COOLING TECHNOLOGY INSTITUTE

THE ANNUAL CONFERENCE NEWS FOR MANUFACTURERS, OWNER/OPERATORS, AND SUPPLIERS OF HEAT REJECTION EQUIPMENT

PUBLISHED ANNUALLY - $5.00

2024 ANNUAL CONFERENCE NEWS

PLAN

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PRESIDENTS NOTE

Ken Mortensen
SPX Cooling Technologies

In February, I will complete my term as your CTI President for 2022-2023. Indeed, it has been a privilege and an honor to serve this Organization in this capacity. I will always cherish this experience and the time I spent with all of you, individually and collectively. What a fun ride!

In early 2024, President – Elect Jim Baker will take over the helm. Congratulations to Jim on his election for the second time as CTI President. Jim served previously as President from 2004-2005, when he worked for SPX/Marley Cooling. Jim is unique among CTI Members. I do not know of anyone else who has participated in CTI, as an Owner/Operator [Phillips], a Manufacturer [SPX/Marley Cooling], and now as a Supplier [Galebreaker]. This gives him an exciting and comprehensive perspective on what CTI means. Jim is an excellent communicator and an important leader in our business. He is highly qualified and will do a fantastic job.

Our organization is especially important in the global cooling and refrigeration markets. As I stated in my 2022 ASHRAE Article, **A Review of Evaporative Cooling's Efficiency and Environmental Value**, "Global populations dependent on cooling and refrigeration to support many types of manufacturing and energy production processes. Evaporative cooling has been a transformative technology enabling innovative mass production and is substantially more energy efficiency than alternatives... Air conditioning is the third largest category of commercial building energy use, after refrigeration and ventilation. Of the available methods, evaporative cooling requires the lowest energy input per unit cooling output, effectively minimizing fossil fuel usage, CO2 production, and related environmental impacts." CTI is a strong brand. It is our job to keep it well positioned for the long-term future.

The Last Two Years

CTI has made substantial progress as an organization during the last two years. From the Website upgrade to the prototype SharePoint based electronic document handling system, to process improvements in finance and staff capabilities, we are planning for the long-term success of CTI. When I began as President, my thoughts on top issues included: successful restart of in-person meetings, completing the Website upgrade, Technology Utilization for documents and meetings, and succession planning. We have made progress in all these areas.

Meetings - The re-emergence of this organization, as it has historically existed, depended on a strong return to in-person meetings after the pandemic. Many comparable member-based non-profits were struggling with this issue. Through the strong work of Vicky Manser, with help from Drew Manser, Angie Montes, and Kelli Velasquez, the Office set a course to promote the "Value of CTI" and re-engage the Membership in coming together in 2022, after being shut-down and remote for the 2021 Winter Conference. Vicky emphasized the organization's relevance and substantial technical value and willed the 2022 Conference to success. CTI's results have been better than most comparable organizations, achieving 74% and 81% of pre-pandemic attendance levels in 2022 and 2023. Bravo, well done, Vicky!

Website - The new Website was rolled out before the '22 Summer Meeting. A solid and diverse team that included Vicky Manser, Drew Manser, Angie Montes, Kelli Velasquez, Michael Rodriguez, Frank Morrison, Mike Womack, Joanne Haynes, Jared Medlen, Steve Chaloupka, and Jim Baker completed Phase I of this substantial changeover. Thermal Certification Information was one of the major keys. The voluminous data had to be presented in an accurate, timely, and completely accessible format to have the website fully functional. The Team completed and tested plans to upload and revise this information on a continuous basis. System trials were then completed by Performance and Technology Committee's hand-picked Beta phase users. The team had to solve an access problem for Asia market and in the end had to provide a mirrored website host for the China market to complete global access. Phase I finished the basics providing Home Page, Thermal Certification verification, Publications links, and current Press Releases/Blogs. Phase II, in process, adds functions enabling a Regulatory Issues Newsletter, availability of the CTI Thermal Performance Tool Kit, Committee Pages, and a section for Members Only Access and Content.

Technology – With the Website upgrade work completing in Spring/Summer '22, it would become the CTI's base of communication. An Engineering Standards and Maintenance based group, including James Blake, Nina Woicke, Joe Evans, Bill Howard, Steve Witt, Jamie Bland, Jared Medlen, Scott Nevins, and Michael Rodriguez, created a plan to allow online access and updating of the Meeting Scheduling, via spreadsheet containing 5 documents: the Master, 3 Standing Committees schedules, and Schedule at a glance. Additional focus on OneDrive and subsequently SharePoint as the storage system for Document work was next. Concepts such as added

Revision notes to Standard/Guideline work had to be incorporated in the technology plan. This Tech group met with P&T, WT, and CTI office and continues to work on creating a database with Technical Committee rosters, schedule, documents list, working documents system with on screen edit, to increase efficiency of the document writing and revision processes. Board of Directors reporting and discussions advanced the supporting concepts.

Organizational Succession and Structure – In 2023, CTI has conducted both Financial and Human Resources Audits to provide input and direction for functional changes to the Organization. CTI has grown from a tiny industry organization operating on a shoestring budget to a major technical resource in our markets, under the care and supervision of Vicky Manser. A restructured CTI Personnel Committee, along with an HR Consultant, have been added to our tools going forward. CTI is in-process on communication, leadership, and succession discussions that insure the Organization's long-term well-being.

Looking Forward

CTI Office and Leadership are now looking forward to future plans that include Organizational Alliances, such as a proposed CTI/AWT working agreement, more robust engagement on Regulatory issues, and a thorough Insurance Evaluation for the organization.

There is a starting proposal for ongoing involvement with AWT, the Association of Water Technologies, as a substantial and fruitful source of complementary expertise for both organizations. CTI is beginning to reach out to parallel organizations, where strategically advantageous. Here I would like to cite the vision of Michael Bourgeois, Chemco, Past President of AWT, and AWT Liaison to CTI, for his thoughtful proposal on a working relationship between the CTI and AWT organizations. Such an agreement might include Joint Branded CTI/AWT for Documents, Copyrighting, and perhaps Matrix of Membership permission/attribution, with discount registrations both ways. AWT also offers good training options that CTI is not in position to create.

In the Regulatory space, there are many government and technical organizations that make rules that impact CTI businesses. CTI needs to be more active and engaged during rule-making processes. An example of this type of activity is the CTI response to California Title 24 change proposals, where direct involvement was pushed to good effect by persistent and factual communication, allowed positive change to California Energy Commission proposals. The main drivers were Frank Morrison, Paul Lindahl, and individuals at Evapco, BAC, and SPX/Marley. There are many exciting issues to look forward to!

Finally

If you recall my Summer Meeting address and Summer Journal column in which we examined U. S. economic conditions and data, including GDP, Gross Domestic Product, Unemployment rate, Inflation rate, Interest rate, and stock market indices, I can report that the United States is not in recession, so far. Stay tuned. Quiz to follow...

Best Regards to You All and Thanks Again for a Wonderful Two Years –

Ken Mortensen

FROM THE PROGRAM CHAIR

Phil Kiser
Program Chair

Your Program Committee invites you to the 2024 CTI Annual Conference in Houston, TX, from February 4-8, 2024. We have an excellent program for you, featuring more than 25 technical sessions being presented in concurrent sessions on Monday and Tuesday ranging in topics from water treating, performance and technology, and engineering standards and maintenance.

