INTERNATIONAL WATER CONFERENCE®

2020 PROGRAM GUIDE

Schedule-at-a-Glance
ALL TIMES EASTERN

MONDAY, NOVEMBER 9

9:00 AM ET	Nutrient Reduction Papers1-3	Produced Water & SAGD Papers 4-6	RO & Membranes Papers 7-9	ASME #1 Atypical Steam Generation Papers 10-12
12:00 Noon ET	Keynote Session			
12:30 PM ET	Exhibit Hall Tour Time - visit and live chat with exhibit staff!			
1:30 PM ET	Refining Papers 13-16	Sustainability Papers 17-20	Potable Water Papers 21-24	ASME #2 Corrosion Inhibition Papers 25-28
4:30 PM ET	Exhibit Hall Tour Time - visit and live chat with exhibit staff!			

TUESDAY, NOVEMBER 10

9:00 AM ET	Industrial Wastewater Papers 29-32	Brine Management Papers 33-36	Business of Water Papers 37-40	Cooling Water Papers 41-44
12:30 PM ET	Exhibit Hall Tour Time - visit and live chat with exhibit staff!			
1:30 PM ET	FGD Papers 45-48	Reuse Papers 49-52	PFAS 1 Papers 53-56	Monitoring Papers 57-60
4:30 PM ET	Exhibit Hall Tour Time - visit and live chat with exhibit staff!			

WEDNESDAY, NOVEMBER 11

9:00 AM ET	Mining Papers 61-64	Power & Ash Papers 65-68	PFAS 2 Papers 69-72	Modelling & Predicting Papers 73-76
12:30 PM ET	Exhibit Hall Tour Time - visit and live chat with exhibit staff!			
2:00 PM ET	Continuing Education Workshops (separate registration required)			

THURSDAY, NOVEMBER 12

9:00 AM ET	Continuing Education Workshops (separate registration required)
2:00 PM ET	Continuing Education Workshops (separate registration required)

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 1,000 (approx.) end users, researchers, practicing engineers, managers, educators, suppliers and contractors. It is dedicated to advancing new developments in the treatment, use and reuse of water for industrial and engineering purposes.

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

CONFERENCE PROCEEDINGS

All registered attendees (except Exhibit Only) receive the Official Conference Proceedings of the 81st Annual International Water Conference®. The CD will be mailed to you approximately two months following the conference. Additionally you may now download this content via file transfer.

CALL FOR PAPERS

To participate in the 2021 International Water Conference® as a presenter, please watch for the opening of the IWC Call for Papers. The Call for Papers is done exclusively on-line through the IWC home page at www.eswp.com/water.

PROFESSIONAL DEVELOPMENT HOURS

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

SOCIAL MEDIA

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

IWC EXECUTIVE COMMITTEE

The Engineers' Society of Western Pennsylvania (ESWP) is the proud sponsor of the International Water Conference (IWC) ESWP is a member-based, non-profit organization based in Pittsburgh, PA. Since its founding in 1880, ESWP has provided a venue for continuing education, business development, and social interaction among members of the global engineering and technical community. ESWP would like to thank the members of the IWC Executive Committee for their continued efforts in planning the Conference!

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

Michele Funk, P.E.
Bechtel Corporation, Reston, VA

Michael Gottlieb
ResinTech, Inc., West Berlin, NJ

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

William Kennedy, P.E.
Stantec, Charlotte, NC

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

Tom Lawry
McKim & Creed, Sewickley, PA

Dennis McBride
Burns and McDonnell, Kansas City, MO

Ivan Morales
Integrated Sustainability, Inc., Houston, TX

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

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

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

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

Jonathan Shimko
McKim & Creed, Sewickley, PA

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

Jim Summerfield
Dupont Water Solutions, Saginaw, MI

Lyndsey Wiles
MICRODYN-NADIR, Goleta, CA

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

In Memorium

During this past year, the IWC Executive Committee lost a dear fellow member, Randy Turner. Randy was a long-time contributor to the International Water Conference in every role one could imagine, from exhibitor, to presenting author, discusser, Advisory Council representative, and finally the Executive Committee. We miss the intelligence, and kind manner of this "southern gentleman."

Monday, November 9
Morning Sessions

M1: Nutrient Reduction

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

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

Discussion Leader: Diane Martini, Burns & McDonnell, Chicago, IL

TIME: 9:00 – 11:40 AM (EST)

The use of phosphate and nitrate fertilizers has greatly increased crop yields and has become essential to successfully farming. Of almost equal importance, phosphates and nitrates are used in many industrial processes. Run off and industrial discharges result in significant concentrations of these nutrients entering our waterways. Every summer we hear of toxic algae blooms. These blooms flourish in warm waters that contain nutrients such as phosphates, nitrates, and various carbohydrates released as residues from food manufacturing.

This session on Nutrient reduction features papers that describe the problem as well as various solutions that can be implemented to minimize discharges to the environment. Solutions include biological, ion exchange, and membrane processes.

IWC 20-01: NUTRIENT REDUCTION – WHY SHOULD WE CARE?

Douglas Kellogg, Evoqua Water Technologies, Rockford, IL

TIME: 9:10 AM (EST)

Although nutrient reduction does not stir our hearts the way PFAS, climate change, or the Corona virus does, manmade nutrients in our water supplies present a serious and growing threat to public health. Such nutrients include phosphorus, nitrate, ammonia, and various organic compounds that accelerate the grow of algae and other plant life. The bio mass then reduces oxygen content, causing "dead zones" where aerobic life is not possible. Worse, decaying bio mass releases toxic compounds that can make the water poisonous.

Every summer we hear of toxic algae blooms. These blooms flourish in warm waters that contain nutrients such as phosphates, nitrates, and various carbohydrates released as residues from food manufacturing. Even very large bodies of water such as the Great Lakes have been affected, leaving millions of people without safe drinking water in their taps. Although action at the federal level might not be possible in today's political climate, many states are taking action to limit both industrial and domestic discharges that contain water born nutrients.

This paper covers the origins of the various nutrients, their impact on public health, and the best available technologies for their removal.

Discusser: Carl Galletti, ResinTech, Camden, NJ

IWC 20-02: REDUCING AMMONIA AND OTHER NITROGEN COMPOUNDS IN A MIDWEST AMMONIA PRODUCER'S WASTE STREAM USING REVERSE OSMOSIS

Tom Gurley, III, Jeff Dackin, and Natasha Kramer, ChemTreat, Glen Allen, VA

TIME: 10:00 AM (EST)

At a large Midwestern ammonia plant, a waste stream was created from process condensate used in ammonia production that is contaminated with a high concentration of nitrogen-containing compounds. Previous efforts to purify this stream using ion exchange prior to discharge proved to be costly and unreliable. A trial was conducted to purify this stream using two pass reverse osmosis (RO.) The following paper details chemical treatment strategies and results of the two pass RO trial.

Discusser: Bryan Hansen, Burns & McDonnell, Centennial, CO

IWC 20-03: PHOSPHATE: FRIEND AND FOE

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

TIME: 10:50 AM (EST)

In addition to being an important component of fertilizers that replenish soil and help grow the crops that feed the world, are also useful as scale inhibitors, pH buffers, and flavor enhancers. The production of phosphoric acid remains a very important strategic and economic component of both developing and developed nations around the globe. Without phosphates, our world would be a poorer and hungrier place indeed.

Unfortunately, the very thing that makes phosphates so important, accelerated plant growth, also makes phosphates a concern in the lakes and other waterways that supply much of our drinking water. Discharge of phosphate from agricultural drainage, as well as from industrial waste discharges, contributes to the growth harmful algae blooms that can release cyanotoxins and poison our water supplies.

Discusser: Patricia Scroggin-Wicker, P.E., Burns & McDonnell, Kansas City, MO

M2: Produced Water & SAGD

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

Session Chair: Don Downey, Purolite, Paris, ON Canada

Discussion Leader: Dave Pernitsky, Stantec, Calgary, AB, Canada

TIME: 9:00 – 11:40 AM (EST)

1986 IWC, featured a produced water (PW) paper: "Design & Implementation of a Softening Process for High TDS" authored by Robert Hart and Sally Thomas of Conoco Inc. 2006 in IWC in Orlando, featured the first full Produced Water Session. Since 2006 interest in Produced Water remains high profile; technical papers included hot lime softeners and ion exchange systems to reverse osmosis and evaporators. In this session, we will hear about Conductivity Inaccuracy in Produced Water, Characteristics of particles in Warm Lime Softeners and Sulphate Removal for Oil Fields.

IWC 20-04: OVERCOMING CONDUCTIVITY MEASUREMENT INACCURACY IN HIGH IONIC STRENGTH PRODUCED WATER

Nicole Bartoletta, McKim & Creed, Inc., Sewickley, PA; Amanda Veazey, Seneca Resources Company, LLC, Pittsburgh, PA

TIME: 9:10 AM (EST)

Blending produced water and fresh water to create the best available hydraulic fracturing fluid is commonly done using electrical conductivity. High levels of dissolved solids in produced water from the Marcellus and Utica shale plays make these measurements difficult in the field. This paper contains a discussion of research to develop a reliable conversion factor to allow the use of conductivity to measure high concentrations of dissolved solids for onsite injection fluid blends.

Discusser: Chip Westaby, TDHI, Kirkwood, MO

IWC 20-05: CHARGE CHARACTERISTICS OF PARTICLES IN SAGD WARM LIME SOFTENERS

Lu Zhang and Dave Pernitsky, Stantec, Calgary, AB, Canada; Dinesh Mishra and Qingye Lu, and Kaillun Zhang, University of Calgary, Calgary, AB, Canada

TIME: 10:00 AM (EST)

Warm Lime Softening (WLS) is used in many industrial water treatment applications, including SAGD enhanced oil recovery operations for hardness and silica removal. Hydrated lime (Ca(OH)2), magnesium oxide (MgO), soda ash (Na2CO3, as needed), and coagulants are added into the rapid mixing zone in a WLS where soluble calcium and magnesium hardness precipitate mainly as CaCO3 and Mg(OH)2 and silica precipitates by reacting with MgO. Flocculant polymers are often added for particle aggregation and settling. In spite of the fact that WLS have operated in SAGD installations for 25 years, very little is known about the fundamental interactions and electrokinetic properties (particle charge) of the resulting CaCO3 and Mg(OH)2 particles in the softener. Knowledge of particle charge is of paramount importance for clarification and sedimentation performance as is highly relevant to the selection of appropriate coagulation and flocculation polymers.

This study was undertaken to understand the interactions and electrokinetic properties of the two most common particles in the SAGD WLS: calcium carbonate (CaCO3) and magnesium hydroxide (Mg(OH)2). Effects of various experimental parameters such as pH, temperature, precipitate aging, and the presence of silica, clay and dissolved organics in the inlet water on the electrokinetic properties of the CaCO3 and Mg(OH)2 particles were individually studied by investigating their zeta potential values. Mg(OH)2 particles were found to be positively charged under most conditions, whereas the charge on CaCO3 particles varied depending on inlet water chemistry variables such as carbonate, bicarbonate and divalent metal ion concentration. The presence of high concentrations of silica and humic acid (to represent dissolved organic acids) in the softener inlet water resulted in particles with a significantly more negative charge. In addition to the fundamental particle charge investigations, coagulation experiments with cationic organic polymers were also conducted. The required coagulant dose was found to increase as silica and humic acid concentrations increased. The results of this study will be highly relevant to WLS onsite chemical dosage evaluation and operational controls especially during a WLS effluent off-specification event.

Discusser: Kristen Jenkins, GDH, Duluth, GA

IWC 20-06: LESSONS LEARNED IN THE CONSTRUCTION OF AN 18.3 MGD SULPHATE REMOVAL PROCESS (SRP) SYSTEM FOR OIL FIELD PRODUCTION

Alan Daza and Shaleena Smith, Safbon Water Technology, Inc., Tampa, FL

TIME: 10:50 AM (EST)

In 2017, SafBon Water Technology was awarded one of the largest Sulphate Removal Process (SRP) projects to supply an 18.3 MGD (69,300 m3/d) Nanofiltration (NF) system located in Saudi Arabia.

One of the few land based Sulphate Removal Facilities (SRF) in the world, the construction of the system has taken over 2 years and now entering into its final phase. This presentation will describe the overall process, challenges, successes and lessons learned throughout the project.

Discusser: Drew Desembrana, P.Eng., Ecodyne Limited, Burlington, ON, Canada

M3: Reverse Osmosis & Membranes

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

Session Chair: Tamim Popalzal, Fluor, Sugar Land, TX

Discussion Leader: Kevin Clarke, DuPont Water Solutions, Toronto, ON, Canada.

TIME: 9:00 – 11:40 AM (EST)

Water scarcity is increasing throughout the globe widening the gap between water availability and demand. Therefore, innovation in water treatment is essential to meet our immediate and future water needs. Factors such as climate change, increase in industrialization, population growth, and limited

freshwater resources necessitate incorporating sustainable strategies, technologies, and development in order address the water scarcity challenge.

Since its inception, Reverse Osmosis (RO) has been a key technology that has been utilized as a reliable process to produce high water quality for various applications and industries. However, the RO process has a few limitations which include the energy required to generate freshwater by overcoming the osmotic pressure and the overall potential recovery of the system. Advances in RO membrane technology has provided significant benefits with respect to reduced energy, better ion rejection, and higher recovery. Yet a further question remained in terms of re-evaluating the hydraulic and osmotic conditions within the RO system to optimize recovery while reducing fouling and scaling. The papers in this session will address these concerns by presenting innovative solutions and methods to operate with higher recoveries, reduce fouling and scaling potential, while still producing acceptable water quality at an overall reduced water cost.

IWC 20-07: MEETING THE CHALLENGES OF HIGH PRESSURE DESALINATION APPLICATIONS WITH INNOVATIVE SPIRAL-WOUND ELEMENTS

Elke Peirtsegaele, MICRODYN-NADIR, Goleta, CA; Nik Mehta, MICRODYN-NADIR, Goleta, CA

TIME: 9:10 AM (EST)

While reverse osmosis (RO) and nanofiltration (NF) spiral-wound elements have played a crucial role in the world-wide attempt to alleviate increasing water shortages and meet stringent environmental regulations, additional applications continue to develop that require spiral-wound membrane elements capable of handling high operating pressures. A growing number of minimal liquid discharge (MLD) and zero liquid discharge (ZLD) systems, for example, use ultra-high-pressure RO elements to remove the bulk of dissolved solids from the feed water prior to downstream evaporators or crystallizers. This reduces the load on downstream thermal systems, resulting in decreased brine management costs and increased system efficiency. High-pressure and ultra-high-pressure RO and NF elements have proven an economical solution that allows systems like these to treat feeds with TDS levels greater than what industry-standard brackish water or seawater membranes can handle (>50,000 ppm TDS).

