supplier of disinfection systems; chloride, sodium hypochlorite, chlorine dioxide, ammonia, sulfur dioxide, carbon dioxide, UV and filtration systems; inorganic removal and filters for water and wastewater systems. Severn Trent also designs complete systems and provides service support of equipment for municipal and industrial treatment systems.

SOLARBEE, INC.

Booth: 16
Contact: Robert Nobile
Phone: 203-569-5000
Email: Bob@solarbee.com
Web: www.solarbee.com

SolarBee Inc.'s award- winning long-distance circulation technology (LDC) helps solve difficult water quality problems. The patented technology can prevent and control blue-green algae in lakes and raw water reservoirs, provide energy savings, process improvement, and odor control in wastewater, and completely mix potable water tanks, eliminating stratification and reducing DBP. Solar-powered and grid-connected solutions are available.

SOUTHERN RESEARCH INSTITUTE

Booth: 74
Contact: Robert (Bob) Dahlin
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Web: www.southernresearch.org

Southern Research provides on-site testing, analytical services, and contract R&D to help industries address environmental issues. On-site testing includes sampling and analysis of effluents for metals, organics, and other parameters affecting water quality. Contract R&D includes conducting pilot-scale tests to demonstrate technologies for water conservation, hybrid cooling technologies, moisture recovery, and advanced wastewater treatment.

STERILEX

Booth: 72
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Email: alex@sterilex.com
Web: www.sterilex.com

Sterilex Corporation provides proprietary EPA registered anti-biofilm/biocide solutions for recirculating, once-through, and closed loop water systems. Sterilex's patented PerQuat® technology is the only approved product on the market for the removal of biofilm, slime, and algae while concurrently providing broad spectrum biocidal performance. PerQuat® chemistry, with hybrid oxidizing/non-oxidizing biocidal activity, simultaneously kills both sessile and planktonic organisms and can be used in place of non-oxidizing biocide/dispersant programs or as the sole biocide in a system. The use of PerQuat® technology has been shown to increase efficiency, remediate, and enhance operational performance at a lower cost to treat.

SWAN ANALYTICAL USA

Booth: 5
Contact: Jeff Parke
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Email: jeff.parke@swan-analytical-usa.com
Web: www.swan.ch

Swan Analytical Instruments is a Swiss company which develops and markets globally instrumentation for on-line analysis in potable and waste water drinking plants and other industries, in particular power plants. Swan offers solutions to complex measurement issues.

THERMAX INC.

Booth: 34
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Web: www.thermax-usa.com

Thermax manufactures different varieties of ion exchange resins for various applications in water treatment and specialty areas such as pharma, biotech, catalyst, sugar, metal recovery and more. Thermax resins are marketed under trade name Tulsion

TURNER DESIGNS HYDROCARBON INSTRUMENTS, INC.

Booth: 64
Contact: Gary Bartman
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Web: www.oilinwatermonitors.com

Turner Designs Hydrocarbon Instruments, Inc. is the worldwide leader in the application of field portable, laboratory and 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.

U S PEROXIDE

Booth: 68
Contact: Lovella Hebert
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Web: www.h2o2.com

US Peroxide provides treatment solutions and rapid response to many large U.S. companies and refineries. Our turn-key treatments include hydrogen sulfide removal, supplemental DO, cooling tower cleaning, BOD/COD removal, high strength wastewater, NOx, and more. Our full-service, "hands-off" solutions include chemical treatment application, storage and dosing systems, and technical expertise.

U.S. WATER SERVICES

Booth: 12
Contact: John Vogt
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Email: john.vogt@uswaterservices.com
Web: www.uswaterservices.com

US Water Services is a water treatment company that provides integrated solutions combining engineering, equipment, chemicals and services. We help industries find optimal solutions for their most challenging water, energy and compliance problems.

VEOLIA WATER SOLUTIONS & TECHNOLOGIES

Booth: 20
Contact: Kati Ardaugh
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Email: katherine.ardaugh@veoliawater.com
Web: www.veoliawaterst.com/

Veolia Water Solutions & Technologies North America offers comprehensive water and wastewater solutions for Industrial and Municipal customers.

WATERS EQUIPMENT CO.