In addition, we're pleased to announce the return of both the Owner/Operator Seminar and the Water Treating Panel Discussion. And while you're there, don't miss out on the annual Ask-the Expert Seminar featuring experts on a range of topics and all prepared to answer your questions during a live Q&A event.

Phil Kiser

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Westin Galleria • Houston, TX

Tuesday, February 6, 2024

Layout for Exhibits - as of November 14, 2023

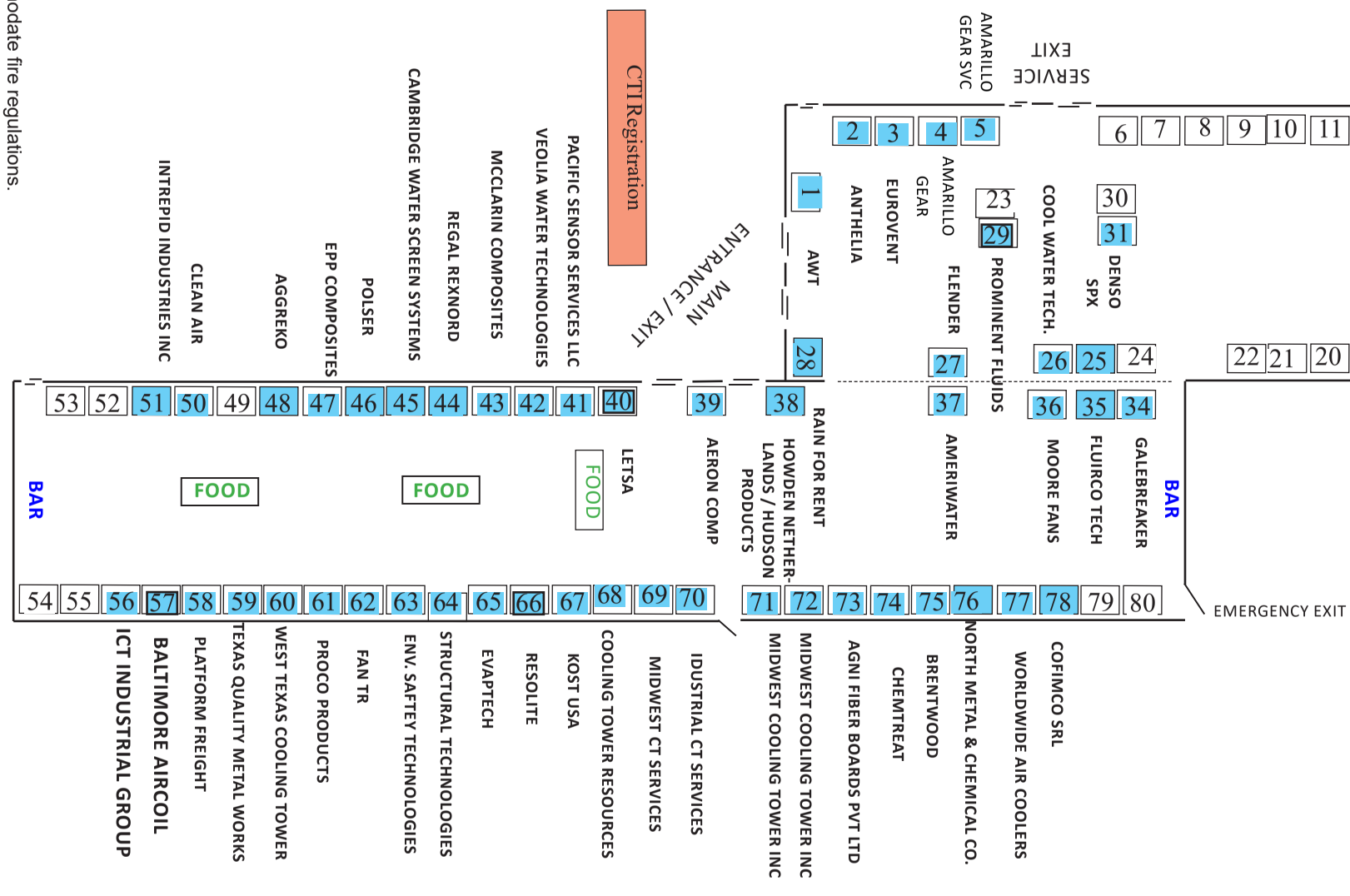

***Table subject to be moved to accomodate fire regulations.

OWNER | OPERATOR SEMINAR

Lee Seela
Black & Veatch

Lee Seela is a specialist in the Mechanical Engineering group at Black & Veatch. He specializes cooling towers, ACC, fluid coolers, WSAC, and fin-fan coolers. His career experiences range from being a Nuclear Machinist's Mate in the US Navy, manufacturing and facilities maintenance, and cooling tower research and development prior to obtaining his Mechanical Engineering degree. At Black & Veatch, Lee handles all aspects of cooling towers for his clients. From new tower designs including the pump intake basin to analyzing vendor proposals for tower refurbishments

Dr. Stuart Cain
Alden Research Laboratory

From Pump to Plume: CFD Modeling to Enhance Cooling Tower Performance

ABSTRACT: Computational Fluid Dynamics (CFD) is a powerful tool for troubleshooting and optimizing cooling tower performance. In this paper, we highlight two important case studies which showcase its applicability in solving challenging problems related to cooling tower fluid flow and heat transfer. The first study utilizes CFD modeling during the initial design process to evaluate the extent to which the high temperature, high humidity cooling tower exhaust plume is re-circulated into the proposed cooling tower ambient air inlet and suggest modifications to ensure favorable plume dynamics. The second study employs a combination of CFD and physical modeling to determine the cause of reduced condenser flow (and subsequent increase in plant heat rate) in a ring header following a cooling tower upgrade project and develops a piping modification which restores full flow.

BIO: As Associate Vice President and Technical Lead, Dr. Cain collaboratively develops the future direction of the company. Dr. Cain also brings significant technical expertise and project management experience to the Alden Area. For 30 years, he has utilized CFD and physical modeling to solve complex two and three-dimensional fluid flow problems involving civil hydraulic and mechanical structures, nuclear and fossil power plant systems and components, and process gas flow systems. He has managed large, multifaceted, projects including safety-related nuclear power plant system modifications involving extensive utility/regulator interface and management. He has written and developed numerous computer codes for studying both internal and external flows and has experience using the commercial codes Fluent and Flow 3D.

Dr. David Werth
Clemson Engineering

Lessons Learned In Cooling Tower Pump Intake Design

ABSTRACT: Physical modeling has long been used for final design, optimization and Hydraulic Institute compliance of pump intake structures. Cooling water pumps are a critical component of any cooling tower design and they are particularly sensitive to the transition from basin to intake. This paper shares our experience in modeling hundreds of cooling tower pump intakes and discusses the pros and cons of several different types of transitions including vertical step, sloped floors and recessed configurations. Case studies are presented which show the sensitivity to minor details and the importance of considering the intake transition early in the tower siting and design and how these minor details can significantly impact pump performance.

BIO: Dr. Werth has over 30 years of hydraulic modeling experience and specializes in physical hydraulic modeling, pump station and intake design, hydraulic structure analysis, pipeline hydraulic studies and energy losses in both open and closed conduit flow regimes. Dr. Werth has conducted over 1000 physical hydraulic model and lab studies including pump intake structures for water & wastewater, the power industry, control structures, mixing systems, diversion works, closed conduits, river works and erosion control structures, cavitation, transients, energy loss, and dissipation and efficiency.