Discusser: Rich Franks, Hydranautics, Oceanside, CA

IWC 20-08: ENERGY EFFICIENT FORWARD OSMOSIS FOR FGD WASTEWATER VOLUME MINIMIZATION

Nandakishore Rajagopalan, University of Illinois, Champaign, IL ; Xuesong Zhang, Martina del Cerro, Sriraam Chandrasekaran, and Vinod Patel, Illinois Sustainable Technology Center, Champaign, IL

TIME: 10:00 AM (EST)

The use of forward osmosis (FO) to concentrate wastewater is a relatively recent technology. One of the primary challenges in forward osmosis is the regeneration of the draw solution in an energy efficient manner using low grade heat. In this presentation, we describe a process utilizing the principles of aqueous two phase separation to accomplish draw solution regeneration using low grade heat. In brief, a salt solution is used as a draw solution to concentrate the wastewater in a first step. In a second step, the diluted salt solution is mixed with an immiscible concentrated water-soluble polymer. The diluted salt solution is regenerated as water is transferred to the polymer solution. The polymer solution is regenerated by heating beyond a critical threshold temperature causing water release. Both the salt and polymer are internally recycled. The extracted water contains small quantities of residual polymer and is polished in a final step. Energy consumption is of the order of 200 kJ/kg thermal and 2.2 kWh/m3 electrical.

We present results of bench and laboratory studies on the applicability of the above process to concentrate FGD wastewater and resulting water quality. Process flow sheets, mass and energy balance and a techno-economic analysis will also be discussed.

Discusser: Michael Boyd, Desalitech, Newton, MA

IWC 12-09: CURTAIL THE SCALE: TREATMENT TECHNIQUES FOR SATURATED COOLING PONDS

Kristen Cooper, Duke Energy, Saint Petersburg, FL; Justin Higgs, Evoqua Water Technologies LLC, Pittsburgh, PA

TIME: 10:50 AM (EST)

A 1,200 acre cooling pond has experienced increased total dissolved solids from natural evaporation and waste streams influx. Several water treatment processes were considered. After evaluating effectiveness, capital and O&M cost, membrane filtration was determined to be the most efficient technology for this application. A pilot study was conducted to demonstrate process effectiveness and establishing full scale design criteria while comparing two secondary membrane technologies.

Discusser: John Elliott, SUEZ Water Technologies & Solutions, Oakville, ON, Canada

M4: Atypical Steam Generation (ASME #1)

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

Session Chair: Jerry Jones, Ecolab, Sugar Land, TX

Discussion Leader: Jess Stamp, Exxon Mobile, Spring, TX

TIME: 9:00 – 11:40 AM (EST)

The energy industry has many steam systems designs that differ from conventional boilers. Each system has its own requirements for control and operation. In this session, we will review and discuss some of these differences as it pertains to steam assisted gravity drainage (SAGD) once through steam generators (OTSG), proper control of the sodium to phosphate ratio (Na:PO4) in chemical plant transfer line exchangers (TLE) by accounting for the amine distribution in the boiler water, and reuse of contaminated process condensate in steam methane reforming units.

IWC 20-10: TOPICS IN ONCE-THROUGH STEAM GENERATION AND PRODUCED WATER TREATMENT

Martin Godfrey, ChampionX, Calgary, AB, Canada; Vita Martez, SAIT, Calgary, AB, Canada; Zack Labine, Erin Carlyle, and Graeme Finley, ChampionX, Fort McMurray, AB, Canada

TIME: 9:10 AM (EST)

Steam assisted gravity drainage produces oil using once-through steam generators (OTSGs) fed with produced water. Corrosion in OTSGs involves destabilization of the passive oxide layer on the boiler steel. Corrosion product measurements during the use of a metal passivating agent in an OTSG are presented. A second topic deals with the use of an antifouling agent on produced water coolers. Finally, initial data on simulating scale and deposit formation with laboratory test OTSGs is presented.

Discusser: Melonie Myszczyszyn, Cochrane, AB, Canada

IWC 20-11: STEAM METHANE REFORMING PROCESS CONDENSATE REUSE

George Patrick, Timothy Eggert, Alex Lazariciu, and Warren Harbs, SUEZ Water Technologies & Solutions, Trevose, PA

TIME: 10:00 AM (EST)

Steam Methane Reforming (SMR) is the predominant method of hydrogen production in the United States. The SMR produces hydrogen from hydrocarbon feedstock reacted with excess steam in the presence of a catalyst. Organic acids, carbon monoxide, carbon dioxide, ammonia, and other byproducts are collected in the condensation of the excess steam. Case studies will be presented to highlight reuse of this "Process Condensate" in the steam generator with the aid of computer modeling.

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

IWC 20-12: CALCULATING THE IMPACT OF AMINE CONTRIBUTION TO THE NA:PO4 MOLAR RATIO CALCULATION

David Puchan and Robert Bryant, Ecolab, Sugar Land, TX

TIME: 10:50 AM (EST)

High pressure ethylene plant TLE steam generators typically employ congruent pH/Phosphate (CPT) as their internal treatment program. The majority of TLE steam generators operate at > 1500 psig. In this area of the CPT control range, the contribution of the neutralizing amine's volatile hydroxide to the measured pH of the boiler water can be significant. Volatile hydroxide correction is needed to ensure the non-volatile Na:PO4 molar ratio is in the 2.3-2.6 range. This paper shows methods to calculate amine contribution correction.

Discusser: Robert Bartholomew, Sheppard T. Powell Associates LLC, Baltimore, MD

H2O Theatre presentation

BUILDING WATER RESILIENCE IN YOUR COMMUNITY

Karen Edwards-Lindsey, U.S. EPA, Washington, DC

TIME 10:00 AM (EST)

Drinking water and wastewater systems across the country are at risk to many kinds of water emergencies, causing disruptions in their service. The risks and threats range from floods, droughts, fires, cyber attacks or broken mains. The types of assets that need to be resilient to these hazards include: pipes, physical barriers, source water, water collection and intake, electronic, computer, or other automated systems and many more. To help with this planning, the United States Environmental Protection Agency (USEPA) developed tools and resources that can help build resilience within your water system.

Monday, November 9 Afternoon Sessions

IWC Keynote Session

IWC Rep: Jim Summerfield, DuPont, Saginaw, MI

TIME: 12:00 NOON EST

The IWC Keynote Session is the official start to the 2020 conference. In addition to the presentation of the annual awards, we are pleased to have Gabriel Collins, BA, J.D. as our 2020 Keynote Speaker.

Gabriel Collins is the Baker Botts Fellow in Energy & Environmental Regulatory Affairs at Rice University's Baker Institute. He was previously an associate attorney at Baker Hostetler, LLP, and is the co-founder of the China SignPost™ analysis portal. Collins has worked in the Department of Defense as a China analyst and as a private sector global commodity researcher, authoring more than 100 commodity analysis reports, both for private clients and for publication.

Collins' research portfolio is global. His work currently focuses on legal, environmental and economic issues relating to water — including the food-water-energy nexus — as well as unconventional oil and gas development, and the intersection between global commodity markets and a range of environmental, legal and national security issues. His analysis draws from a broad swath of geospatial and other data streams, and often incorporates insights from sources in Chinese, Russian and Spanish.

Collins received his B.A. from Princeton University and a J.D. from the University of Michigan Law School. He is licensed to practice law in Texas.

IWC Award of Merit

Each year, the International Water Conference presents the IWC Award of Merit to honor an outstanding individual in the field of industrial water technology. This year's Merit Award Winner is Daniel Sampson, P.E. "Dan" works for HDR, Inc., and is a frequent participant at the IWC, and a long time contributor to the conference, and water industry.

Paul Cohen Award

As a memorial, to Paul Cohen and his contributions to the power generation industry, the IWC is proud to recognize the authors of the most precise and innovative presentation in the field of power systems water technology that was presented at the 80th Annual IWC. This year, we honor Ken Kuruc of Hach for his presentation of IWC 19-03: On-Line Iron Studies using a Film Forming Product and a Film Forming Amine.

First Time Presenter and Overall Best Paper Award

These awards are to be presented annually to an IWC presenting author (or authors) who best exemplifies the goal of clearly communicating new information, or a new understanding about a significant aspect of water use or water chemistry, or best enhances the knowledge that enables effective utilization of water in industry or another use that benefits humanity. To that end, the IWC is pleased to announce the winners of these awards:

The First Time Presenter Award Winner is Christopher Stanfill, P.E., from Arcadis for the presentation of IWC 19-53: Treatment of Aerospace Machining and Inspection Wastewater.

The Best Overall Paper Award Winner is Robert Bartholomew, P.E. from Sheppard T. Powell Associates, for the presentation of IWC IWC 19-13: Mechanical and Operating Problems with Deaerators.

Monday, November 9 Afternoon Sessions

M5: Refining

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

Session Chair: Holly Churman, GHD, Houston, TX

Discussion Leader: Ramesh Kalluri, Kalluri Group, Houston, TX

TIME: 1:30 – 5:10 PM (EST)

Decades of experience have shown that the refining sector offers a wide array of wastewater treatment challenges to our engineering community. As refinery operations have expanded and diversified at many sites coupled with ever more stringent treatment standards, the call to achieve better treatment efficiency with improved solutions and better mechanisms to measure performance is greater than ever. Please join us to learn how our peers are answering this call by tackling important issues at refineries around the world.

IWC 20-13: MORE FOOD FOR THOUGHT – USING TRUE F:M TO PREDICT AND UNDERSTAND TREATMENT PERFORMANCE AT REFINERY AND INDUSTRIAL WWTP'S

Mark Knight, P.Eng., MASc, ISSP-SA, SUEZ Water Technologies & Solutions, Oakville, ON Canada

TIME: 1:40 PM (EST)

This paper will review two case studies of refinery wastewater treatment plants using a "True F:M" approach for proactive bio-monitoring and improved operational performance. Cellular ATP (cATP) is used as an alternative parameter for F:M calculations. ATP was chosen because it can be rapidly measured (<10 minutes) and provides a direct measurement of active biomass. This approach was applied to a Moving Bed Biofilm Reactor (MBBR) process and a Conventional Activated Sludge (CAS) process.

Discusser: Jonathan Sandhu, P.E., Gulf Coast Authority, Houston, TX

IWC 20-14: MOVING BED BIOFILM REACTOR (MBBR) & DISSOLVED AIR FLOTATION (DAF) FOR REFINERY TO MEET BOD AND AMMONIA LIMITS

Chandler Johnson, World Water Works, Oklahoma City, OK

TIME: 2:30 PM (EST)

The refinery wastewater treatment system was outdated and had future effluent ammonia regulations being imposed. A new biological treatment system with a small footprint was needed. The recommendation was a multi-stage MBBR treatment system followed by dissolved air floatation (DAF) for solids separation. MBBR and DAF technologies are ideal in this application, as they are capable of treating a wide range of loadings with a consistent effluent quality in a relatively small footprint.

Discusser: Paul Wood, P.E., Lockwood, Andrews & Newnam, Inc., Houston, TX

IWC 20-15: UPGRADE OF A REFINERY WASTEWATER TREATMENT PLANT TO MEET MORE STRINGENT LIMITS AND ENHANCE WATER RE-USE

Serena Cattaneo, Anna Garetto, and Carlo Zaffaroni, Golder Associates, Turin, Italy; Andrea Nebuloni, ENI S.P.A., Pavia, Italy

TIME: 3:30 PM (EST)

The Sannazzaro Refinery, located in the North of Italy, is provided with a treatment plant (WWTP) for oily wastewater including gravity oil/water separation, dissolved air flotation (DAF) and single-stage conventional activated sludge biological treatment. Part of treated effluent is sent to a "water re-use" plant to produce demineralized water. The WWTP is authorized with "Integrated Environmental Authorization" No. 74 of 7th March 2018; the renewed authorization imposes a new sampling point downstream existing secondary clarifiers.

Discusser: Barbara Mumford, WesTech, Salt Lake City, UT

IWC 20-16: BASHNEFT-UFANEFTEKHIM REFINERY IN UFA, REPUBLIC OF BASHKORTOSTAN, RUSSIA SOLUTION TO COMPLY WITH STRINGENT DISCHARGE REQUIREMENTS

Brian Arntsen and Jeffrey Cumin, SUEZ Water Technologies & Solutions, Oakville, ON Canada; Eduard Timashev, State Petroleum Technological University, Ufa, Bashkortostan, Russia; Petr Sudilovskiy, SUEZ Water Technologies & Solutions FRANCE, Praha 2, Czech Republic; Ilya Lerman, SUEZ IL WTS, Tel Aviv, Israel

TIME: 4:20 PM (EST)

Bashneft –Ufaneftekhim is one of the largest refineries in Russia, that is majority owned and operated by Rosneft Oil Company. It specializes in refining several types of hydrocarbons (West Siberian oil, a high-sulphur oil blend from the Arlanskoye field and gas condensate) producing various fuel grades and petrochemicals. The refinery has fuel, gas catalysis, goods production, service units and aromatic hydrocarbons production. Technological units operate at the refinery ensuring a high rate of crude oil refining depth (delayed coking, hydrocracking, catalytic cracking…

Discusser: Robert Thompson, Jacobs Engineering, Houston, TX

M6: Sustainability

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

Session Chair: Chris Hertle, GHD, Irvine, CA

Discussion Leader: Alan Daza, Safbon, Tampa, FL

TIME: 1:30 – 5:10 PM (EST)

There is a trend towards looking at recovering valuable resources from wastewater. Water has been recovered in municipal sector for decades but is starting to gain traction for Industrial Water management. These papers provide examples of resource recovery from a variety of industries – Meat processing, Power, automotive, electronics. The drivers are recovering water, energy (as heat or through biogas), nutrients and other components of the wastewater. Technologies such as biological (Anaerobic and aerobic), membranes are applied to achieve this.

IWC 20-17: SUSTAINABLE EFFLUENT TREATMENT COMBINING ANAEROBIC TREATMENT AND ANAMMOX

Willie Driessen, Paques Technology, BALK, Friesland, Netherlands; Martin Tielbaard, Paques Environmental Technology, Inc., Burlington, MA; Emil Sandstra, Paques Europe, BALK, Friesland, Netherlands; Arnt Vlaardingerbroek, Darling Ingredients International, SON, Netherlands

TIME: 1:40 PM (EST)

At the rendering plant of Darling Ingredients a unique combined anaerobic-anammox effluent treatment plant was built. The treated effluents are derived from a rendering plant, an animal byproduct facility and a facility producing renewable energy and fertilizers by digestion of organic byproducts and manure. Benefits of the new treatment plant include production of biogas, savings on aeration energy and significantly reduced biosolids production. Long term operational results including loading rates and removal efficiencies are presented.

Discusser: Norton Fogel, P.E., GHD, Farmington Hills, MI

IWC 20-18: CONSTRUCTION OF A NEW WASTEWATER RECLAMATION SYSTEM ADDRESSING INDUSTRY WATER RESOURCE ISSUES

Yaozhen Chen, Ikuno Nozumu, and Tada Keijiro, Kurita Water Industries, Tokyo, Japan

TIME: 2:30 PM (EST)

This paper presents a new standardized wastewater reclamation system composed only of the pretreatment and desalination equipment, which can overcome water resource shortage issues. The system can accommodate various water qualities by combinatorial optimizing technologies and providing a long-period stable operation even at a high recovery rate with much fewer units and chemicals. Also, a concrete example application in the electronics factory was introduced with multiple prospect values.