Booth: 53
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Phone: 262-567-7256
Email: markg@sentry-equip.com
Web: www.watersequipment.com

Waters Equipment Company has been engaged in the design and construction of steam and water sampling systems since 1963 and is the pioneer in the field. Waters Equipment also manufacturers many of the major sample conditioning components including sample coolers, high pressure reducers, refillable resin columns, high temperature

shut off valves, multi-stream sequencers, FTA secondary temperature control systems and degassing spargers. We also manufacturer systems that complement the sampling process such as cooling water isolation skids (CWIS), condenser leakage monitoring systems (CLMS) and portable samplers. Waters Equipment became a division of Sentry Equipment Corp in 2011.

WATERTECTONICS

Booth: 63
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Email: tj@watertectonics.com
Web: www.watertectonics.com

Established in 1999, WaterTectonics is an international leader in on site water treatment technology and services. The company engineers and manufactures custom water treatment solutions for storm, ground, industrial, marine and contaminated water applications. Innovators of leading edge technology that is easy to implement, WaterTectonics' sustainable approach to water treatment is effective among diverse high-volume waste streams.

WESTECH ENGINEERING INC.

Booth: 25
Contact: Jimmy Woods
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Web: www.westech-inc.com

For raw water pretreatment, cooling water, water reuse, wastewater and potable water treatment, WesTech is your independent source for a full range of reliable industrial and municipal process treatment equipment designed, engineered and built for long lasting efficiency. For new plants, design build projects, retrofits, or entire plant flowsheets, WesTech offers the process, manufacturing and project experience required.

WORLEYPARSONS

Booth: 61
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Web: www.worleyparsons.com

WorleyParsons is a leading global provider of technical, project and operational support services to the resource, energy and complex process industries. Our comprehensive network enables us to provide our customers with local support backed by global expertise in Infrastructure & Environment, Hydrocarbons, Minerals, Metals & Chemicals and Power. With more than 37,800 employees across 44 countries and 148 offices, we continue to push boundaries and extend our capabilities in water and waste water treatment around the world

ZEQUANOX BY MBI

Booth: 4
Contact: Kristie Jones
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Web: www.marronebio.com

Zequanox®, by Marrone Bio Innovations (MBI), is the industry's only biological product for controlling zebra and quagga mussels. It is applied directly into the water system using standard injection equipment and personnel need only minimal personal protective equipment (PPE). Treatments of Zequanox can occur during the workday and can be completed within hours. Unlike chemicals and chlorine, it has minimal use restrictions and is safe for workers and the environment. In addition, it is noncorrosive and does not require detoxification upon discharge. Effective, simple and safe, Zequanox provides the ability to keep cooling and process water systems free of destructive mussels without having to procure and maintain specialized equipment, or put employees, equipment or the environment at risk.

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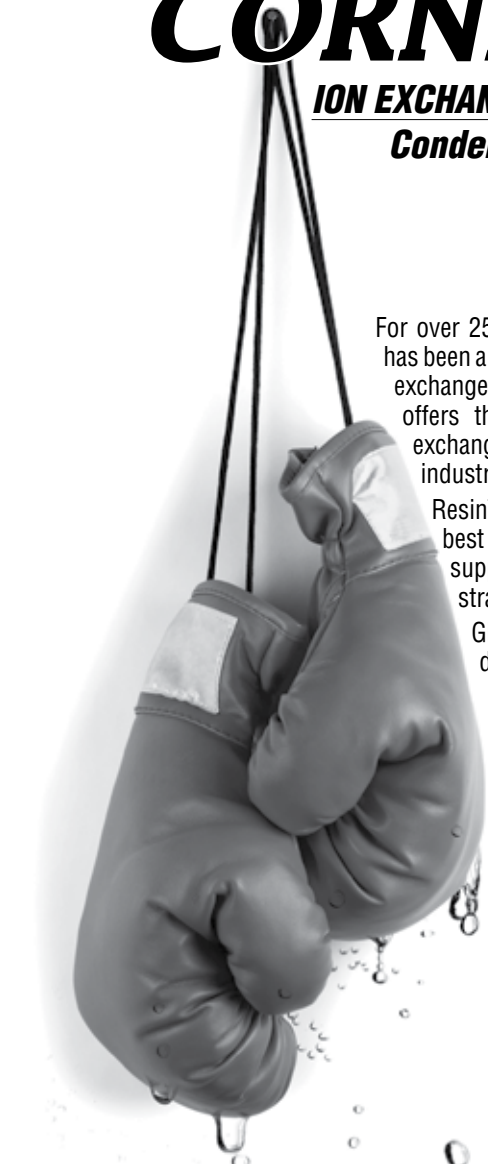

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