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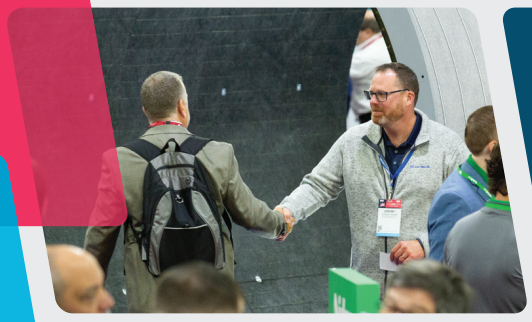

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EDUCATIONAL SEMINAR

Keep Updated with Our Educational Seminar!

Frank Morrison
Baltimore Aircoil

Scheduled for Wednesday morning of the Winter Conference, our 2024 Education Seminar will be packed with many timely topics presented by experienced Industry experts that are relevant to many of your upcoming projects. The first session will cover selecting the proper materials for cooling tower fans and fan blades that can help ensure successful tower performance and a long service life for this critical tower component. Our second session will focus on cooling tower maintenance and will provide key information to keep your towers running efficiently and safely under any service condition.

A frequent topic in the news today is the growing scarcity of fresh water. Our third session will address alternative source of make-up water for cooling towers, both external and internal. The Speakers will provide key insights on the use of treated municipal sewage plant effluent (reclaim) water for cooling tower make-up as well as explore opportunities to reuse internal water sources from within the facility itself.

Lastly, focusing again on the use of water, a relatively new class of heat rejection will be explored in the fourth and final session. Adiabatic heat rejection offers energy savings versus traditional air-cooled designs while enabling water savings compared to conventional evaporative heat rejection. In this session, you will learn more about adiabatic devices operate and explore the balance between the use of water and energy with all three classes of heat rejection.

Each session will highlight relevant CTI publications, available at the conference for a nominal charge, that can assist you in the day-to-day operation of your facility. There will also be time for your questions and responses from our speakers on their presentations.

Please join us for an exciting Educational Session filled with information on timely topics that you can start applying in your work immediately after the conference! PDH credits will be offered for attendance.

Alternative Sources for Cooling Tower Makeup Water

David Anton
Ascend Materials

Robin Wright
Veolia

Part 1: Reclaim Water

Over the past four decades, freshwater scarcity has forced industrial plants to seek alternative makeup water sources for their open evaporative recirculating cooling water systems. In North America, treated municipal sewage plant effluent, sometimes referred to as “reclaim water,” is the primary source of externally generated reuse water for cooling tower make-up. This often requires adjustments to the cooling tower chemical treatment, and may require softening, filtration, or changes in cooling system metallurgy. Factors such as the type of cooling tower fill being used, the presence of heat exchangers with cooling water on the shell side, and environmental discharge constraints must be considered. The discussion will also provide examples where unique chemical treatment programs have enabled cooling water systems to operate successfully using reclaim water.

Part 2: Internal Water Re-use

The second part of the discussion will examine internal water re-use and focus on driving factors (water restrictions, sustainability), financial considerations (water and sewage costs, impact on service and chemical providers) and system management issues (internally operated or outsourced). The steps for development of an internal water recycle project will be outlined. This involves a site water mass balance, creation of a detailed water specification including system constraints and energy use optimization, as well as analysis of factors such as ranking of waste streams for treatment potential, layers of protection, and ability to meet specifications. Examples of successful internal water re-use and recovery systems will be provided.

Yoram Yerushalmi
YWCT Ltd.

Session: Cooling Tower Service and Maintenance: A Comprehensive point of view

ABSTRACT - The maintenance of cooling towers involves multiple organizational departments, each with its own agenda, including Operations, Process, Maintenance, Procurement, and Environment. To truly optimize this process and bring maximum value to the owner, it is essential to adopt a comprehensive and holistic point of view.

This seminar aims to introduce three prisms through which maintenance value can be estimated: Cost, Availability, and Performance. Additionally, optional Key Performance Indicators (KPIs) for each prism will be presented, along with a detailed methodological implementation plan.

SPEAKER BIO - Yoram Yerushalmi is a third-generation leader in the cooling tower industry, with almost 20 years of expertise as CEO of Yerushalmi Water Cooling Towers Ltd. (YWCT), Israel's premier cooling tower manufacturer. Despite an eclectic educational background, which includes a B.A. Program for Honor students in Philosophy and Economics from Haifa University, completion of law school at Bar Ilan University, and an MBA from Kellogg School of Management, Northwestern University, and Tel-Aviv University in Israel, Yoram's profound knowledge and lifelong exposure to cooling towers have made him an authority in cooling tower maintenance.

Ricardo Reis Costa
FanTR

Leandro Moutinho
FanTR

Title: Selecting Materials for Fan Blades and Fans: A Comprehensive Guide

ABSTRACT - This session provides a comprehensive guide on selecting materials for fan blades and fans. It covers the various materials available in the market for fan manufacturing, including their strengths, weaknesses, and the parameters considered by fan suppliers when choosing materials. The presentation also discusses the manufacturing processes involved in fan and fan blade design and their relationship to the materials used. Emphasis is placed on the importance of selecting the appropriate material based on specific application requirements. Additionally, the session will briefly touch upon different types of hardware, their advantages, cost impacts, as well as the standards and qualification process for testing fan structures in validation and fatigue tests.

SPEAKER BIO(S) - Ricardo Reis Costa holds a degree in Aeronautical Sciences with academic experience in Aerospace Engineering and Business Administration. With 16 years of experience, he began his career working on wind tunnel projects and has since been involved in research and development of ventilation systems, axial fans, experimental design, and composite materials. Ricardo has over 15 years of experience in product testing and validation, structural analysis, aerodynamics design, computational fluid dynamics (CFD), automation, and control. He is currently a member of the Research and Development team at FanTR, responsible for blade designs and aerodynamic assurance.

Leandro Moutinho is a mechanical engineer specializing in thermomechanical and fluid dynamics. He has built a distinguished career as a cooling tower expert and has been instrumental in GEA/Kelvion's success in the energy, petrochemical, and chemical sectors in Latin America. With over 15 years of experience in commercial, product engineering, and contract management, Leandro has been at the forefront of technology exchange between cooling tower companies in Europe and Latin America. He brings his expertise in manufacturing processes to his current role as the Global Sales Manager for Cooling Tower Fans at FanTR.

Andrew Sickler
Baltimore Aircoil

Fundamentals of Adiabatic Heat Rejection

ABSTRACT - Adiabatic heat rejection has become more widely available, saving energy and water without the need for water treatment. Engineers and owners are now challenged with comparing the benefits and tradeoffs of air-cooled, water-cooled, and adiabatic systems. After attending this session, you will know how to compare different cooling systems, when adiabatic units are right
for your projects, the different types of adiabatic coolers and condensers available, and requirements for code compliance.

SPEAKER BIO - Andrew Sickler, Senior Industrial Business Development Manager for Baltimore Aircoil Company, a global leader in sustainable cooling solutions. Andrew has seen many facets of mechanical systems in his career. He has held various positions including service technician (while finishing his engineering degree), service manager, construction project management, and project engineering. This background shapes Andrew's approach and allows him to deliver his clients thoughtful and responsible solutions to their engineering and design challenges.