Discusser: Shaleena Smith, Safbon Water Technology

IWC 20-19: WATER MINING AND WASTEWATER REUSE SYSTEMS OVERCOME SCARCITY

Michael Butler, Dynatec Systems, Inc., Burlington, NJ; Tom Doherty, Dynatec Systems, Inc., Burlington, NJ; Bill Fisher, Dynatec Systems, Inc., Burlington, NJ

Time: 3:30 PM (EST)

A new automotive plant needed additional water for various plant applications beyond what was available from city water. A reuse system consisting of an out-of-basin MBR and RO which treats the combined sanitary and production wastewater, reduces the water demand of the plant. Still having a shortage of water available, the plant is taking effluent from the local POTW and further treating it before combining it with the other waste streams prior to the MBR.

Discusser: Ken Martins, Stantec

IWC 20-20: REDUCING THE CARBON AND WATER FOOTPRINTS FOR POWER GENERATION

Jasbir Gill, Water Energy Solutions Inc., Naperville, IL

TIME: 4:20 PM (EST)

Electric power generation using renewal resources such as wind, solar, and geothermal are known to reduce greenhouse gasses which are produced from burning fossil and which requires very little water. These renewal resources also reduces the amount of fresh-water draw. The paper discusses scenarios to further optimize the water use and reduce the greenhouse gases production by balancing operating conditions such as pH and cycles of concentration in the cooling tower.

Discusser: Bryan Hansen, Burns & McDonnell, Centennial, CO

IWC 20-M6-RESERVE: CASE STUDY OF K.B. SPECIALTY FOODS ANAEROBIC DIGESTION AND BIOGAS UTILIZATION PROJECT

Daniel Bertoldo, Evoqua Water Technologies Canada Ltd., Fredericton, NB Canada; Shannon Grant, Evoqua Water Technologies Canada Ltd., Fredericton, NB Canada

K.B. Specialty Foods, a subsidiary of Kroger, invested significant capital to upgrade their existing wastewater treatment system and create green energy from the plant wastewater as part of their zero-waste initiative. K.B. Specialty Foods partnered with ADI Systems, an Evoqua brand, to design, construct, and commission the wastewater treatment and biogas utilization systems. The upgraded wastewater treatment plant has met all upgrade project objectives, advanced sustainability initiatives, and provides significant long-term economic and environmental benefits.

M7: Potable Water

IWC Rep: Jim Summerfield, DuPont, Saginaw, MI

Session Chair: Donna DeFlavis Murphy, DuPont Water Solutions, Spring House, PA

Discussion Leader: Greg Madden, H2O Innovation, Champlin, MN

TIME: 1:30 – 5:10 PM (EST)

This session will look at the challenges in drinking water treatment systems from commissioning to maintaining compliant infrastructure and disinfectant systems. Our presenters will share the challenges they faced and the lessons they learned.

IWC 20-21: LESSONS LEARNED FROM THE START-UP AND COMMISSIONING OF A 0.94 MGD SEAWATER DESALINATION PLANT IN A PALESTINIAN TERRITORY

Shaleena Smith, SafBon Water Technology, Tampa, FL; Alan Daza, SafBon Water Technology, Tampa, FL

TIME: 1:40 PM (EST)

In a Palestinian territory, fresh water sources have deteriorated beyond suitability for human consumption so much that seawater desalination became the necessary solution to meet the potable water demand. In 2018, a modular pre-assembled RO system was installed with a capacity of 0.94 MGD. The 24-month project was not without challenges in procurement and logistics. Some of the lessons learned will be shared as well as potential considerations for installations in similar regions.

Discusser: Alan Sharpe, Lanxess Corporation, Birmingham, NJ

IWC 20-22: INDUSTRIAL FACILITY EPA LEAD & COPPER RULE COMPLIANCE – BENCH SCALE TESTING TO INCREASE CONFIDENCE IN CORROSION CONTROL TREATMENT STRATEGY

Cristina Piekarz, HDR, Walnut Creek, CA

TIME: 2:30 PM (EST)

All potable water systems are subject to the EPA LCR and are responsible for monitoring and maintaining drinking water quality. Meeting compliance will become more challenging as EPA LCR regulations change and infrastructure ages. This paper expands upon a case study presented at the International Water Conference in 2019. It examines a large industrial facility that received a lead action level exceedance from State and County public health regulators in 2016 and the work completed.

Discusser: Melissa Nichols, P.E., WesTech Engineering, Inc., Salt Lake City, UT

IWC 20-23: DISINFECTION BYPRODUCT REDUCTION VIA NOVEL MULTI-CONTAMINANT TREATMENT APPROACH USING OZONE, BAC, AND ION EXCHANGE

Greg Gilles, AdEdge Water Technologies, Duluth, GA

TIME: 3:30 PM (EST)

The Central Valley of California has many potable groundwater systems operating on subsurface wells that have primary and secondary regulatory drinking water issues. Given the very challenging water quality as recognized the Division of Drinking Water, the City of Lemoore, CA water supply (consisting of multiple well clusters) is exceeding the compliance targets for Disinfection By-Products, mainly Total Trihalomethanes or TTHMs. Contributing precursors to TTHM formation in the water include naturally occurring organic matter (NOM), ammonia, color, and other compounds, that when combined with chlorine disinfection in the distribution are consistently resulting in exceedances of the drinking water standard of 80 ug/l TTHMs. The City, under a compliance order from the State of California to bring their system into compliance, considered multiple options for treatment in accordance with their Corrective Action Plan (CAP). Among them included coagulation & filtration, breakpoint chlorination, GAC, and other methods. The water exhibits very challenging characteristics with high color over 30 color units, elevated Total Organic Carbon (TOC) over 2.5 mg/L, moderate levels of Ammonia at 0.5 mg/L, sulfides, iron, and elevated turbidity. A 10-month extensive small-scale field pilot study was undertaken to test a unique combination of ozone, GAC/BAC, and Ion Exchange on what was considered the worst water quality on one of the City's well clusters of to achieve the primary and secondary water quality objectives with the primary goal of TTHM compliance. With this treatment train via physical/chemical and biological means, TTHMs were reduced by over 75%, Ammonia reduced by 95%, color reduction of 90-95% and final chlorine demand of the treated water was reduced by over 80%. With all primary and secondary water quality objectives being achieved, the technology was selected and awarded via a progressive design-build contract for full-scale implementation by the City at two well clusters that serve the entire City's 26,000 population. The two treatment systems will provide over 14 MGD of new treatment capacity. This represents one of the largest groundwater treatment plants in the United States to be constructed in 2020. The results of this work will be presented including piloting, methodology, treatment techniques, design parameters, lessons learned, and operating costs. The two full-scale plants are currently under construction with completion anticipated by the end of 2020.

Discusser: Lance Littrell, P.E., Kimley Horn, Orlando, FL

IWC 20-24: IMPROVING PUBLIC SAFETY & DISINFECTION PERFORMANCE IN AN URBAN DRINKING WATER

Matthew Loehrlein, Darrin Lowe, and Michael Soller, Bowen Engineering, Indianapolis, IN; Tyler Cross, Tennessee American Water, Chattanooga, TN

TIME: 4:20 PM (EST)

This paper describes how an urban water company converted their chlorine disinfection process from a gas to liquid form application at their 65MGD plant to improve performance and enhance both operational and community safety. Further, the company wanted a reliable and timely delivery of the projects to minimize expense and disruption. This paper describes the cost saving process to deliver the improvements on time despite significant design changes that lowered the life-cycle cost.

Discusser: Marlon Garcia, Marlon Garcia, Brookhaven, MS

M8: Corrosion Inhibition (ASME #2)

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

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

Discussion Leader: Kirk Buecher, Mettler Toledo, Billerica, MA

Time: 1:30 – 4:20 PM (EST)

The past few years, film-forming substances (FFS) have received considerable attention in conferences and various industrial user groups for the power industry. However, the initial use of these chemicals was in industrial steam cycles, with boilers using softened water makeup and sites with extensive steam distribution and condensate collection systems. This session will review what these chemicals are, how they prevent corrosion, and some typical uses in industrial steam cycles.

IWC 20-25: Film Forming Substances in Industrial Steam Cycles

Dale Stuart, Chemtreat, Glen Allen, VA

Time: 1:40 PM (EST)

Filming amines have been used for over 50 years to reduce corrosion and the subsequent iron deposition on boiler tubes. The early filming amines were primary fatty amines such as octadecylamine and oleylamine. The use of the primary fatty amines led to operational complications due to formation of gelatinous material called gunk balls, which led to limited use of these amines. The next generation of filming amine adds propylamine to oleylamine forming a diamine named oleylpropylenediamine (OLDA), which has an improved distribution ratio and forms a more stable film. The proper application of OLDA leads to a resilient hydrophobic coating throughout boiler and condensate systems that reduces iron and copper corrosion rates.

OLDA is a sparingly soluble compound that is frequently formulated with neutralizing amines to make a stable blended amine based filming product (AFPB.) Application of the AFPB at power plants led to elevated cation conductivity, which exceeded turbine manufacturer warranties and made it more difficult to detect condenser leaks. Because of this, use of AFPB in power plants was substantially reduced; however, the need for corrosion control led to the introduction of non-amine based filming products (NFP.) NFP contain a substance that is a surfactant that is comprised of hydrocarbons with either one or two amide groups in the middle of the molecule and may or may not have an organic acid group within the molecule. These molecules do not form the same strong bond that FFA molecules do but form a film when the active ingredient concentrates to during application to the necessary concentration and this film effectively controls corrosion.

This paper introduces the structural differences of the molecules, the film behavioral differences, and field observations using electrochemistry, microscopy, literature references, and photographs of customer accounts using FFAP. The electrochemistry and field observations indicate that the resilient film created by OLDA gives advantages over the use of non-amine filming products for use outside of the power industry. Newer formulations and the measurement of residual have allowed the application of OLDA in the power industry to limit cation conductivity contribution. However, non-amine filming products are effective with maintained residual and should be considered for customers considering the maintenance of cation conductivity at less than 0.2μmhos.

Discusser: Vickie Olson, Honeywell, Duluth, GA

IWC 20-26: FFS AS A HEAT TRANSFER EFFICIENCY IMPROVER FOR STEAM FACILITIES

Shintaro Mori, Ujiie Shogo, Masakazu Koizumi, Kazuyoshi Uchida, and Qian Lin, KURITA WATER INDUSTRIES LTD., Nakano-ku, Tokyo Japan

TIME: 2:30 PM (EST)

Hydrophobicity using film-forming substance (FFS) has been focused on decreasing the thickness of the condensed water film on heat exchangers. The liquid film layer of condensed water on metal can be reduced by FFS, so that heat transfer resistance is decreased accordingly. In this paper, successful applications of FFS for the reduction of steam consumption in pulp and paper mill factories are also presented.

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

IWC 20-28: AMINE-BASED FILMING PRODUCT BLENDED (AFPB) APPLICATION FOR BOILER WATER TREATMENT IN FERTILIZER INDUSTRY

Levie Lensun, Helamin France, Saint Genis Pouilly, Rhone Alps, France

TIME: 3:30 PM (EST)

In petrochemical process producing ammonia, the plant operates with waste heat recovery boilers generating steam pressure and temperature at around 1595 psi and around 968°F respectively. Hot process gas from the secondary reformer first enters the tube side close to 1832°F and cooled by steam generation to about 662°F. In second waste heat boiler with shell and tube type design, CO-shift converter exit gas is cooled from about 770°F to about 644°F, where it shared common steam drum with the first boiler.

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

Tuesday, November 10
Morning Sessions

T1: Industrial Wastewater Treatment

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

Session Chair: Chloe Grabowski, HDR, Missoula, MT

Discussion Leader: Neal Gallagher, Golder Associates, Lakewood, CO

TIME: 9:00 AM – 12:40 PM (EST)

For industrial wastewater, treatment challenges continue to be wide-ranging and multifaceted. To comply with environmental regulations and adapt to the rising challenge of water scarcity there is a growing need for robust and innovative solutions. In this session, we will discuss the many challenges of treating high strength wastewaters. We will examine the various approaches to these challenges and the numerous lessons learned from system design through operation. This session will also explore treatment of organic selenium, an area of increased attention as some regulators consider fish-tissue based limits.

IWC 20-29: CONSIDERATIONS FOR THE TREATMENT OF HIGH STRENGTH WASTEWATER

Joseph Stanfill, Arcadis, Atlanta, GA

TIME: 9:10 AM (EST)

Treatment of high strength wastewater comes with unique design considerations, starting with how to define high strength with respect to both organic and inorganic loads. High strength organic wastewaters can affect the biology of the system, including the need for nutrient (micro and macro), temperature generation, monitoring, etc. Inorganic high strength wastewaters can affect toxicity or inhibition of biological systems and scaling of systems. Two case studies will be examined to show how these design considerations are implemented in actual designs.

Discusser: Sailesh Singh, Golder Associates, Calgary, AB, Canada

IWC 20-30: LESSONS LEARNED FROM TREATING A HIGH STRENGTH INDUSTRIAL WASTEWATER

Greg Harmer, Wood, Cambridge, ON Canada; Ed Greenwood, Wood, Cambridge, ON, Canada

TIME: 10:00 AM (EST)

A food industry ingredient manufacturer needed to upgrade the wastewater treatment plant at one of their sites to meet increasingly stringent discharge requirements for nutrient removal to a large complex river system with eutrophication issues. Unfortunately, the wastewater was typically very difficult to treat as it was both highly variable, and concentrated with ammonia levels often greater than 1,500 mg/L. A robust treatment solution was required as the new wastewater treatment plant needed to fully nitrify and denitrify the influent wastewater to produce an effluent suitable for direct discharge into the river.

Discusser: Jaron Stanley, WesTech, Salt Lake City, UT

IWC 20-31: HIGH RECOVERY WATER SYSTEM INTEGRATED WITH ZLD FOR A BREWERY PLANT IN INDIA

Harkirat Kaur and Thentral N, SUEZ Water Technologies & Solutions, Bengaluru, India; Josh Dewanaga and Craig Van Dyke, SUEZ Water Technologies & Solutions, Bellevue, WA

TIME: 11:00 AM (EST)

Water scarcity is a growing challenge for industry, especially when it's a key ingredient of the production process and an important resource for plant operations. International companies operating in water stressed countries like India are needing to adopt advance solutions to reduce fresh water consumption and eliminate discharge of plant wastewater to protect nearby aquifers. For an international beverage company, producing 2-million-hectare liters of beer per year from their brewery plant in India, their goal was to reduce fresh water consumption from 5 liters down to about 3 liters for every liter of beer produced. To achieve this water savings target, a high recovery water treatment system utilizing electrodialysis reversal (EDR) was used to recover 90% purified water from the existing plant's RO system, and combined with thermal crystallizer, the brewer plant now achieves zero liquid discharge (ZLD). This paper will discuss specific challenges with treating brewery wastewater, and how the addition of EDR and Crystallizer was able to improve plant water efficiency using collected operating and plant performance data.

Discusser: Holly Churman, P.E., GHD, Houston, TX

IWC 20-32: TREATMENT PROCESSES FOR ORGANIC SELENIUM REMOVAL

David Pernitsky, Stantec, Calgary, AB, Canada; Stanley Okonji, John Albino Dominic, and Gopal Achari, University of Calgary, Calgary, AB, Canada

TIME: 11:50 AM (EST)

Selenium can be a concern in wastewaters from mining, coal-fired power generation, oil and gas production, and refining. Treatment is complex and meeting low discharge limits can be challenging. Biological reduction processes have been shown to be effective for selenium removal from a variety of industrial effluents. However, researchers have found that in natural systems, microbiological metabolism of inorganic selenium can result in the formation of organic-selenium compounds, such as Selenomethionine ($C_5H_{11}NO_2Se$) and Selenocysteine ($C_3H_7NO_2Se$). These organic selenium compounds may be more bioavailable, toxic and are much more likely to bioaccumulate in the fish living in the receiving streams, as the organic portion of the molecule makes the compounds more lipid-soluble and quicker to diffuse through tissue and cell membranes. Canadian and US regulations are moving towards fish-tissue based selenium limits rather than the traditional end of pipe, concentration-based regulations. If highly lipid-soluble, organic selenium compounds are being formed in current biological treatment processes used for treating industrial effluents, fish-tissue based regulations may be harder to meet. It is therefore important for the industry to be prepared to remove organic selenium compounds after biological treatment processes, if these compounds are found to be present in the effluents of these treatment plants.

This paper presents results from a bench-scale research project that looked at the effectiveness of four treatment processes for the adsorption of organic selenium species. These treatment processes include conventional ferric chloride ($FeCl_3$) chemical precipitation/adsorption, adsorption on preformed magnetite (Fe_3O_4), adsorption on nano-scale zero-valent iron (nZVI), and granular activated carbon (GAC) adsorption.

Discusser: Jeremy Aulbach, Brown and Caldwell, Meridian, WI

IWC 20-T1-RESERVE: ARSENIC REMOVAL AND THE COMPARISON OF DIFFERENT UNIT PROCESSES DEFINED BY THE REQUIRED TREATMENT OBJECTIVES

Rachel Jentzsch, Harley Schreiber, and Jake Blattman, P.E., WesTech Engineering, Inc., Salt Lake City, UT

Arsenic contamination of process and tailings water from coal fired power plants and mineral processing operations is a common concern. Development of effective treatment efforts requires establishing methods specific to each particular application. Although arsenic removal methods are well established, difference in influent arsenic concentration and effluent requirement can dramatically affect the ultimate process design. This paper compares two operating treatment installations having different arsenic influent concentrations and effluent requirements. One installation had higher influent arsenic and had a much more stringent effluent requirement. Arsenic removal to very low concentrations requires a much higher ratio of coagulant to arsenic level. This coupled with the increased influent concentration required orders of magnitude higher coagulant dosage than the other installation. The increased dosage required additional process unit operations to mitigate the addition of other undesirable dissolved constituents associated with the coagulant. In addition, where direct filtration could be used to process the low suspended solids concentration in the low arsenic installation, the increased coagulant demand of the other necessitated an additional clarification step prior to filtration. Process differences, in addition to the use of a molar ratio calculator to determine the most efficient ferric dosages and points of injection are addressed in this paper.

T2: Brine Management

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

Session Chair: Wayne Bates, Hydranautics, Rockton, IL

Discussion Leader: Mike Preston, Black & Veatch, Overland Park, KS

TIME: 9:00 AM – 12:40 PM (EST)

ZLD and MLD (Minimum Liquid Discharge) systems are becoming more popular as the industry is being asked to maximize water recovery and minimize the volume of liquid concentrate (brine) that requires disposal. This session reviews current and new concentrate disposal methods with an emphasis on full scale case studies for the following plants: seawater, microelectronics, municipal and a cooling tower blowdown application. We consider these processes to be MLD since recoveries can be limited to 90- 97% of the feed and not 100% as expected for a ZLD process with downstream thermal processes.

IWC 20-33: MAKING IT WORK – BRINE RECOVERY SYSTEM CASE STUDY AND IMPROVEMENT OPTIONS

Daniel Sampson, HDR, Walnut Creek, CA

TIME: 9:10 AM (EST)

The paper summarizes the findings of a holistic assessment of the two brine recovery systems at a large power production facility. It examines operating data and documentation, original design, and historical performance. The provided recommendations include operational and mechanical design changes that are broadly applicable to other brine recovery systems. The study provides a template that similar facilities can use to examine and, potentially, improve the capacity and reliability their own brine recovery systems.

Discusser: Krystal Perez, P.E., Worley, Kirkland, WA

IWC 20-34: A SWOT ANALYSIS TO INCREASE THE WATER RESILIENCY OF LIVORNO OIL REFINERY

Andrea Capriati and Carlo Zaffaroni, Golder Associates S.r.l., Torino, Italy; Andrea Giacomelli and Silvia Giusti, Eni R&M S.p.A., Stagno, Tuscany, Italy

TIME: 10:00 AM (EST)

Livorno Eni R&M Oil Refinery ("LEOR") is equipped with an Industrial Wastewater Treatment Plant ("WWTP") and in the close future it should be operated in a new context because of the more restrictive limits for some parameters (Total Suspended Solids ("TSS"), Nitrogen and metals) defined by the new discharge permit, recently issued. The WWTP is composed by different sections realized in different periods and with different levels of automation/redundancy/reliability.

For the purpose described above, a Strengths, Weaknesses, Opportunities and Threats ("SWOT") Analysis has been carried out on the current configuration of WWTP in order to evaluate, so far and in the light of the new discharge limits, its strengths, weaknesses, improvement opportunities and potential threats.

Moreover, at a feasibility and basic design level, solutions to improve the wastewater treatment system installed on Site have been provided to obtain a more adequate and reliable system for the future context and to increase as well the water resiliency of the site, by partial substitution of river water as source with tertiary treated effluent (available after the revamping of the WWTP).

SWOT Analysis has confirmed the accuracy of some actions undertaken by LEOR, but it has also underlined some troubles due to the sequence of treatment applied to industrial wastewater so far.

This paper identifies a strategy to value the actions undertaken by LEOR and suggests enhancements, in order to comply with the final goal to increase the reliability of whole Integrated Water Cycle of the Site, to improve the integration between the WWTP and the Water Treatment Plant ("WTP") and to increase the water reuse and the overall water resiliency of LEOR.

SWOT Analysis as well as water resiliency evaluation have been based on data supplied by LEOR during the kick-off meeting and the next follow-up meetings that took place on Site. For each stream/ unit/equipment analysed, data collected essentially are: flowrates, water quality analysis, data sheet and duty specification.

Discusser: Steven Russell, P.E., Kiewit, Lenexa, KS

IWC 20-35: FULL SCALE BRINE MINIMIZATION AND RESOURCE RECOVERY – LESSONS LEARNED AT THE CHINO CONCENTRATE REDUCTION FACILITY

Brandon Yallaly, Carollo Engineers, Inc., Boise, ID; Ben Armel, Jurupa Community Services District, Jurupa Valley, CA ; Vincent Hart, Carollo Engineers, Inc., Broomfield, CO

TIME: 11:00 AM (EST)

Commissioned in 2017, the Chino Concentrate Reduction Facility (CRF) has been treating brine from the Chino II Desalter for over 2 years. The process uses a combination of conventional treatment technologies (pelletized softening, solids contact softening, media filtration, and reverse osmosis) to remove hardness and silica to allow for additional water recovery and a reduction in brine disposal. The facility employs a first of its kind combination of treatment systems, and as such, valuable operation and design lessons have been learned during the first two years of service. These lessons learned have led to recent design modifications to further optimize the process and relieve operational stress points. This paper will discuss the operational history of the CRF and the recently implemented design improvements.

Discusser: Mitch Mueller, Black & Veatch, Overland Park, KS

IWC 20-36: COUNTERFLOW REVERSE OSMOSIS – FULL SCALE IMPLEMENTATION

Richard Stover, Gradiant Osmotics, Woburn, MA ; Simon Choong, Gradiant International Holdings, Singapore; Prakash Govindan, Gradiant International Holdings, Singapore

TIME: 11:50 AM (EST)

Gradiant's CounterFlow Reverse Osmosis (CFRO) process is a non-evaporative, membrane-based method for desalinating brines. This paper presents performance data from a full-size CFRO plant in Saudi Arabia. Fed with 65,000 mg/l TDS SWRO brine, the unit operates at 40-50% recovery, producing permeate with less than 300 mg/l TDS, with normalized energy consumption of 7 kWh/m3 permeate. The unit has run continuously since November 2019 with no flux loss due to organic fouling or calcium scaling.

Discusser: Craig Mills, WesTech Engineering, Salt Lake City, UT

T3: Business of Water

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

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

Discussion Leader: Mark Owens, HDR, Richmond, VA

TIME: 9:00 AM – 12:40 PM (EST)

Within this session, the presenters will cover topics that evaluate the business end of designing, constructing, and operating water plants, as well as, the operations of the plant, the impacts against the bottom line, and how the appropriate delivery method matters to the overall success of the project. In addition, the emergencies and natural disasters that threaten our water systems will be discussed and the methods that are put in place to manage the impacts.

IWC 20-37: KEYS TO A SUCCESSFUL EPC WATER TREATMENT PROJECT

Ereka Hunt, Brian Clarke, P.E., Behrang Pakzadeh, Ph.D., P.E., Caroline Wilson, and Logan Green, Kiewit, Lenexa, KS

TIME: 9:10 AM (EST)

While there are a variety of project delivery methods for water and wastewater treatment projects, the Engineering Procure Construct (EPC) model offers a fast paced, collaborative approach to complex projects that is attractive to clients. The EPC project model has seen wide spread acceptance in the industrial water treatment sector but has traditionally been not allowed for publicly funded projects. In recent years, the municipal water industry has evolved to be more accepting of collaborative delivery models like Construction Manager at Risk (CMAR), design build, and EPC, making it more important than ever to understand how to successfully execute an EPC project on schedule and under budget. EPC projects rely on early integration of engineering and construction, strong relationships with clients and vendors, and the ability to manage risk, budget, and schedule all while maintaining a focus on safety, quality, and compliance.

Discusser: Lindy Johnson, Stantec Consulting Services Inc., Chattanooga, TN

IWC 20-38: THREE STREAMS, ONE PROJECT. MULTIPLE SOURCE COMPLEX WATER TREATMENT USING EPC AND TECHNOLOGY SOLUTIONS

Sam Hill IV, Bowen Engineering Corp., Evansville, IN; Colton Motz, Bowen Engineering Corp., Evansville, IN; Michael Soller, Bowen Engineering Corp., Indianapolis, IN; Mark Owens, HDR, Richmond, VA

TIME: 10:00 AM (EST)

This case study describes the design development and lessons learned from an EPC Flue Gas Desulfurization project. The project treated multiple waste streams from the plant and landfill leachate using a novel high rate filter that did not require the addition of hydrochloric acid. Project impacts due to late owner directed changes are discussed along with the successful mitigation measures utilizing non-traditional construction delivery practices to meet the customer's needs and achieve on-time commissioning.

Discusser: James Beninati, HDR, Pittsburgh, PA

IWC 20-39: OPTIMIZING THE EQUIPMENT SELECTION PROCESS FOR POWER AND INDUSTRIAL PROJECTS

Aryka Thomson and Josh Prusakiewicz, HDR, Ann Arbor, MI

TIME: 11:00 AM (EST)

Water treatment is an essential component of most industrial facilities. Despite common misconceptions that "water is water", both supply water quality and anticipated wastewater quality are critical factors in maximizing performance while minimizing water treatment costs. This paper will present a method to evaluate water treatment options based on qualitative and quantitative criteria. A case study will be presented to showcase how the approach can be used to optimize equipment selection based on project goals.

Discusser: Rudy Labban, SUEZ Water Technologies & Solutions, Glen Allen, VA

IWC 20-40: NEW SOLUTIONS TO OLD PROBLEMS: TECHNICAL INNOVATION IN MATURE MARKETS

Daniel Cicero, Nalco Water, an Ecolab Company, Naperville, IL

TIME: 11:50 AM (EST)

Market leaders need innovation to grow. This paper discusses the decisions inherent in the development of a successful commercial offering in the industrial water treatment market. Topics include development of the value proposition, field evaluation, the commercialization and rollout process and post-launch support. A number of real-world examples — from relatively simple, chemical-only solutions to highly complex offerings —will be used to highlight some of the challenges and illustrate how they can be overcome.

Discusser: Adriano Vieira, Ph.D., P.E., SUEZ Water Technologies & Solutions, Ashland, VA

IWC 20-T3 RESERVE: KEYS TO A SUCCESSFUL EPC WATER TREATMENT PROJECT

Ereka Hunt, Brian Clarke, P.E., Behrang Pakzadeh, Ph.D., P.E., Caroline Wilson, and Logan Green, Kiewit, Lenexa, KS

While there are a variety of project delivery methods for water and wastewater treatment projects, the Engineering-Procure-Construct (EPC) model offers a fast-paced, collaborative approach to complex projects that is attractive to clients. The EPC project model has seen wide-spread acceptance in the industrial water treatment sector but has traditionally been not allowed for publicly funded projects. In

recent years, the municipal water industry has evolved to be more accepting of collaborative delivery models like Construction Manager at-Risk (CMAR), design-build, and EPC, making it more important than ever to understand how to successfully execute an EPC project on-schedule and under-budget. EPC projects rely on early integration of engineering and construction, strong relationships with clients and vendors, and the ability to manage risk, budget, and schedule all while maintaining a focus on safety, quality, and compliance.

This paper provides tips for water treatment vendors entering the EPC space or working with an EPC contractor for the first time, lessons learned from EPC work, and case studies from several projects to demonstrate the advantages of the EPC model and how critical processes and tools are successfully implemented throughout the life-cycle of the project.

T4: Cooling Water

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

Session Chair: Joshua Pendergrass, Stantec, Nashville, TN

Discussion Leader: Juvencio Casanova, Evoqua, Houston, TX

TIME: 9:00 AM – 12:40 PM (EST)

Poor cooling water quality can result in equipment fouling, reduced heat exchange rates, and damage to critical process equipment that can lead to unplanned downtime. This session will explore several operational and process control approaches to prevent cooling water degradation and treat systems effected by fouling.

IWC 20-41: SUCCESSFUL MONITORING, APPLICATION AND OPTIMIZATION OF OXIDIZING BIOCIDES IN COOLING WATER

Timothy Duncan, Solenis, Ballwin, MO

TIME: 9:10 AM (EST)

Novel devices to monitor KOIs and KPIs have enabled further study comparing different oxidizing biocides used in cooling water systems. The devices allow optimization of system fouling factor and corrosion. Benefits of optimized mild oxidizing programs include plant reliability and efficiency directly correlating to reduced total operating costs and total cost of ownership. Reductions in microbiologically influenced corrosion and improved heat transfer have been documented along with chemical treatment cost savings and water use reductions.

Discusser: Loraine Huchler, CMC, P.E., MarTech Sytstems, Inc., Trenton, NJ

IWC 20-42: PREVENTING IMPROPER BOILER STARTUPS BY USING ONSITE TOTAL ORGANIC CARBON (TOC) ANALYSIS

Amanda Scott, Mphil, SUEZ Water Technologies & Solutions, Boulder, CO ; Michael McDaniel, SUEZ Water Technologies & Solutions, Trevose, PA ; Oscar Echols, Tennessee Valley Authority-Allen Combine Cycle, Memphis, TN

TIME: 10:00 AM (EST)

A glycol leak is detrimental to plant integrity and process equipment. Glycol degrades to corrosive organic acids at elevated temperatures and pressures. Plant aging is difficult to quantify, but plant shutdown costs several million dollars in lost revenue. Conductivity and pH are insufficient to detect glycol leaks. The TVA Allen Plant learned from two nearby plant shutdowns and implemented TOC analysis for operational monitoring to protect equipment and maintain plant uptime, detecting even trace glycol.