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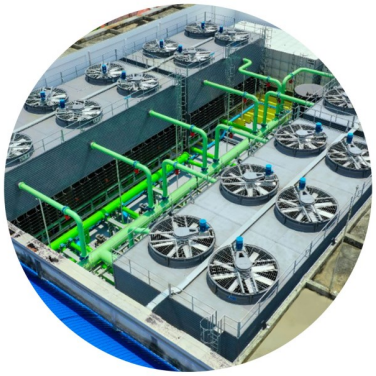

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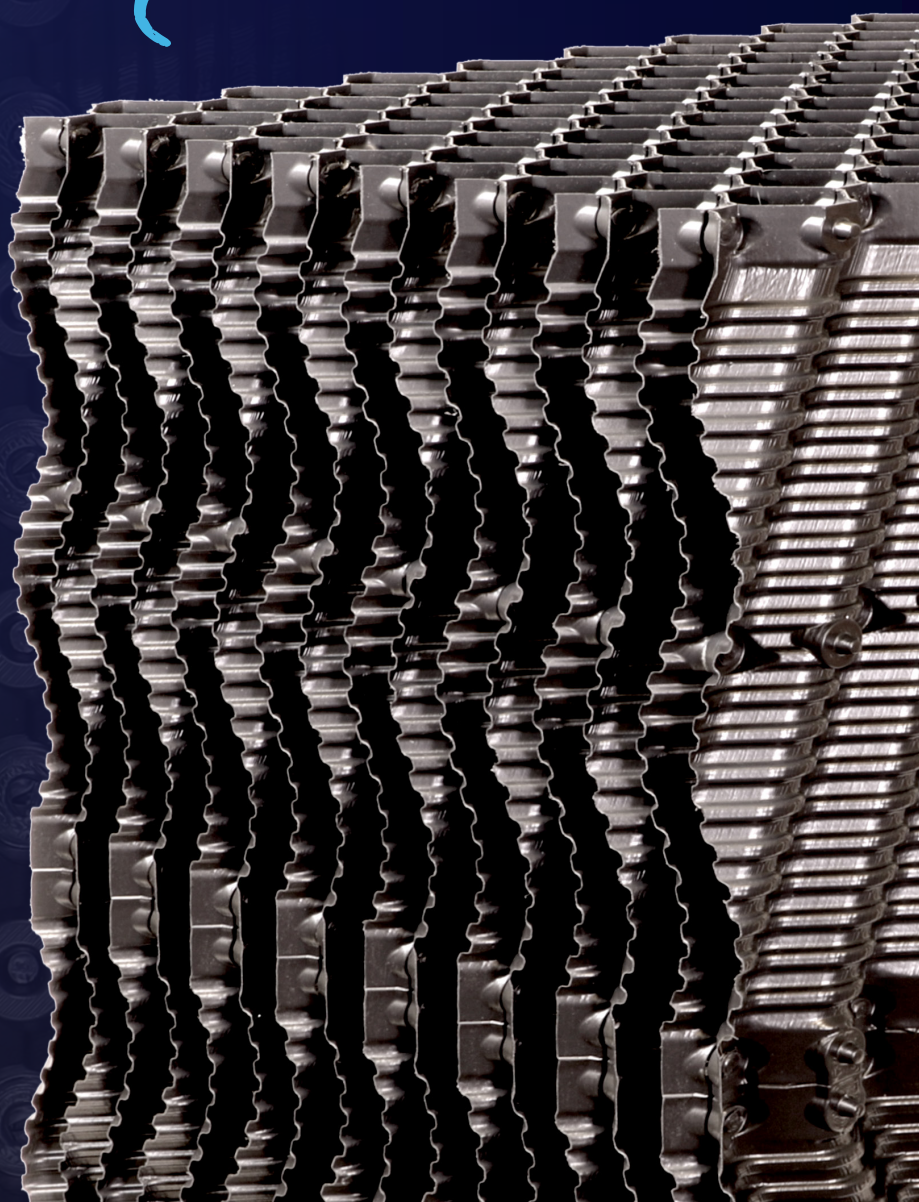

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WATER TREATING DISCUSSION

2024 Water Treating Panel Discussion

Water Treating Panel Discussion, Chair - Jack Bland, ChemTreat
Water Treating Panel Discussion, Vice Chair - Al Feltzin, Becht, Inc.

The 2024 Water Treatment Panel Discussion (Monday, February 5, 2:00-3:30 pm) will address the importance of microbial control in evaporative cooling water systems. Jack Bland (Panel Discussion Chair) will provide an overview of the topic and introduce four expert panelists who will highlight the critical need for biological deposit prevention, monitoring techniques, and the consequences of improper microbial control in industrial cooling water systems.

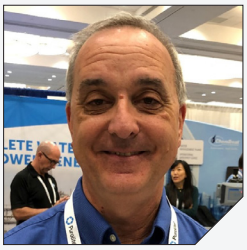
Expert panelists from Buckman laboratories, ChemTreat, Veolia Water Technologies, and Calpine Corporation will discuss individual topics. Al Feltzin (Panel Discussion Vice Chair) will summarize expected learnings and takeaways, followed by a 20–30-minute open discussion for questions and answers.

- A general introduction is provided, showing the cooling water treatment triangle and how the vertices of the triangle relate to one another. This review of MB basics will set the stage for arriving at the critical need for microbial control. Monitoring of dosages and performance is also addressed in this section.
- The consequences of biological activity and fouling, MIC, heat transfer reduction, tower collapse, and Legionella impact the total cost of ownership and have potential negative health consequences, driving home the point that MB control is a must.
- Consequences of MB including real-world examples from an experienced owner-operator. He will drive home the point that proper treatment is necessary in every phase of the operation. "Negative" examples such as severe localized corrosion, and tower fill collapse are presented.
- The need for a holistic microbial control program – oxidizer, non-oxidizer, bio dispersant are discussed.
- Important considerations such as registered applications and discharge and environmental aspects are reviewed, along with a brief recap/summary.

Please join the Water Treating Committee for sponsoring this important aspect of cooling water system state-of-the-art with respect to microbial control.

Jack Bland
ChemTreat, Inc.

Al Feltzin
Becht, Inc.



Stan Avallone
Calpine

Chris D. Baron
ChemTreat, Inc.