Discusser: John Pasterczyk, Atlantium Technologies, Wilmington, DE

IWC 20-43: LESSONS LEARNED ON THE USE OF PTSA IN A COOLING TOWER SYSTEM AND THE DEVELOPMENT OF A CONTROL ALGORITHM

Gary Engelgau, Athlon, A Halliburton Service, Houston, TX

TIME: 11:00 AM (EST)

The PTSA fluorescent tracer has long been used in open recirculating cooling systems to monitor a chemical treatment application. Benefits include ease in monitoring, compatibility for nearly all water treatment chemical formulations, and improved statistical control of the treatment program. Field study work is presented to explain the possible causes for lower than expected readings and the consideration of an algorithm to properly control chemical treatment when the tracer can be affected by the environment.

IWC 20-44: ENHANCING BIOFILM REMOVAL IN INDUSTRIAL COOLING WATER TREATMENT APPLICATIONS BY ADDING AN ORGANIC DISPERSANT

Corinne E. Consalo, Solenis LLC, Wilmington, DE

TIME: 11:50 AM (EST)

A key performance indicator in industrial cooling applications is the efficient functioning of heat exchangers. Microbial biofilms, which have thermal conductivities three to four times lower than mineral scales, are highly effective insulators that must be mitigated. Other consequences of microbial growth in a fixed location versus suspended growth include gradients in oxygen, nutrients, excretions and pH changes, which can lead to microbiologically-influenced corrosion (MIC). Microorganisms in biofilms see variations in growth rates, food sources and environmental conditions, which can drastically reduce their susceptibility to antimicrobial agents. Oxidizing and non-oxidizing biocides can impact biofilm growth to an extent but combining their use with an organic dispersant provides a robust, cost-effective system that can provide superior control. This paper summarizes experimental results that demonstrate that the addition of an organic dispersant to a microbial control program can impact biofilms more quickly and effectively than an oxidizing biocide alone or in combination with a non-oxidizing biocide. Organic dispersant/oxidizer combinations were able to rapidly reduce biofilm surface coverage and thickness. Details concerning organic dispersant best practices, including dosing sequence and frequency, and indicators of a successful treatment are also discussed.

Discusser: Chris Baron, ChemTreat, Newark, DE

IWC 20-T4-RESERVE: HOLISTIC APPROACH TO MONITORING MICROBIAL LOAD AND FOULING IN A COOLING WATER SYSTEM ACHIEVES BIO-HEALTH CONTROL TO OPTIMIZE PERFORMANCE

Nicholas Denny, Nalco Water, Naperville, IL

Understanding the magnitude and effect of microbial load and biofouling on a cooling water system has for the most part always been done with lagging or indirect indicators. Measuring planktonic bacteria can lag up to two days. Directly monitoring biofouling or simulating it in the heat exchanger can be cumbersome, unreliable and take up to 90 days to see results from a coupon swab. These lagging indicators on the performance of critical asset can put entire production systems at risk.

Over the past few years, new technologies were developed to help monitor the microbial health of a cooling water system and reduce this delay in treatment. These technologies include a hand-held digitally capable test that instantly determines total aerobic bacteria in the cooling water, minimizes all operator error and allows for real time adjustments. This aerobic bacterial measurement combined with a real-time sensor for oxidant residual join to achieve best in

practice bio-health control around a critical asset with a wide variety of biocides from ClO2 to bromine to monochloramine. This paper describes these advances in a biocide program aimed at ensuring the health of cooling water systems and minimizing any impact on production or process performance.

Tuesday, November 10
Afternoon Sessions

T5: FGD

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

Session Chair: Derek Henderson, Duke Energy, Raleigh, NC

Discussion Leader: Riley Flowers, Southern Corporation, Birmingham, AL

TIME: 1:30 – 5:10 PM (EST)

In this session, we will dive into intriguing methods and approaches to treating and managing FGD wastewater generated in the electric power industry. From innovative technologies applied to treat, as well as alternative approaches to managing FGD wastewater will be explored. So if you are looking for solutions or an engaging discussion on FGD wastewater treatment, then this is the session for you!

IWC 20-45: MERCURY REMOVAL IN FLUE GAS DESULFURIZATION (FGD) WASTEWATER

Jessica Hudson, SUEZ Water Technologies & Solutions, Johns Island, SC

TIME: 1:40 PM (EST)

This paper discusses two systems designed around the principles of metal hydroxide and organosulfide precipitation with coagulation and co-precipitation for treatment of flue gas desulfurization wastewater. The two systems were started up and operated under similar conditions. System one (1) having an average influent mercury level of 10.4 μg/L yielding an effluent of 71.1 ng/L. System two (2) having an average influent mercury level of 16.1 μg/L yielding an effluent mercury level of 62.6 ng/L.

Discusser: Ron Ruocco, P.E., Stantec, Charlotte, NC

IWC 20-46: HOLISTIC APPROACH TO ZERO LIQUID DISCHARGE FOR FGD AND INDUSTRIAL WASTEWATER

Keith Benton, P.E., and Claire Schmit, P.E., AECOM, Austin, TX

TIME: 2:30 PM (EST)

Faced with ever more stringent regulations, industrial facilities and coal-fired power plants are challenged to comply with requirements for wastewater discharge. Due to concerns regarding the reliability of treatment systems, and changing future regulations, zero liquid discharge solutions are gaining popularity. Case studies will be presented describing a holistic approach to reduce the quantity of wastewater through reuse, reconfiguration and retrofit of the upstream system resulting in a lower overall cost of compliance.

Discusser: Mahyar Ghorbanian, Ph.D., P.E., LG&E and KU Energy, Louisville, KY

IWC 20-47: A TALE OF TWO ELGS

Krystal Perez, P.E., Worley, Kirkland, WA ; Laura Reid, Worley, Charlotte, NC; Dennis Fink, Worley, Oakland, CA; Christina Joiner, Worley, Atlanta, GA; Thomas Higgins, Worley, St. Augustine, FL

TIME: 3:30 PM (EST)

In November 2019, the Environmental Protection Agency (EPA) issued proposed revisions to the final 2015 Steam Electric Power Generating Effluent Guidelines (ELGs), with regulatory changes for flue gas desulfurization (FGD) wastewater and for bottom ash (BA) transport water. While awaiting finalization of the revised ELG rule, many coal-fired power plants are left in an indeterminate state and are facing challenges on how to start on a path to compliance for two potential ELG rules.

Our paper will highlight some of the specific technical challenges that sites may be facing and suggestions to begin working towards potentially revised compliance requirements, such as:

Lowered FGD wastewater mercury effluent limit: We'll identify relatively simple design and equipment choices that are key to meeting even lower mercury limits and compliant effluent. We will share specific case study examples of how these methods have led to reducing the mercury effluent concentration by two orders-of-magnitude in a matter of a few weeks.

Technology considerations for complying with the revised FGD wastewater voluntary option: We will provide an evaluation framework that would benefit sites considering the voluntary option. This will include considerations for selecting membrane versus thermal technologies (or both), and key design factors such as concentration factor, brine solidification and disposal options.

Bioreactor residence time: The revised ELG considers both low- and high-residence time bioreactors with the provision for ultrafiltration polishing. We will discuss how to design for successful bioreactor operations by paying particular attention to changing influent conditions, aggressively sized residence times, process control, and coordination of nitrate and selenium removal.

Plans for managing bottom ash purge allowance: The 2015 ELG required that sites maintain a closed-loop in the BA system, whereas the revised rule would allow for a ten-percent volumetric purge. We'll share key aspects of our experience helping plants select a bottom ash compliance strategy and specific items to watch out for such as water imbalances from intermittently large flows, water acidification and fines build up.

Permitting strategy: The ELG leaves some things open to the judgement of permit writers. This presents risks and opportunities. We will discuss how having a strong permitting strategy and supporting justifications will be key to feasible compliance schedules and operational flexibility.

Discusser: Trent Rogers, EPRI, Charlotte, NC

IWC 20-48: DEMONSTRATION OF A NOVEL PROCESS FOR REDUCING DISSOLVED SELENIUM AND MERCURY IN FGD LIQUOR AND WWT DISCHARGE WATER

Douglas Ritzenthaler, American Electric Power, Columbus, OH; Steven Feeney, Steve Feeney Consulting, LLC, Lancaster, OH

TIME: 4:20 PM (EST)

The proposed Effluent Limitation Guidelines (ELG) monthly average discharge limit for selenium is currently 31 micrograms/liter. For those coal-fired plants with WFGD systems, this proposed limit may pose a

challenge since typical FGD phys-chem wastewater treatment systems have not consistently demonstrated compliance to the proposed rule primarily due to the inability to precipitate and remove (dissolved) selenate from the discharge.

In the present paper a novel approach to selenium reduction is described which focuses on sequestering a greater percentage of the total dissolved selenium into the solid phase, while simultaneously reducing the dissolved mercury concentration in the slurry and thereby reducing stack mercury emissions.

Initial results from jar testing justified a 5-day full-scale demonstration on a 1300 MW unit equipped with a wet limestone forced oxidation (WLFO) FGD system. The FGD system consists of two 50% capacity FGD vessels. The patent pending method was employed on both vessels. The chemical was injected at a modest rate and liquor and other samples were taken to assess its efficacy. Unfortunately, the unit tripped due to unrelated boiler issues after only 44 hours of testing. Results from the abridged tests demonstrated a dramatic reduction of stack mercury within about 5 minutes of injection. Furthermore, total dissolved selenium in both of the FGD vessels trended down linearly over the course of the test for an end-of-test reduction of about 50%. Data collected 24 hours after the trip indicated little to no "rebound" in total dissolved Selenium. This post-test data point is important since it demonstrates that the selenium is sequestered even during the upsets in temperature, pH, ORP, etcetera that occur after a unit trip. Plans have been approved to repeat this test at the same site with an expanded scope to include multiple units and WWT sampling. Jar tests have also been completed to determine whether and to what extent this treatment could be utilized for both leachate and/or existing phys-chem WWT systems. Results are forthcoming.

Discusser: Carson Brown, Southern Company, Hoover, AL

T6: Reuse

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

Session Chair: Matthew Flannigan, Nalco Water, an Ecolab Company, Naperville, IL

Discussion Leader: Dan Sampson, HDR, Walnut Creek, CA

TIME: 1:30 – 5:10 PM (EST)

Industrial water reuse has come of age with the combined stresses of climate change and increasing municipal water prices. The incentive to reuse water has reached a diverse set of industries. This session begins with a broad overview of industrial reuse and then moves on to several specific examples of innovative approaches to address this challenge.

IWC 20-49: SQUEEZING THE LAST DROP – WASTEWATER REUSE AS AN INDUSTRIAL WATER SOURCE

John Van Gehuchten, Thomas Lawry, and Jonathan Shimko, McKim & Creed Inc., Sewickley, PA

TIME: 1:40 PM (EST)

When treating wastewater from industrial facilities there are unique engineering and treatability challenges. The mix of sanitary and industrial wastewater streams can lead to interesting process and engineering complications. This paper will review the basic economics of the why industrial facility and wastewater reuse and will also go into detail on the technical challenges that must be overcome for treating water to meet regulation standards and facility specific standard.

Discusser: John Korpiel, P.E., Veolia Water Technologies, Wexford, PA

IWC 20-50: STEAM ELECTRIC POWER STATION WATER REUSE AND SUSTAINABILITY CATALOGUE

Matthew Heermann, Sargent & Lundy, Chicago, IL

TIME: 2:30 PM (EST)

This paper catalogues basic information and provides guidance to effectively evaluate and screen appropriate technological solutions to reduce a steam electric generating station's water withdrawal volumes and improve its sustainability footprint. At its core, this document provides information on performance, cost, and implementation requirements on a range of applicable technologies that can meaningfully impact power plant water withdrawal and provide guidance on where and under what conditions these technologies will work.

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

IWC 20-51: WASTE WATER REUSE SYSTEM DESIGN IN A SPACE CONSTRAINED ENVIRONMENT

Evan Claytor, SUEZ Water Technologies & Solutions, Richmond, VA; Zachary Canfield, SUEZ Water Technologies & Solutions, Richmond, VA

TIME: 3:30 PM (EST)

An industrial client has developed a large soil washing plant in North America. Located in a highly populated urban area, the client needed a wastewater treatment solution to help clean the waste wash water while providing a design which is sustainable, has a low operating cost and a compact footprint. We developed a solution that met the customers need while also incorporating a novel high rate filter.

Discusser: Kevin Boudreaux, ChemTreat, Sioux Falls, SD

IWC 20-52: WATER REUSE AT A SEMI-CONDUCTOR FACILITY – A CASE STUDY

Roman Lis, Stantec, Chicago, IL

TIME: 4:20 PM (EST)

This paper presents a case study of a water reuse project at a semi-conductor manufacturing facility. The reuse program was completed to help the company achieve their water sustainability goal of 20% company-wide reduction in water usage by 2020 (based on a 2015 baseline year). Their sustainability program utilizes a combination of best management practices, water audits, and water conservation and reuse projects to reduce water usage across a large portfolio of manufacturing locations.

Discusser: Cristina Piekarz, HDR, Walnut Creek, CA

T7: PFAS 1

IWC Rep: Lyndsey Wiles, MICRODYN-NADIR, Goleta, CA

Session Chair: Tony Fuhrman, LG Chem, Torrance, CA

Discussion Leader: Kristen Jenkins, GHD, Duluth, GA

TIME: 1:30 – 5:10 PM (EST)

A hot topic in the municipal water sector is the treatment and removal of PFAS (per- and polyfluoroalkyl substances) from drinking water. PFAS are a group of man-made chemicals that includes PFOA (perfluorooctanoic acid), PFOS (perfluorooctanesulfonic acid), GenX, and many other chemicals. PFAS compounds are found in a wide range of consumer products, including nonstick cookware, stain repellants, and fire-fighting foams. These compounds are very chemically stable, can accumulate in living organisms, and have been associated with a variety of human health issues, including low infant birth weights and negative effects on the immune and endocrine systems. This session will explore some innovations and cost reduction alternatives to traditional activated carbon adsorption for the removal of PFAS from water.

IWC 20-53: REVIEW OF PFAS TREATMENT TECHNOLOGIES

Eric Bergeron, Golder Associates, Sherbrooke, QC Canada; Valérie Léveillée, Golder Associates, Montréal, QC, Canada

TIME: 1:40 PM (EST)

Although per- and polyfluoroalkyl substances (PFAS) have been used since the 1940s, they have become a major problem in recent years due to their toxicity, mobility and high chemical stability. Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), two human-made highly fluorinated compounds, are the most known of the PFAS family. These products are widely used at industrial and domestic level, notably as coatings, packaging, household maintenance products, surfactants and fire-fighting foams. Regulated limits and guidelines …

Discusser: Steven Grise, The Chemours Company, Wilmington, DE

IWC 20-54: NOVEL DEVELOPMENTS IN PFAS REMOVAL UTILIZING SUPERFINE POWDERED ACTIVATED CARBON AND CERAMIC MEMBRANE MICROFILTRATION TECHNOLOGY

Terence Reid, David Holland, and Joseph Campanaro, Aqua-Aerobic Systems, Inc., Loves Park, IL

TIME: 2:30 PM (EST)

Super fine powdered activated carbon with a 1 μm mean particle diameter has demonstrated specific PFAS adsorption rates significantly higher than granular activated carbon. The increased effective surface area and smaller diameter permits greater access to internal micro- and mesopores thereby enhancing both long and short-chained PFAS compound removals. A novel technology employs cross-flow ceramic membrane microfiltration to generate a highly concentrated SPAC suspension and produce superior removals of broad-spectrum PFAS compounds from contaminated water.

Discusser: Cathy Swanson, Purolite

IWC 20-55: BATCH AND COLUMN STUDIES ON PFAS REMOVAL FROM LANDFILL GROUNDWATER USING MEDIA

Francisco Barajas, AECOM, Austin, TX; Daryl Beck, AECOM, St. Paul, MN

TIME: 3:30 PM (EST)

Per- and polyfluoroalkyl substances (PFAS) are a group of emerging contaminants with widespread presence in the environment, such as landfills, and may pose a risk due to leaching into groundwater and/or surface water bodies. These contaminants may be treated in-situ or ex-situ via technologies that rely on separation from water. Adsorbing media, such as granular activated carbon (GAC) has been widely used to that end. In-situ applications of adsorbing media treatment include the use of permeable barriers. However, depending on the size and design of the barrier, the use of adsorbents may be costly. Biochar, peat moss, and bentonite may be more cost-effective alternatives than GAC for in situ remediation purposes. This study evaluated the removal of PFAS in groundwater samples from a landfill site by using those media as amendments and by a sample of the material currently used at the site (site select-fill).

Treatability studies were conducted using impacted groundwater from the landfill site, with focus on the removal of perfluorooctanoic acid (PFOA) and perfluorooctanoic sulfonic acid (PFOS), although other PFAS compounds and total organic carbon were also quantified. Batch experiments were used to screen for adsorption capacity by biochar, peat moss, a modified bentonite, and GAC. Biochar and GAC (mixed with sand) were selected for a column test to mimic field conditions and to determine the breakthrough of PFAS. In addition, a mixture of soil and wood (site select-fill) currently used at the impacted landfill site was also tested.

Results from the batch experiment indicated that peat moss had the lowest adsorption capacity, while the rest of the amendments showed close to 100% adsorption of PFAS. Results from the column test indicate breakthrough of PFAS in the site select-fill after only four pore volumes of water moved through the column; this suggests that the removal capacity of the site select-fill is partially depleted. Retention of short-chain PFAS was poor in the site select-fill as well. GAC amended columns showed no breakthrough after 124 days of column operation, whereas biochar amended columns showed breakthrough only for pentafluoro benzoic acid (PFBA) and total organic carbon at 107 days. These results demonstrate that both biochar and GAC provided high removal of long-chain PFAS. These findings provide insight on the longevity of a permeable barrier and will be supported by a subsurface transport model and cost-analysis to determine the most viable treatment alternative.

Discusser: Ken Martins, Stantec

IWC 20-56: STRATEGIC APPROACH TO TREATMENT OF PERFLUOROCARBON CONTAMINANTS IN LANDFILL LEACHATE

Wiley Parker, Ph.D., and Bo Hernandez, HTX Solutions LLC, Houston, TX; David Strobel, Lummus Technology, Pasadena, TX

TIME: 4:20 PM (EST)

In martial arts and chess, often the most prudent approach to a difficult opponent involves studying the opponent's strengths to develop a strategy which exploits the perceived strength. In this paper we will describe a strategic approach for coping with perfluorocarbon contaminants in landfill leachate. We exploit the molecular properties of the perfluorocarbon contaminants to cycle up the perfluorocarbon components into a much smaller volume. We further describe an encapsulation scheme which provides a long-term disposal strategy for perfluorocarbons.

Discusser: Rick Szilagyi, WesTech

T8: Monitoring

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

Session Chair: Brad Buecker, Chemtreat, Lawrence, KS

Discussion Leader: Vickie Olson, Honeywell, Duluth, GA

TIME: 1:30 – 5:10 PM (EST)

Proper monitoring and data interpretation are critical items at power and water plants, and other industrial facilities. Without accurate and timely data, upsets and possible failures can occur very rapidly. In this session, two of the authors outline advanced technologies for corrosion monitoring in power-generating systems to help maintain reliable operation. The third paper outlines the heretofore difficult ability to monitor copper in wastewater streams, which has potential for many applications. The final paper discusses the expanding utilization of artificial intelligence (AI) for a variety of water and wastewater management issues.

IWC 20-57: CONTINUOUS MONITORING OF TRACE LEVEL METALS IN A POWER GENERATION PROCESS STREAM

Ken Kuruc, Hach, Perrysville, OH

TIME: 1:40 PM (EST)

Trace level metals can enter a water stream from a variety of locations. Some may be brought in at the source while others may be introduced in the process itself. In either case, they must be considered in light of their potential impact downstream. The ability to detect the presence, as well as concentration levels of trace metals, can be critical especially when this water will be discharged into a regulated body of water.

IWC 20-58: THE VALUE (AND THE CHALLENGES) OF CORROSION TRANSPORT MONITORING

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

TIME: 2:30 PM (EST)

Monitoring of corrosion products in power plants is an indicator of the success of the cycle chemistry program. This paper will discuss the value of instituting a formal corrosion transport monitoring program and detail the effort involved in optimization of a plant-specific program. It will review methods for corrosion transport monitoring in steam generator cycles including the associated benefits and limitations. Case studies will be utilized to illustrate the process and the obtainable benefits.

Discusser: Erin Westberg, Florida Power & Light Company, West Palm Beach, FL

IWC 20-59: SEMICONDUCTOR MANUFACTURING PROCESS IMPROVEMENTS AND THE ROLE OF REAL-TIME COPPER WASTEWATER ANALYSIS

Vladimir Dozortsev, Aqua Metrology Systems, Sunnyvale, CA; Luke Wilson and Mike Knapp, Samsung Austin Semiconductor, Austin, TX

TIME: 3:30 PM (EST)

In 2018, Samsung Austin Semiconductors installed an ion exchange (IX) system to better manage its wastewater. A novel online copper analyzer (MetalGuard Copper) that uses direct voltammetry was installed to improve the safety and quality of measurements for copper wastewater streams, while reducing operational and maintenance costs. Through a high frequency of accurate and reliable data on effluent copper levels provided by the online copper analyzer, Samsung Austin Semiconductors has been able to optimize the IX system and avoid premature regeneration of the IX resins.

Discusser: Christopher Leitz, Leitz Environmental Consultants, Fort Meyers, FL

IWC 20-60: AI AND DECISION SUPPORT TOOLS: INNOVATIVE DIGITAL OFFERINGS IN WATER AND WASTEWATER

Graham Symmonds and Matt Mallory, Bluetech Research, Vancouver, BC, Canada

TIME: 4:20 PM (EST)

Opportunity exists to re-imagine smart water management and data analysis for the production, treatment, and delivery of water, wastewater, and storm-water services using artificial intelligence (AI). Differentiating conventional decision support systems from true AI is vital. Conventional systems used hard-programmed "rule-based algorithms" in "if-then-else" linear diagnostic structures to manage variability within a narrow knowledge base but are incapable of operating within dynamic systems with competing, indirect interests. True AI uses pattern recognition applications that employ a set of inputs, weighting factors, summation and transfer functions that are autonomously and dynamically updated as new information is presented. Using this new approach can achieve previously unattainable optimization and in turn, capital and operational savings. However, the human impact should not be underestimated; as algorithms perform more of the perfunctory and basic analyses, interpreting the output is going to be a fundamentally important job requirement for operator staff.

The paper highlights the two main forms AI is taking on in the water sector: Learned AI and derived AI. A review of commercially available AI and decision support products targeting the water and wastewater market was undertaken for a qualitative analysis of the current state of the art. Through primary research and voice of customer interviews carried out with providers and end users, we evaluate market drivers and barriers for the implementation of AI, the greatest opportunities for AI in the water sector, and finally, an evaluation of nine different product offerings.

Historically, limited capacity in data acquisition and the tools to curate and analyze that data have limited the use of "big data" in water. With the availability of open data SCADA, advanced metering infrastructure (AMI), decreasing cost of sensors, and mass data sets, utilities can now expand their data footprint. AI will fundamentally change the way utilities operate and manage water in an increasingly volatile environment, but the most immediate challenge is to structure data and smart water management services to maximize AI's potential.

Wednesday, November 11
Morning Sessions

W1: Mining

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

Session Chair: Jeff Easton, WesTech Engineering, Salt Lake City, UT

Discussion Leader: Evan Claytor, SUEZ Water Technologies & Solutions, Richmond, VA

TIME: 9:00 AM – 11:50 AM (EST)

Extraction and removal of dissolved metals and minerals from mine waters and brines can be tricky business. In this informative session we will have a chance to learn about offsetting mine water remediation costs by recovering copper values and how microalgae is being used to remove heavy metals. In this session you will learn through case studies about the array of fully deployed dissolved selenium removal processes and how these technologies are maturing, as well as interesting techniques for lithium recovery from brines. This session promises to offer a diverse and unique view of water treatment with respect to metal and mineral removal and recovery.

IWC 20-61: NOVEL CHEMICAL SOLUTION LEADS WATER SAVINGS IN MINING OPERATIONS

Ignacio Guerrero, Solenis Technologies Mexico, Gustavo A. Madero, Mexico; Michael Bluemle and Maria Nydia Lynch, SOLENIS LLC, Wilmington DE

TIME: 9:10 AM (EST)

Water scarcity is a major concern in many parts of Mexico and around the world. To keep their operations running, large mine sites are looking for new ways to improve water recovery in their facilities and avoid paying fines for excessive exploitation of well water. New equipment alternatives, such as high contact thickeners, are being exploited to maximize water recovery. However, the increased viscosity and difficulty in pumping the high solids (70% is typical) mineral slurries that are generated in these applications has also made implementation of this technology challenging.

Discusser: Tyler Ball, P.Eng., M.Sc.A., Dorval, QC, Canada

IWC 20-63: COPPER RECOVERY OPTIONS FOR PIT LAKE WATERS

John Schubert, HDR, Sarasota, FL, Chloe Grabowski, HDR, Missoula, MT, and Sriram Ananthanarayan, BHP, Tucson, AZ

TIME: 10:00 AM (EST)

Many closed mines have onsite open pits, which accumulate water. This water usually includes components of leaching solution, and can be strongly acidic, containing a variety of metals. An evaluation of the various metals present in one pit water indicated that there could be value in the recovery of copper. Four methods were identified to recover copper. These included solvent extraction, ion exchange, sulfide precipitation and cementation. Evaluation of economics for each is described herein.

Discusser: Jonathan Witt, Simplot

IWC 20-64: SELENIUM REMOVAL ISN'T CHEAP OR EASY – A REVIEW OF 30 FULL-SCALE OPERATING PLANTS

Tom Rutkowski and Paige Pruisner, Golder Associates, Lakewood, CO ; Henlo Du Preez, Golder Associates Ltd., Vancouver, BC, Canada

TIME: 11:00 AM (EST)

Significant progress has been made in the past decade on selenium removal from industrial wastewater including installation of full-scale systems, compliance with stringent discharge limits, and development of new technologies. A survey of end-users, vendors, and consultants was developed and distributed to collect information on operating plants. Survey results indicate that thirty full-scale selenium removal systems have been installed since 2007. Despite numerous installations, selenium technologies have not reached technological maturity.

Discusser: Mike Surface, Dominion Energy, Richmond, VA

W2: Power & Ash

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

Session Chair: Tom Higgins, Worley, St. Augustine, FL

Discussion Leader: Kristen Cooper, Duke Energy, St. Petersburg, FL

TIME: 9:00 AM – 12:40 PM (EST)

Air, water, and solid waste are regulated separately by the EPA under the Clean Air Act (CAA), the Clean Water Act (CWA) and the Resource Conservation and Recovery Act (RCRA). As a result of evolving regulation, power plants have had to implement new technologies to achieve compliance. CAA required the addition of FGD scrubbers that then required wastewater treatment, Coal Combustion Residual (CCR) rules necessitated closure or modifications of treatment ponds, and landfill requirements resulted in leachate that needs treatment. The papers presented in this session will address various aspects of the synergies between these regulated media. Our first paper discusses the impacts of using dry absorbents for SO3 mitigation, an air emission requirement to eliminate the blue plume of sulfuric acid which results when SO3 mixes with water vapor. Selection of dry absorbent affects scaling of equipment and treatment in downstream ponds. The second paper discusses the use of sulfite control in FGD scrubbers, which reduces air emissions of mercury, but also improves down-stream wastewater treatment for mercury and selenium. Our third paper addresses treatment of landfill leachate. The final paper will present DOE research on improving the synergies between energy and water resources.

IWC 20-65: MANAGING & REHABILITATING COAL ASH PONDS USING PASTE SURFACE STACKING TECHNOLOGY

Antonio Accioly and Jerold Johnson, Westech Engineering Inc., Salt Lake City, UT

TIME: 9:10 AM (EST)

One common technology employed in the cleansing of flue gas from coal-fired power plants is wet gas scrubbing. Plants have addressed scrubber wastewater management with large ponds to contain solids and evaporate and/or decant supernatant. Permanent impoundment of solids requires large ponds, or they are periodically dredged with solids sent to landfill. Due to a recent high-profile CCR impoundment failure, the risks and pond life of these sites are pressing issues. This paper discusses site management.

Discusser: Mahyar Ghorbanian Ph.D., P.E., LG&E and KU Energy, Louisville, KY

IWC 20-66: CONTROLLING OXIDATION AIR IN AN FGD ABSORBER AS A MEANS TO SIMPLIFY WASTEWATER TREATMENT

Adam Sutherland, Stantec, Nashville, TN ; Lindy Johnson, Lookout Mountain, TN ; Bill Kennedy, Stantec, Charlotte, NC

TIME: 10:00 AM (EST)

The benefits of an oxidation air control system in a wet FGD scrubber are presented, including significant operational cost savings. Improved wastewater treatability using chemical precipitation to address EPA's proposed 2019 ELG limits for selenium and mercury is discussed. Liquor sulfite concentration, unit load, and inlet SO2 are used to control the oxidation air flow of a once-through forced-oxidation scrubber. Scrubber, water chemistry impacts, and comparisons to pre-sulfite-controlled operations are described.

Discusser: Riley Flowers, Southern Company, Birmingham, AL

IWC 20-67: LANDFILL LEACHATE MANAGEMENT BEYOND IMPOUNDMENTS

Diane Martini, Burns & McDonnell, Chicago, IL

TIME: 11:00 AM (EST)

On April 12, 2019 The Fifth Circuit Court of Appeals threw out the Steam Electric Power Effluent Limitation Guideline (ELG) rules pertaining to legacy wastewater and combustion residual leachate streams and remanded them to the agency for reconsideration. Among other things, the Court ruled that pond treatment did not meet the Best Practicable Technology (BPT) standard for either stream.

Coal Combustion Residual (CCR) landfill leachate contains many of the more soluble constituents found in FGD gypsum, such as chloride and sulfate, and may contain other dissolved solids that can drive discharge options. Some plants have already been required to examine alternatives for treating leachate to meet stream standards, and there are several options available. Leachate may be suitable for reuse as landfill dust control, or for other uses within the plant, or may require stand-alone treatment. In some cases, it may be amenable to treatment along with FGD wastewater, or reuse within the FGD system.