Janet H. Woodward
Buckman

Philip Yu
Veolia WTS

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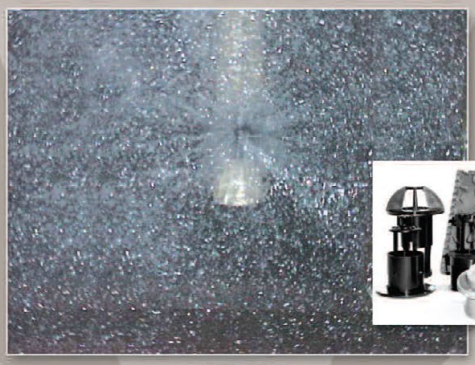

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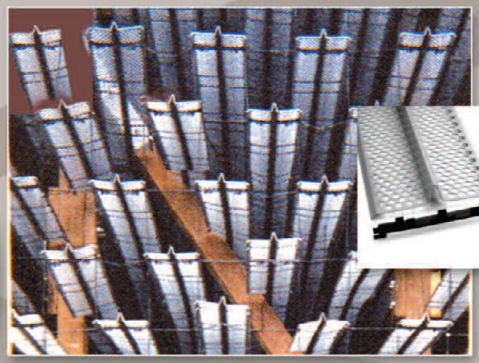

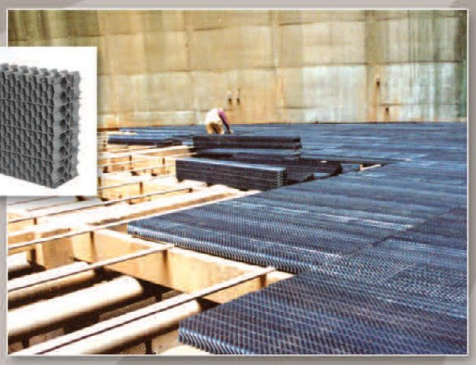

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COMMITTEE CHAIRS

ENGINEERING STANDARDS & MAINTENANCE

(from left to right) Ken Mortensen, SPX, James Blake, American Lightning Protection Systems, Joe Evans, SPX, Jamie Bland, Composite Cooling Solutions, Jon Bickford, Alliant Energy

PERFORMANCE & TECHNOLOGY

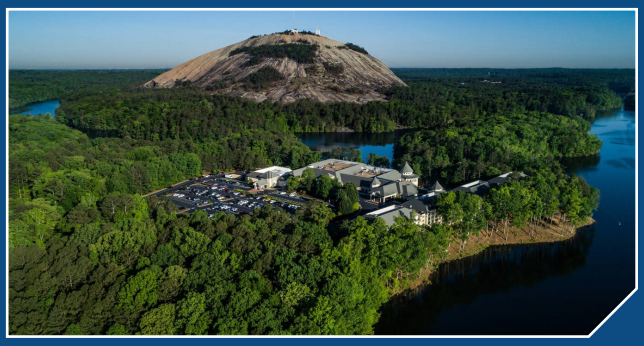
(from left to right) Scott Nevins, Evapco, Jared Medlen, Mesa Associates, Nick Mascarenhas, Baltimore Aircoil

WATER TREATMENT

(from left to right) Bob Hendel, Veolia, Al Feltzin, Becht, Inc., Pete Elliott, ChemTreat, Inc.

SAVE THE DATE !

2024 Annual Conference and CTI Expo
February 4-8, 2024
The Westin Galleria
Houston, TX



2024 Committee Workshop
July 14-17, 2024
Atlanta Evergreen Lakeside Resort
Stone Mountain, GA

2025 Annual Conference and CTI Expo
February 2-6, 2025
The Peabody Memphis
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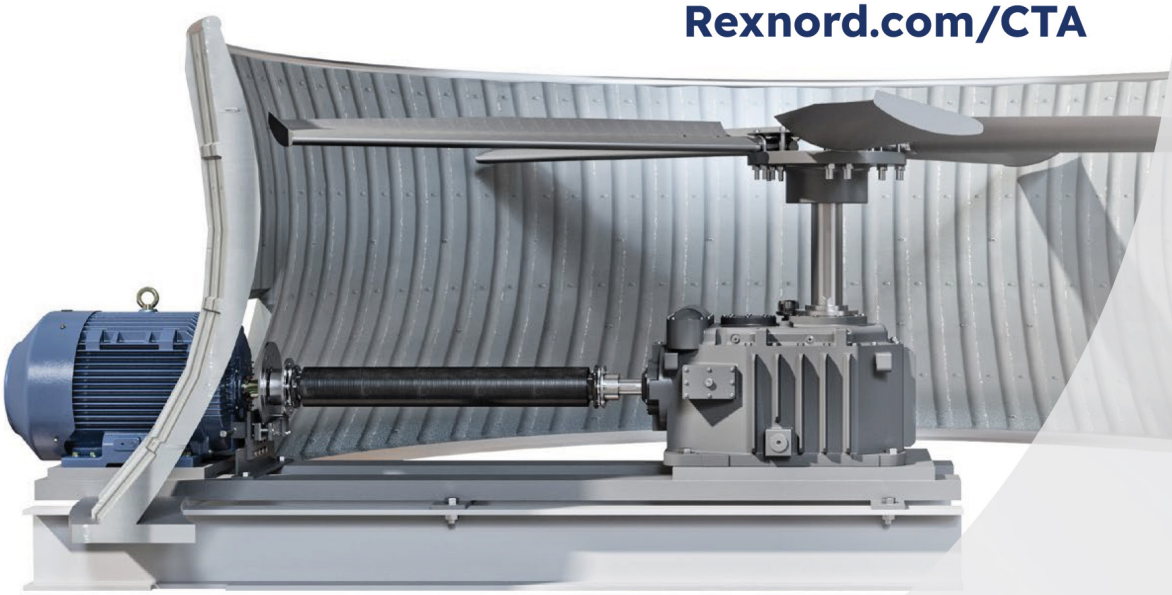

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TECHNICAL PAPERS

TP24-01 – Overview of the Features of CTI ToolKit Version 4.0
Dave Wheeler, CleanAir
2/05/24 – 8:30 AM

In 2023, CTI will release the newest version of CTI Toolkit®, version 4.0. In addition to being compatible with the newest versions of computer operating systems, this version of the program offers an improved user interface, extended help functions, and learning tools. The new version preserves the features of the earlier versions of the program such as psychrometrics and the analysis of thermal performance data using the performance curve method. The paper presents an overview of the features of the newest version of CTI Toolkit®.

Mr. David Wheeler has been the Technical Director of CleanAir's Performance Group in Knoxville, Tennessee since the group's inception in 2006. Mr. Wheeler has designed and conducted hundreds of power plant component tests, successfully collecting temperature, pressure, flow, and power data in some of the most challenging commercial environments. Much of his research and technology development has focused on thermal and drift emissions testing for cooling towers and he has authored numerous papers on these and other related topics including measurement uncertainty. He is passionate about getting accurate and reliable data in real world applications. He has been participating in the CTI since the early 1990s. At various times He has served on most of the CTI Test code committees in addition to his participation in the ASME test codes PTC 23 for Atmospheric Water Cooling Equipment and PTC 30.1 for Air Cooled Steam Condensers. He is currently chairman of the task group for water flow measurement, CTI STD 146 and was the lead author of the CTI Pitot Study Report. Mr. Wheeler received a BS in Chemical Engineering and an MS in Environmental Engineering from the University of Tennessee, and he is a Registered Professional Engineer in the State of Tennessee.

TP24-02 – Water Impurities: What You Don't know Can Hurt You
Brad Buecker, Buecker & Associates
2/05/24 – 8:30 AM

As is well known, experienced people, e.g., Baby Boomers, across many industries are retiring. This "brain drain" is forcing many younger personnel to learn new concepts very quickly. This paper, which could also be titled "Water 101", is designed to outline important water fundamentals to help those new to the cooling water industry. For example, even seemingly minor upsets in cooling water biocide systems can allow explosive growth of microorganisms that foul cooling tower fill, process heat exchangers, and other system equipment. The increasing use of alternatives to fresh water supplies such as wastewater treatment plant effluent may introduce excessive impurities to cooling systems, including suspended solids, food and nutrients for microbes, and even corrosive agents such as chloride that can attack certain metals. These topics and more will be highlighted in this paper.