This paper will review case histories of leachate treatment options and relative costs. A discussion of the new landfill leachate standards will be included if they are available at the time of publication.

Discusser: Kirk Ellison, EPRI, Charlotte, NC

IWC 20-68: WATER MANAGEMENT FOR FOSSIL ENERGY POWER GENERATION

Briggs White, National Energy Technology Laboratory, Pittsburgh, PA

TIME: 11:50 AM (EST)

The Water Management R&D program within the Crosscutting Research Portfolio addresses the inextricable link between power generation and water usage. The program leads a critical, national effort directed at removing barriers to sustainable, efficient, water and energy use; developing technology solutions; and enhancing the understanding of the intimate relationship between energy and water resources. Fossil-fueled power generation faces numerous, broad challenges to maintain economic competitiveness within a rapidly shifting energy generation paradigm. This presentation will highlight recent accomplishments within the program and describe the potential market and environmental benefits of broad adoption of these technologies. Further, this presentation will describe the vision for the Water Management R&D program within a rapidly evolving energy generation paradigm and seek to test and validate the challenges the program is best equipped to deliver solutions against into the future.

Discusser: Jason Monnell, EPRI

W3: PFAS 2

IWC Rep: Jim Summerfield, Dupont Water Solutions, Saginaw, MI

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

Discussion Leader: Eric Klinker, Dupont Water Solutions, Edina, MN

TIME: 9:00 AM – 12:40 PM (EST)

While the waters may be dark at times, we have presenters and discussers who are working very hard to shine new light on PFAS, PFOS, and their many related compounds. This session palaces a spotlight on how engineers, equipment suppliers, and others have been developing technologies and techniques to better detect and treat these scattered materials to the very low concentrations for which they are regulated.

IWC 20-69: REMOVAL OF SELECTED PERFLUORINATED COMPOUNDS (PFCS) FROM DRINKING WATER USING ALTERNATE ION EXCHANGE RESINS

Tom Smith and Kaitlyn Clark, ResinTech, West Berlin, NJ

TIME: 9:10 AM (EST)

Perfluorinated contaminants (PFCs) are an emerging class of drinking water contaminants that have been detected at trace concentrations (ng/L to μg/L) in drinking water around the world. These substances owing to their high polarity and strong carbon-fluorine (C—F) bonds, have some unique chemical attributes including extremely high thermal and chemical stability. They are primarily used as surfactants in numerous industrial and consumer products such as firefighting foams, paints, non-stick cookware, carpets, upholstery, semiconductors, photographic films, pesticide formulations, food packaging. High water solubility, simultaneous hydrophobic/hydrophilic properties, and low volatility of most perfluorinated contaminants contribute to their presence in our water systems. At present there is limited information regarding fate and behavior of PFCs in drinking water treatment processes. The PFCs we chose for study due to their occurrence, varied chemistries, branched chained, short chained, long chained, organic acids, and organic sulfonates. The PFCs are: HFPO-DA (Gen X), PFOA, PFAS, PFNA, PFBS, PFHxS. The current study was undertaken to investigate ion exchange resins for removal of these persistent compounds.

PFCs are typically analyzed using liquid chromatography/mass spectrometry (LC/MS/MS) based analytical methods, most labs do not have accesses to expensive LC/MS/MS instrumentation. Two methods were then developed 1) a direct injection LC/MS/MS method for higher levels of PFC's and 2) a solid phase extraction-based LC/MS/MS analytical method was then developed for the project to successfully analyze the target PFCAs at trace concentration (sub ppt range) in synthetic water. Equilibration studies at varied concentrations provided interesting results. Controlled synthetic water column studies are being conducted at lower initial PFC concentrations.

In this paper we trace the start of our method development to deliver alternate ion exchange solutions for the removal of these persistent compounds.

Discusser: Patrick McKeown, ECT2, South Portland, ME

IWC 20-70: PREVENTING PFAS CROSS-CONTAMINATION IN SAMPLING AND DECONTAMINATION EQUIPMENT AND MATERIALS

Craig Holloway, AECOM, Austin, TX; Katherine Davis, AECOM, Newark, DE

TIME: 10:00 AM (EST)

Per- and poly fluoroalkyl substances (PFAS) is a class of emerging contaminants that have been released into the environment from industrial and firefighting activities. PFAS are used in the manufacturing of intermediary products and hundreds of articles of commerce used in electronics, semiconductors, outdoor apparel/equipment, chemical/pharmaceutical manufacturing, and aqueous film forming foams (AFFF) used for fire training and firefighting. Various screening criteria and laboratory reporting limits for PFAS compounds have and continue to decrease over time. For example, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) established Drinking Water Maximum Contaminant Levels (MCL) of 8 ng/L for PFOA and 16 ng/L for PFOS. Due care must be taken in the design and implementation of a PFAS sampling program as residual PFAS in sampling or decontamination equipment may be potential sources of cross-contamination.

When planning and implementing a sampling program that includes PFAS compounds, specific procedures and materials should be used that eliminate cross-contamination, are specific to the environmental media, are appropriate for the data quality objectives, and are protective of sampling personnel and the environment. A methodology has been developed, based upon a stop light metaphor, for characterizing materials and equipment that have the potential of cross-contamination concerns into three color-coded categories:

RED – items that should not come in contact with the sample, be used in sample equipment decontamination, be in the immediate sampling environment or come into contact with the sample being collected. Examples: Polytetrafluoroethylene (PTFE) plumber's tape, Low-density polyethylene (LDPE) Hydrasleeves, Viton® O-rings, Gore-Tex® treated clothing

YELLOW – items that need to be evaluated prior to use in the immediate sampling environment. Examples: Clothing described as waterproof, LDPE plastic bags, aluminum foil, coated Tyvek®, Sharpie, Post-It-Notes®

GREEN – materials that can be used in the sampling environment. Examples: High-density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC), stainless steel, Alconox®, QED Sample Pro® 1.75" Portable Bladder Pump

Methods for testing YELLOW items will be presented, including examples for testing of insect repellent and insect repellent treated clothing, and testing of an ISCO 3700 Portable Sampler with flow attachments.

Understanding, identifying, and testing for possible sources of cross-contamination will provide confidence in the validity of results, prevent costly resampling, and add to the list of equipment and materials that are approved for use while sampling PFAS contaminated media.

Discusser: Julie Bliss Mullen, Aclarity, Hadley, MA

IWC 20-71: THE MEDIA YOU USE FOR ARSENIC TREATMENT WILL BE DISCONTINUED: A NJ COMMUNITY RAPIDLY RESPONDS TO INSTALL NEW TREATMENT BUT ALSO FINDS PFAS

Tyler Butel and Martin Lawrence, AdEdge Water Technologies, Duluth, GA

TIME: 11:00 AM (EST)

While designing six new arsenic treatment systems to replace a discontinued adsorption media, a community in NJ discovers that two of the wells also have PFOA concentrations over the 14 ppt maximum contaminant limit. This presentation will discuss in detail the process of selection for media to remove PFOA, the unique site and equipment design considerations required for multi-contaminant treatment, and share performance data collected since start-up.

Discusser: Adam Redding, Ph.D., Calgon Carbon Corporation, Moon Township, PA

IWC 20-72: THE REMOVAL OF PFAS (PER-FLUORINATED ALKYL SUBSTANCES) WITH ION EXCHANGE AND REVERSE OSMOSIS PROCESSES

Alan Sharpe, Lanxess Corporation, Birmingham, NJ ; Dirk Steinhilber, Lanxess Deutschland GmbH, Koeln, Germany; Jens Lipnizki, Lanxess Deutschland GmbH, Koeln, Germany

TIME: 11:50 AM (EST)

Technical solutions exist to remove PFAs from waste water with ion exchange (IX) resins and/ or reverse osmosis (RO) membranes. This paper will present information on the removal of PFAs by IX and RO, present case study data using anion exchange resins, present rejection data for GenX, 1,4-Dioxane, and approx 15 PFA variants from an RO pilot study, and conclude with a comparative summary of these technical solutions, including a comparison with activated carbon.

Discusser: Thomas Mallmann, Evoqua Water Technologies LLC, Rockford IL

IWC 20-W3-RESERVE 2: DESTRUCTION OF PFAS IN GROUNDWATER

Chad Felch, Siemens Energy, Rothschild, WI; Philip Burclaff, Siemens Energy, Rothschild, WI

Per- and polyfluorinated alkyl substances (PFAS) are a growing concern as a contamination of ground- and drinking water as their negative health effects are becoming clearer. There is discussion of PFAS regulatory limits for drinking water being established on a federal level. As a fluorocarbon, PFAS does not biodegrade and thus needs some form of advanced oxidation to destroy. While there has been success with using ion exchange or other adsorbents to remove

W4: Modelling & Predicting

IWC Rep: Patricia Scroggin-Wicker, P.E., Burns & McDonnell, Kansas City, MO

Session Chair: Ivan Morales, Integrated Sustainability, Inc., Houston, TX

Discussion Leader: Adam Sutherland, Stantec, Nashville, TN

TIME: 9:00 AM – 12:40 PM (EST)

The use of technology is not only making our lives easier or better in many aspects of our daily activities. The technology applied in industrial water treatment is achieving new frontiers. The session will explore a variety of experiences with papers discussing modeling scale precipitation, predicting performance using state point analysis, case studies on biocide application for reverse osmosis, and data integration with augmented reality to improve plant performances.

IWC 20-73: MODELLING MINERAL SCALE PRECIPITATION MASS IN INDUSTRIAL SYSTEMS

Robert Ferguson, French Creek Software, Inc., Phoenixville, PA

TIME: 9:10 AM (EST)

Indices and Saturation Ratios predict whether a scale is likely to precipitate from a cooling water, RO concentrate, produced water or in a flow back pond. The foretell the tendency to scale but do little to quantify the mass of precipitation expected in a finite, economically significant time.

Simple and sophisticated indices have been developed and used to predict precipitation quantity. Municipal water treatment chemists use the Calcium Carbonate Precipitation Potential to quantify the mass of scale expected. Oil field modelling programs use similar indices for a variety of scales. Momentary excess is used to predict an instantaneous precipitation, as opposed to the total Precipitation Potential.

This paper discusses the modelling methods for dynamic flowing streams and for stagnant ponds or reservoirs. Iterative approaches required for predicting precipitation in systems where parameters such as pH change as scale forms, drastically affecting the driving force in many cases are covered.

The use of these methods for predicting the quantity of precipitation is discussed as well as their use as driving forces in scale inhibitor models.

Discusser: Justin Higgs, Evoqua, Nolensville, TN

IWC 20-74: A NOVEL APPROACH USING STATE POINT ANALYSIS AS A PREDICTIVE PERFORMANCE AND OPTIMIZATION TOOL IN INDUSTRIAL METALS PRECIPITATION AND SOFTENING

Harley Schreiber, Jaron Stanley, and Jeff Easton, WesTech Engineering, Salt Lake City, UT

TIME: 10:00 AM (EST)

State Point Analysis is a widely practiced graphical method used to assist in predictive performance and control of secondary clarifiers in the biological activated sludge process. This paper discusses the application of this method to optimize performance of other treatment processes, including metals precipitation and softening. The results of this analysis illustrate the potential benefits of internal solids recirculation, as can be achieved with a Solids Contact Clarifier, versus external solids recirculation.

Discusser: Robert Simm, Stantec, Tempe, AZ

IWC 20-75: NEW AUTOMATIC CONTROL SYSTEM TO OPTIMIZE BIOCIDE DOSING FOR STABLE RO OPERATION

Yuta Ohtsuka, Kurita Water Industries Ltd., Tochigi, Japan; Kunihiro Hayakawa, Kurita Water Industries Ltd., Tochigi, Japan; Darunee Sae-Tae, Kurita-GK Chemical Co.,Ltd., Samutprakarn, Thailand; Sara Pietsch, Avista Technologies, Inc., San Marcos, CA

TIME: 11:00 AM (EST)

A big challenge of biofouling control in RO systems is how to deal with biofouling potential changing from moment to moment. This paper explores methods to optimize the chemical treatment against biofouling and how the combination of the sophisticated biocide and the dosing controller impacts operation of RO systems. A case study covering a successful application of dosing controller in a food factory is also included.

Discusser: Gordon Carter, SUEZ Water Technologies & Solutions, Waterford, VA

IWC 20-76: SPLUNK TO IMPROVE INDUSTRIAL WASTEWATER TREATMENT PLANT PERFORMANCE

Yakup Nurdogan, Ph.D., BECHTEL, Pueblo, CO ; Andrew Shaffer, Ph.D., James Earley, and Kevin Fu, BATTELLE, Pueblo, CO

TIME: 11:50 AM (EST)

The Pueblo Chemical Agent Destruction Pilot Plant (PCAPP) has been destroying chemical agent stored at the Department of Defense (DOD) Pueblo Chemical Depot. The DOD selected neutralization for agent destruction and biotreatment for wastewater treatment as alternatives to incineration. PCAPP has been using the Splunk™ tools to monitor wastewater treatment plant functions, troubleshoot upset conditions, repairs, and forecast preventative maintenance. The machine learning toolkit was used to troubleshoot and confirm the effectiveness of maintenance evolutions in lieu of costly test and evaluation activities. These tools allow PCAPP to respond to upset conditions faster, smarter, and more efficiently. This builds client trust and saves money.

The first application of Splunk™ let a rapid identification of the root cause of a 700-gallon spill; this took 4 hours rather than weeks using older tools. Different data sources were combined in Splunk™ data lake and different data streams were compared to identify patterns around the spill events. It was possible to determine that a pressure event was related to foaming in the evaporator. This foaming caused a false level indication that led to a false indication and a pressure safety valve release. When data were examined over a longer time period, this event was coincided with an increase in biotreatment system (BTS) organic loading rate and temperature. To reduce foaming, the project implemented operational changes including anti-foaming agent addition into the BTS feed and lowering organic loading during hot days.

The Splunk™ mobile and Augmented Reality (AR) applications provide an interactive experience within a real-world environment. Real-time images can be enhanced by computer-generated perceptual information. The first step in the process is securely getting the data into the mobile application. At PCAPP, data comes from an air-gapped system to a business network (where Splunk™ resides) via data diode. Challenges include obtaining the correct firewall settings and getting cloud access to the business network. The Splunk™ mobile app was used to build dashboards with simple graphics and illustrations for the operators. These graphics were then placed in a real-time environment t to contextualize their data 4. Splunk™ AR application that provides up-to-the minute readings on top of live images of equipment.

Discusser: Paul Togna, Envirogen Technologies, Inc., Allentown, NJ

Sunday, November 8, 2020
Time: 1:00 – 5:00 PM (EST)

W1: WATER TREATMENT 101

The objective of the workshop is to provide the participant a chance to hear some of the basics of the water treatment industry to help form a foundation for further understanding as they attend other workshops and sessions. It can, at times, also provide a beginning to networking within the industry as participants are directed to other industry experts and suppliers that may have been difficult for them to establish on their own.

Presenter: Dennis McBride, Burns & McDonnell, Kansas City, MO

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

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

Presenter: Bryan Hansen, Burns & McDonnell, Centennial, CO

Wednesday, November 11, 2020
Time: 2:00 – 6:00 PM (EST)

W1A: WATER TREATMENT 101 (REPEAT)

The objective of the workshop is to provide the participant a chance to hear some of the basics of the water treatment industry to help form a foundation for further understanding as they attend other workshops and sessions. It can, at times, also provide a beginning to networking within the industry as participants are directed to other industry experts and suppliers that may have been difficult for them to establish on their own.

Presenter: Dennis McBride, Burns & McDonnell, Kansas City, MO

W2A: THE WONDERFUL WORLD OF REVERSE OSMOSIS (REPEAT)

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

Presenter: Jane Kucera, Nalco Water, an Ecolab Company, Plainfield, IL

W5: MEMBRANE AND THERMAL BRINE RECOVERY SYSTEMS

This workshop will provide attendees with a basic understanding of brine recovery systems and their capabilities, technologies, chemistries, and challenges. It begins with an introduction describing the common building blocks of brine recovery systems, then continues with a more detailed examination of specific technologies and chemistry impacts. The workshop will conclude with case histories provided by the presenter or by the attendees (if any attendees present have case histories to share).

Presenter: Daniel Sampson, HDR, Walnut Creek, CA

W6: INDUSTRIAL WASTEWATER REUSE – A ROADMAP FOR THE FUTURE

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

– The three key aspects of water chemistry that drives design

– Options to get from point A to point B – an unbiased comparison of the more popular water reuse flowsheets (i.e. membranes vs non-membrane approach)

– Navigating the changing water treatment technology landscape – an unbiased comparison of the more popular treatment technologies (i.e. Clarifiers, MMF, MF, UF, GAC, IX, RO, ED, Chlorine, Ozone, AOP, UV)

– Emerging technologies and opportunities

– "Fit for purpose" water reuse strategies

– Optimizing cost and reliability

– Lessons learned and avoiding pitfalls

Facilitators will present on significant developments in the field of water reuse, relevant case studies that demonstrate successes and lessons learned that impact the design of the next generation of water reuse plants.

Participants will leave the workshop with a broad understanding of the industrial water reuse landscape, why certain technologies are useful, how they work and how the capabilities of water reuse systems have grown in recent years.

Presenter: Ed Greenwood, Wood, Cambridge, ON, Canada

W7: INDUSTRIAL BOILER WATER TREATMENT

Provide a basic background in industrial boiler water treatment including a discussion of potential problems when not controlled properly.

Participants will learn:

- How deaerators work and common errors that cause boiler feedline corrosion problems.
- The causes of boiler deposits and corrosion and their control.
- The problems caused by steam contamination and steps to avoid these problems
- The causes of condensate system corrosion and treatment technologies to control

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

W8: PFAS TREATMENT – ANALYSIS, DESIGN, TREATMENT AND DESTRUCTION

The objective is to educate attendees on the technical aspects of PFAS water, wastewater and groundwater contamination treatment including the challenges of water sampling, lab analysis, technology selection, lab and/or pilot testing, treatment system operation and final disposal/destruction of captured PFAS. The chemistry of PFAS is complicated due to the number of chemistry forms (4,000 + and counting) and in each case the optimum technology selection is based on the PFAS to be removed, interference of co-contaminants and the strategy for ultimate disposal and/or destruction of the PFCs.

This workshop is designed to educate attendees on the specific criteria to be considered for technology selection, optimization and effective operation. Practical consideration will be given to the applications development and common constraints often encountered in the initial sampling and water analyses. Technical details such as PFAS molecular weight will serve as method to prioritize technologies for potential cost effective treatment. This level of detail will be critical to the evaluation of activated carbon, ion exchange and reverse osmosis membranes used individually or in some combination.

Presenter: John Peichel, SUEZ Water Technologies & Solutions, Minnetonka, MN

Thursday, November 12, 2020
Time: 9:00 AM – 1:00 PM (EST)

W9: PRODUCED WATER SOCIETY TRAINING FUNDAMENTALS OF WATER TREATING, HANDLING AND MANAGEMENT

This course will have 4 modules. The first and last will consist of overview level information, while the second and third modules will present deep dives on development lifecycles and water management lifecycles from production through to disposal, reuse or trading. The course will offer a foundations-level knowledge of water chemistry applicable to produced water management..

This course will answer the following:

- What are the challenges?
- Where do opportunities lie?
- What are the volumes of water at play and what's required to move them?
- What are the differences between water reuse treatment options?
- What should we expect for the future of the region?

Participants will leave with an understanding of common terminology and jargon, water chemistry and how treatment works (via jar testing demonstrations), best practices for water handling and management in unconventional plays.

Presenter: Chip Westaby, Turner Designs Hydrocarbon Instruments, Kirkwood, MI

W10: ELECTRODEIONIZATION

Electrodeionization (EDI) is a hybrid of two well-known processes, ion-exchange deionization (IX) and electrodialysis (ED). It was developed to allow the production of deionized water without the use of the hazardous acid and caustic that is required to regenerate ion exchange resins. EDI is now over 30 years old and is used extensively in many industries, especially in the production of deionized water for pharmaceutical formulations, power generation and manufacture of microelectronics/semiconductor devices. It is usually employed as a polishing demineralization step with reverse osmosis (RO) upstream as the roughing demineralizer.

This workshop will start by reviewing the principles of the EDI process, how it differs from IX, how EDI modules are constructed, and EDI feed water requirements. It will then focus on practical aspects of EDI system design, operation, maintenance and troubleshooting. This is an introductory course that requires no prior exposure to electrodeionization or electrodialysis. Some prior knowledge of basic water chemistry will be helpful.

Presenter: Jonathan Wood, Evoqua Water Technologies, Lowell, MA

W11: FLOW ACCELERATED CORROSION AND IRON MONITORING

The intent of this workshop is to educate those who are responsible for operating and maintaining high pressure steam systems regarding an industry wide concern. Flow Accelerated Corrosion (FAC) has proven to be a widespread issue across the Power and Steam verticals that has claimed lives as a sort of "silent killer". Yet, to date, many facilities still either do not have a plan in place to remedy the problem or the ability to monitor its presence and progression.

In this workshop, the presenters will walk through an overview of the phenomenon and where it occurs. They will then move to discussing the various technologies available for identifying its presence. A more detailed discussion will be had regarding simple monitoring programs that can be implemented at nearly any facility, regardless of size or staffing. Finally, some of the options that have shown some promise for controlling FAC will be reviewed.

The workshop will be co-presented by Denton Slovacek, Application Development Manager for Power, and Ken Kuruc, Industry Application Manager for Fossil Power, both with Hach. Together, Denton and Ken have over 50 years of experience working on water and steam applications across multiple vertical markets.

Presenter: Ken Kuruc, Hach, Loveland, CO

W12: ARSENIC AND SELENIUM IN WASTEWATER TREATMENT

Changes in regulations in the coal-fired power industry and existing standards in the mining industry are but two examples of increased regulatory attention on arsenic and selenium. These ions have not been the focus of wastewater treatment historically. Many new technologies are being promoted for use in arsenic and selenium treatment. However, it is difficult to assess the real potential of treatment technologies to cost-effectively achieve the desired goals without substantial background in this area. This course provides a sound basis for those concerned with arsenic, selenium or both to make sound decisions about treatment options. The course reviews the chemistry, sources and regulatory basis for these elements. The various treatment approaches currently available, included physical/chemical, biological, membrane, and adsorption processes, are thoroughly discussed.

The attendee can expect to gain a better understanding of the sources of arsenic and selenium in the environment, their chemistry and the approaches available to them for treatment of contaminated water.

Presenter: John Schubert, HDR, Sarasota, FL

W13: REMOVAL OF COMMON INORGANIC CONTAMINANTS

This workshop explores the behavior and methods of removal for a number of the more common inorganic trace contaminants found in water and wastewater with an emphasis on precipitation, adsorption, and ion exchange processes. The information presented will be useful to process and environmental engineers faced with the task of selecting and implementing an appropriate unit process.

The topics are arranged into approximately 25 minute segments. In addition to visual aids, a number of spreadsheet calculators are provided as well as essential data regarding chemicals, adsorption medias, and ion exchange resins. Students can expect to take away sufficient knowledge to be able to evaluate which unit process is best for a given application as well as various process requirements such as media replacement, chemical use, and waste products produced.

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

W14: INDUSTRY LEADERSHIP AND CAREER GROWTH WORKSHOP

FREE – NO Cost to attend this workshop

The International Water Conference Mentorship Committee will provide a four-hour workshop that will provide an opportunity for students and early career professionals to learn leadership and career skills that will help them succeed in the industry of water treatment. A panel of career professionals in the water industry will provide instruction and personal insight into a number of daily career and leadership skills. Topics covered will include:

- Overview of the Water Industry
- Ten "Soft Skills" that can Lead to Success in Life and Your Career
- Essential Communication Skills
- How to Interact with a "Customer"
- Diversity & Inclusion in the Water Industry
- How to Stand out Amongst our Peers
- Maintaining a Work-Life Balance
- Industry Panel Discussion and Q/A

This workshop will be interactive and will provide opportunities for participants to engage in useful dialogue to gain understanding and familiarity with the concepts presented. In addition to short presentations on each topic, participants will be asked to collaborate with each other on activities that provide simulations into real life situations. The goal of this workshop is to energize and equip each participant with skills and tools that can provide a lifetime of support and help change their career trajectory for the better. Additionally, participants will have the opportunity to interact with water industry experts and hear their stories and get their advice.

Presenters: Jonathan Shimko, McKim and Creed, Pittsburgh, PA; Tom Higgins, Ph.D., P.E., Worley, St. Augustine, FL; Colleen Scholl, HDR, Whitewater, WI; Jane Kucera, Nalco Water, an Ecolab Company, Naperville, IL; John Yen, Graver Water / Ecodyne, New Providence, NJ,; Lyndsey Wiles, Microdyn-Nadir, Goleta, CA

W15: UF, RO AND EDI MAINTENANCE AND CLEANING

Provide a simple view of what are considered two complex problems; what RO and CEDI operating data to collect, how to evaluate the data, how to determine the most probably foulants, and generic methods for cleaning foulants off RO membranes and CEDI modules. Discussion of RO membrane cleaning includes how to minimize the need for cleaning with recommendations for selecting and optimizing RO pretreatment and optimizing RO operation. Discussion of optimizing operation includes introduction to Filmtec WAVE software. Discussion of RO data evaluation includes using a data normalization spreadsheet. Discussion of CEDI cleaning includes the three most common foulants, how to avoid them, and generic cleaning solutions and procedures. Source material is 40 years of field experience as a technician, sales representative, and technician and customer trainer. Source materials for RO-membrane care includes Evoqua's internal expertise, recommendations from RO membrane manufacturers and RO-membrane-cleaning formulators. Source materials for CEDI data collection and cleaning includes IonPure's expertise.

Presenter: Robert Cohen, Evoqua, Rochester, NY

Thursday, November 12, 2020
Time: 2:00 – 6:00 PM (EST)

W3A: ION EXCHANGE TECHNOLOGY AND PRACTICAL OPERATING PRACTICES (REPEAT)

Ion exchange technology is not new yet most industrial ion exchange systems do not operate at top efficiency. Ion exchange technology is often not well understood by operating personnel. The participant of this workshop will:

- Better understand basic ion exchange equipment, operations, and resins used for water treatment operations
- Better understand what can go wrong with ion exchange systems
- Develop a logical troubleshooting approach to discover and correct operating problems.

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

W16: INDUSTRIAL SEDIMENTATION PRINCIPLES, PRACTICES AND HANDS-ON EXPERIENCE

For many people, sedimentation including clarification and thickening is somewhat of a black-box process. Because of the wide array of process variables; sizing, troubleshooting and optimization of sedimentation equipment can be difficult. This workshop is designed for owners, consulting engineers, plant process engineers and plant operators who could benefit from a deeper understanding and application of sedimentation principles. In this course, fundamental principles of sedimentation are discussed and demonstrated in both live and simulated scenarios. This hands-on experience will solidify understanding of the principles and facilitate their application in specifying and operating clarifiers, thickeners, solids contact clarifiers, settlers, ballasted floc units and many other types of sedimentation equipment. At the end of this course the participant will have a better understanding of settling types, coagulation, flocculation, solids contacting, testing, and troubleshooting. There will be opportunities to discuss specific challenges you might have with a panel of experienced engineers and educators who can help you better understand your sedimentation process needs.

Presenters: Harley Schreiber, Jaron Stanley and Jeff Easton, WesTech Engineering, Salt Lake City, UT

W17: COAGULATION AND FLOCCULATION: THEORY, PRACTICE, AND EXAMPLES

The workshop has three major objectives;

(1) Provide a sound basis of theoretical understanding – The discussion will be suitable for both engineers and operating staff and will provide a solid basis of understanding applicable to virtually any industry. Students will be introduced the concept of colloids and particle stability, the measurement of particle charge with zeta potential and streaming current instruments, the role that

dissolved organic material (such as color and humic acids) plays in coagulation, and most importantly the relationships between particle charge and clarification and filtration performance. The fundamental chemistry of inorganic and organic coagulants, and especially the critical role of pH, will be described. This background theory section will provide a solid understanding of the chemical behavior of "coagulant" chemicals both for "coagulation" applications for particle removal, but also for precipitation and surface adsorption applications commonly employed for metals and metalloid (As, Se, Hg removal).

(2) Provide a clear summary of typical industry practices – The students will understand the practical differences between inorganic and organic coagulants and flocculants (i.e., charge type, molecular weight, percent charge, physical form), typical industry practices for makedown and application of coagulants and flocculants, and design features for coagulation and flocculation systems (i.e., tank features, mixer energy, shear, and tip speed, etc.),

(3) Illustrate Common Industrial Applications – Students will be introduced to a broad spectrum of water and wastewater applications across the major heavy industries. The course will discuss applications such as common clarification and filtration, lime soda softening, biofloc, biopolymers and augmentation with flocculants, oily water treatment, and dewatering applications. The students will understand realistic expectations for the performance impacts of coagulants and flocculants as applied for varied applications and industries.

Presenter: Ken Martins, Stantec, Irvine, CA

W19: ACID MINE DRAINAGE: ORIGIN, CAUSES AND ENVIRONMENTAL IMPACTS, RECYCLE AND REUSE TECHNOLOGIES

Acid mine drainage (AMD) is a very acidic and contaminated wastewater generated from mine operations. It is currently one of the largest environmental problems facing mining companies and municipalities regarding its management. The main objective will be: To share with delegates, unbiased expertise and advocacy with respect to the causes, management and amelioration of the impacts of Acid mine drainage (AMD) the specific objectives are described as follows:

- To provide in-depth overview of AMD around the world
- To describe the origin and the formation of AMD
- To analyze the in details the environmental impacts of AMD
- To provide information related to treatment methods, recycle and reuse strategies of AMD

Presenter: Dr. Joseph Bwapwa, Mangosuthu University of Technology, Durban, South Africa

W21: CHLORINE DIOXIDE: CHEMISTRY, GENERATION, ANALYSIS, ENVIRONMENTAL ISSUES AND APPLICATIONS

The goal is to provide attendees with a working knowledge of ClO2, including safety, production chemistry and equipment, reaction chemistry, analytical, environmental issues, and some specific applications such as cooling towers, influent treatment, biofilm control etc. The book included is essentially a technical manual with references.

Presenter: Greg Simpson, Pureline Treatment Systems, Houston, TX