Brad Buecker most recently served as Senior Technical Publicist with ChemTreat, Inc. He has over four decades of experience in or affiliated with the power and water treatment industries, much of it in steam generation chemistry, high-purity makeup water treatment, air quality control, and results engineering positions with City Water, Light & Power (Springfield, Illinois) and Kansas City Power & Light Company's (now Evergy) La Cygne, Kansas station. He also spent two years as acting water/wastewater supervisor at a chemical plant, and eleven years with two engineering firms, Burns & McDonnell Engineers, and Kiewit Engineering. Buecker has a B.S. in chemistry from Iowa State University with additional course work in fluid mechanics, energy and materials balances, and advanced inorganic chemistry. He has authored or co-authored over 250 articles for numerous technical trade magazines and has written or edited four books on power plant/industrial water treatment chemistry and air pollution control. Buecker is a member of the ACS, AIChE, AIST, ASME, AWT, NACE (now AMPP), and the Electric Utility Chemistry Workshop planning committee. He is active with the International Water Conference and received the IWC's 2013 Paul Cohen Award and the 2022 Award of Merit.

TP24-03 – Characterization of Elliptical Pitot Tubes for Water Flow Measurements
Shawn Goedeke, McHale & Associates
2/05/24 – 9:00 AM

In 2018, CTI switched from simplex pitot tubes to an elliptical style pitot tubes for water flow measurements. This change was made to reduce the impact of change in Reynolds number on the calibration coefficient of the pitot tube. In addition, the new design incorporated a one-inch (1") round body to reduce the vibration of the pitot. In this process, the blockage area of the pitot probe was increased. McHale has performed calibration studies at three different laboratories, (TVA Norris Engineering Laboratory, Alden Research Laboratory, LLC., University of Illinois, Urbana Champaign) and noted changes in the estimated coefficients. These calibrations were performed in different diameter pipes at each of the facilities. The relationship between the calibration coefficients and the Reynold's Number varied from test to test. When blockage was considered, the variation in the curves was reduced. In addition, a study was performed in a uniform flow and showed the velocity followed a power law fit to the differential pressure. However, the exponent of the power law was 0.45 which is slightly less than the 0.5 that would be expected from Bernoulli's equation. Based on the variation in the results between laboratories, it is possible that the calibration process may need to be revaluated. At a minimum, if the pitot is not used in the same size pipe as the calibration was made, then blockage must be accounted for in both the calibration and the calculation of the flow.

Dr. Goedeke has experience extending from Research & Development to Power Plant Performance and Maintenance. His performance testing experience includes Gas Turbine Generators, Heat Recovery Steam Generators, Boilers, Air Heaters, Cooling Towers and Solar Energy. Dr. Goedeke is also the Cooling Tower (CTI) Program Manager with McHale & Associates, Inc. and is responsible for business development, operations, and technical leadership of the CTI Testing Program. Dr. Goedeke received his Ph.D. in Mechanical Engineering, Tennessee Technological University in December 2002 while serving as a research associate for the Electric Power Center from 1996 to 2002 and a Research Intern at ORNL from 2000 to 2002.

TP24-04 – Design Guide: Compatibility of Material of Construction for Cooling Water Systems
Loraine Huchler, MarTech Systems, Inc.
2/05/24 – 9:00 AM

Engineering designers often lack the required knowledge and/or water quality information to accurately specify compatible materials of construction in cooling water systems. Consequences include compromised heat transfer efficiency, corrosion, and premature failure. Climate change and sustainability initiatives have increased the complexity of successful equipment design due to the use of poorer-quality make-up waters, recycled sewage effluent (Treated Sewage Effluent (TSE)), and high-stress waterside operating conditions from water conservation initiatives. This paper provides guidance for equipment designers to match the water quality with the compatible materials of construction. Topics include a review of the method to convert the make-up water quality to the recirculating water quality, the maximum specification limits for various materials of construction, and compatibility issues during the commissioning of equipment.

Loraine Huchler is the founder and president of MarTech Systems, Inc., a consulting firm that assesses and manages risk in water-related utility systems. MarTech's technical consulting services optimize the water systems in influent, steam, and cooling systems in industrial and manufacturing facilities and large-scale corporate and university campuses. Other services include technology feasibility studies, water conservation and water reuse studies, technical training, and serving as an expert witness in patent infringement and equipment failure litigation.

Ms Huchler is a member of CTI and served as chair of the committee creating the water treatment guideline 176 and is a vice-chair for the task group for WTG-179: Cooling Water System Audits. She has a Bachelor of Science degree in Chemical Engineering from the University of Rochester, Rochester, New York, is licensed as a Professional Engineer, and has earned the accreditation of Certified Management Consultant® (CMC®).

TP24-05 – Investigation of Water Technology Recovery Systems for Natural Draft Cooling Towers
Christophe Duquennoy, EDF
2/05/24 – 9:30 AM

In a context of climate change, energy transition policy and new builds of nuclear plants, EDF, as a major Utility, is driven to consider for his electricity production plants, the most efficient technological solutions in terms of energetic and environmental performance. In this context, the main production heat sink technology, using water drawn from the environment, plays a major role. Its operation has a direct impact on the electric energy production, and the type of technology used implies significant quantities of water withdrawal or consumption.

In order to explore all possible means of reducing water consumption, EDF is willing to test innovative solutions for optimizing the use of water taken from the environment. One of the solutions currently being explored involves testing the applicability of the process developed by Infinite Cooling to recover demineralized water inside natural draft cooling towers. To this end, EDF plans to use its MISTRAL test facility. EDF MISTRAL test facility is usually dedicated to qualify the thermal performance of cooling tower materials (fills, sprayers) before retrofit. In 2021, France officially embarked on a program to revive nuclear power, with the aim of extending the lifespan of existing plants and building several new reactors (EPR2). In this new context, MISTRAL facility has just been rehabilitated to qualify fills to be used in existing and future EPR2 cooling towers. MISTRAL bench will also produce data for the qualification of the safety cooling towers planned in the EPR2 design. The presentation will outline the main objectives pursued by EDF through these tests aimed at characterizing water capture technology. Particularly, a preliminary assessment of water recovery potential has been made using saturated and over saturated air flow calculated with Poppe modeling approach. Then, after a general presentation of the MISTRAL test facility, fully instrumented for cooling fills performance qualification, we will show how we plan to implement the water collection system and the test procedure in order to stay as representative as possible to the real conditions encountered in natural draft air coolers.

Christophe Duquennoy is a mechanical engineer graduated from the Polytechnic Institute of Toulouse in France. After a PhD in flude dynamics, he started working in 2000 for French nuclear industry developing simulation tools for nuclear safety analyses. Since 2003, he has worked for Electricity of France (EDF), the main French operator producing 70% of its electricity with nuclear power stations. In 2008 he joined testing and department of EDF and became involved in topics concerning EDF cooling towers performance (design, testing, monitoring, R&D). Since that time, he has published papers for IAHR and CTI conferences and has gotten involved in ATC-105 and 174 CTI task group.

TP24-06 – Positive Impact of Elevated Temperatures on Yellow Metal Passivation in Recirculating Cooling Systems
Paul Frail, Veolia Water Technologies & Solutions
2/05/24 – 9:30 AM

In typical aqueous conditions, if the temperature increases, metallurgical corrosion rates and other reactions increase concomitantly. As a rule of thumb, it is often estimated that corrosion rates double for every ten degrees that the temperature increases. This general rule applies to metals in aqueous environments without the presence of corrosion inhibitors. Also, the water is often of low hardness where salt saturation is below the threshold for deposition. Industrial recirculating water systems tend to circumvent that rule since they are often operating in supersaturated conditions and the presence of corrosion inhibitors for iron and copper metallurgies. Coupon bypass racks are often used as a proxy for corrosion monitoring, but those almost always operate with significantly lower temperatures than the heat exchangers. There have been reports from the field about yellow metal coupons in the bypass rack having significantly higher corrosion rates when compared to retractable coupons taken just after the heat exchanger. This paper will explore the positive impacts of increasing temperature on passivating copper metallurgies under industrial recirculating conditions and aim to provide an explanation by examining the surface chemistry at various temperatures.

Dr. Paul R. Frail is currently an Advanced Senior Researcher with Veolia Water Technologies and Solutions with 13 years of experience. Prior to working with Veolia he completed a postdoctoral fellowship and Ph.D. degree at the University of Pennsylvania in the Materials Science and Electrical Engineering Departments and Chemistry Department. Current efforts focus on advancing deposit and corrosion control technologies for industrial cooling systems. He has led the development teams for recent product launches that utilize the engineered film concept for corrosion protection: (i) E.C.O.Film, a non-phosphorous corrosion control; (ii) Engineered Cooper Passivation, ECP Technology, for yellow metal corrosion control.

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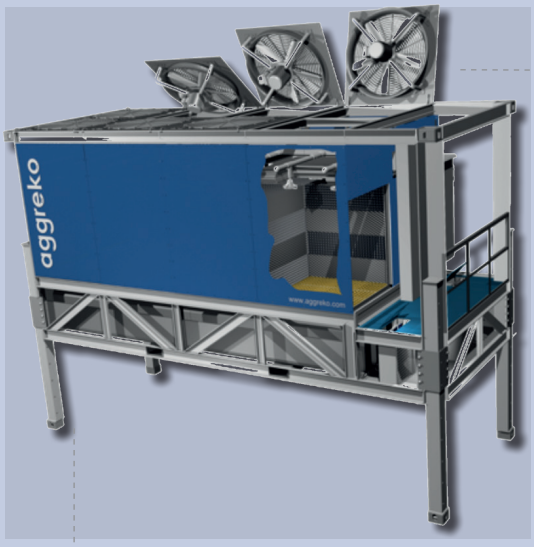

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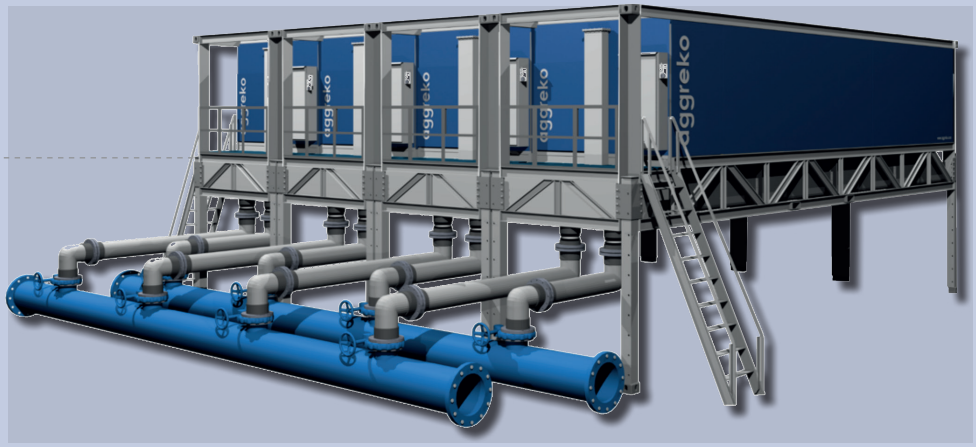

TP24-07 – A Comparison of the new LRFD Design Codes for FRP and Current ASD Practices
Tom Toth, SPIG/Babcock & Wilcox
2/05/24 – 10:00 AM

Field erected stick built cooling towers until the early 1980's, were principally constructed of pressure treated wood products. Until the 1980's the lumber of choice had been old growth Redwood. Due to certain environmental concerns though, old growth Redwood became difficult to obtain and Douglas-Fir became the common choice of material. It was also at that time that Pultruded Fiberglass (FRP) started to make inroads into the market. As FRP was becoming more popular, CTI developed STD-137 which was first published in 1988. This new standard defined physical properties for the pultruded products along with the mention of mechanical properties, design criteria, workmanship, and inspections. CTI continued with development of reference material for use with FRP with the publication of ESG-152 "Structural Design of FRP Components" in 2002. This guideline provides some of the basic design information for use in designing a cooling tower using Allowable Stress Design (ASD) methods.

This paper will compare the design of a cooling tower using ASD with the ASCE standard "Load and Resistance Factor Design (LRFD) for Pultruded Fiber Reinforced Polymer (FRP) Structures" which as of this writing has been approved and is awaiting publication. It will also touch on the limit state design code that has been approved in Europe by the European Committee for Standardization.

Tom is a Technical Consultant for Babcock & Wilcox. He is a licensed Professional Engineer in the states of Virginia, New Jersey, Colorado, Oklahoma and Nebraska. His background includes 4 years in the Engineering office of a major Steel Fabricator and 18 years in Consulting Engineering Offices where he first became associated with the Cooling Tower Industry. All told he has more than30 years of Cooling Tower Design experience including more than 20 years working for Cooling Tower Manufacturers.

He graduated from the New York Institute of Technology with a B.S. Degree in Architectural Technology and received his Master of Administration Degree in Industrial Management from Lynchburg College. He is active on the ASCE Fiber Composites and Standards Committee and has been active in CTI for over 25 years.

TP24-08 – Advacned Corrosion Control with Non-Fouling, Synergistic, and More Environmentally Beneficial Chemical Inhibitor Program for Industrial Cooling Water Systems
Prasad Kalakodimi, ChemTreat, Inc.
2/05/24 – 10:00 AM

Industrial cooling system corrosion and scale inhibition treatment programs have relied on phosphate and zinc chemistry for decades. Phosphate-based cooling water treatment programs emerged as the cooling water technology of choice when chromate- and zinc-based corrosion inhibitors were phased out around 40 years ago. Phosphorus-based treatment programs are difficult to control precisely to avoid deposit formation on hot heat exchanger surfaces. These chemistries can also function as macronutrients that promote toxic blue-green algae growth on cooling towers and ponds, resulting in increased chlorine and biocide usage. Environmental regulations are increasingly limiting phosphorous discharge because of its role as an aquatic nutrient in eutrophication. The EPA has stated that nutrient pollution from phosphorus and nitrogen is one of most costly and challenging environmental problems in the US. This paper describes the development and application of an innovative, next-generation corrosion inhibitor program that will provide superior corrosion protection while eliminating fouling potential. This new treatment can help facilities improve environmental compliance goals thanks its lower aquatic toxicity compared to industry-standard programs. The manufacture of these products also emits significantly less greenhouse gases compared to phosphate-based inhibitors, which can help facilities meet their environmental, social, and governance (ESG) goals. *Compared to industry-standard programs in terms of manufacturing GHG emissions, aquatic toxicity profile, and phosphate/zinc usage

Prasad Kalakodimi received his Ph.D. in Electrochemistry at the Indian Institute of Science in Bangalore India in 2003. Dr. Kalakodimi is currently the Director of Applied Technology for ChemTreat, Inc. in Glen Allen, VA. His responsibilities include development of proprietary chemical/automation solutions for various industry segments such as Chemical, Refining, Power, Primary Metals, etc. Prior to joining ChemTreat, Dr. Kalakodimi served as the Engineering Technical Leader at the GE India Technology Centre in Bangalore and as Product Manager for Chemicals and Monitoring Solutions for GE Water. He has over 20 patent filing, 20 international publications and various conference presentations.

TP24-09 – 2023 CTI Pitot Tube Blockage Study Report
Dave Wheeler, CleanAir
2/05/24 – 10:30 AM

In 2022, the Cooling Technology Institute funded a research project to investigate the effect of blockage in the flow plane on flow measurements conducted with the ellipsoidal pitot tube. The ellipsoidal pitot tube is now the standard pitot design which is used in the CTI 201 program and by the CTI licensed test agencies for all test programs that require water flow rate measurement. As a pitot is inserted into a pipe for flow measurement, part of the cross-sectional area of the measurement plane is obstructed by the pitot itself. The goal of this study was to inform the decision about whether and how to include the effect of pitot blockage in the area used to calculate the flow for pitot calibration and water flow measurements in various pipe sizes. This paper summarizes the results of this study and makes recommendations for the consideration of blockage for calibration and measurement of flow with ellipsoidal pitot tubes.

Mr. David Wheeler has been the Technical Director of CleanAir's Performance Group in Knoxville, Tennessee since the group's inception in 2006. Mr. Wheeler has designed and conducted hundreds of power plant component tests, successfully collecting temperature, pressure, flow, and power data in some of the most challenging commercial environments. Much of his research and technology development has focused on thermal and drift emissions testing for cooling towers and he has authored numerous papers on these and other related topics including measurement uncertainty. He is passionate about getting accurate and reliable data in real world applications. He has been participating in the CTI since the early 1990s. At various times He has served on most of the CTI Test code committees in addition to his participation in the ASME test codes PTC 23 for Atmospheric Water Cooling Equipment and PTC 30.1 for Air Cooled Steam Condensers. He is currently chairman of the task group for water flow measurement, CTI STD 146 and was the lead author of the CTI Pitot Study Report. Mr. Wheeler received a BS in Chemical Engineering and an MS in Environmental Engineering from the University of Tennessee, and he is a Registered Professional Engineer in the State of Tennessee.

TP24-10 – A Necessary Defense: Legionella Public Health Citations
Adam Green, Baker Donelson
2/05/24 – 10:30 AM

The impact of Legionella related public health citations can be disastrous for healthcare facilities and long-term care providers. Beyond the immediate cost of remedial action and expenses incurred to implement a Plan of Correction, the citations may result in wide array of consequences including but not limited to severe monetary penalties, abatement of operations while deficiencies are removed, denial of payment for new admissions under Medicare and Medicaid and the termination of provider agreements. Beyond these calculable penalties, the stigma associated with Legionella related citations can inaccurately portray providers as failing to prioritize patient safety. The consequences may also impact litigation as opposing counsel will invariably inquire about any history of Legionellosis claims, penalties or citations. While the goal should be to have such citations expunged or their severity reduced, there is value in the defense regardless of outcome. It is imperative that those with merits-based defenses challenge improper citations and penalties that are disproportionate to the subject circumstances. The facility's response may prove critical not only to its immediate operations but legal defenses in any future litigation. A failure to present merits-based defenses or challenge the nature or degree of an improper citation may be construed as acquiescence that a Legionella related wrongdoing occurred. Potential adversaries will almost certainly infer that the citations were not challenged because no viable challenge existed. Simply, the lack of defense may be misinterpreted as a tacit acknowledgement that the citations were proper. An accurate identification of Legionella related jeopardy, or the lack thereof, requires a comprehensive and frequently nuanced analysis involving elements of microbiology, chemistry, and the law. Whether defending citations through the Informal Dispute Resolution process or on appeal to the CMS, facilities are well served to enlist the right expertise to mount an effective defense.

Adam Green, ASSE 12080, is an attorney and the Chairman of Baker Donelson's Water Technology and Water Treatment Group. Over the past 20 years, he has successfully consulted and defended water treatment related claims and litigation on a national scale over wide array of matters ranging from legionellosis related wrongful death and personal injury lawsuits to high value property damage claims arising from catastrophic system failures incident to a myriad of operational, design, maintenance and treatment related issues. He is a frequent author and speaker at the Association of Water Technologies, Cooling Technology Institute, International Association of Defense Counsel and others. He has published numerous technical papers on water treatment in the CTI Journal, the AWT Analyst and the National Engineer. Adam frequently ponders how his parents raised him to have confidence that is disproportionate to his looks and abilities. He has successfully challenged and defeated Legionella related public health citations resulting in the reduction or removal of the corresponding penalties.

TP24-11 – Local Ban: Moratorium on Evaporative Cooling
Adam Green, Baker Donelson
2/05/24 – 11:00 AM

In the face of extreme drought in certain parts of the southwestern United States, some state and local authorities have directed their attention to restricting and, in some cases, banning the use of evaporative cooling systems on future projects. Within the last year, authorities in Las Vegas and Henderson, Nevada have taken significant action in restricting the future use of evaporative cooling systems in the name of conservation. Proponents of the moratorium cite the severe drought involving the Colorado River which supplies 90 percent of the water to southern Nevada while urging that businesses should "convert water-guzzling evaporative cooling systems to mechanical air conditioning systems." Environmentalists contend that the use of mechanical cooling systems coupled with energy incentives provided by state energy providers will assist businesses in mitigating the financial disadvantages. Respondents have emphasized that dry-cooled systems are exponentially less efficient and are subject to insulation requirements that don't apply to evaporatively cooled buildings. This paper will explore and undertake a renewed analysis of the efficiency benefits of evaporative cooling compared to dry cooled systems.

Adam Green, ASSE 12080, is an attorney and the Chairman of Baker Donelson's Water Technology and Water Treatment Group. Over the past 20 years, he has successfully consulted and defended water treatment related claims and litigation on a national scale over wide array of matters ranging from legionellosis related wrongful death and personal injury lawsuits to high value property damage claims arising from catastrophic system failures incident to a myriad of operational, design, maintenance and treatment related issues. He is a frequent author and speaker at the Association of Water Technologies, Cooling Technology Institute, International Association of Defense Counsel and others. He has published numerous technical papers on water treatment in the CTI Journal, the AWT Analyst and the National Engineer. Adam frequently ponders how his parents raised him to have confidence that is disproportionate to his looks and abilities.

TP24-12 – Development of a Novel Non-Azole-Containing Water Treatment Programs
Caroline Sui, Veolia Water Technologies and Solutions
2/05/24 – 11:00 AM

Since the introduction of phosphate to replace chromate-based cooling water treatment programs, azoles have been widely used to inhibit corrosion of copper and copper alloy heat exchangers, and to prevent galvanic attack on mild steel components. Some azoles and the films they produce are not stable in the presence of oxidizers, such as sodium hypochlorite, which significantly reduces the level of protection they offer. Moreover, azoles also have a challenging environmental profile. Chemical improvements have been made to this chemical class to enhance their compatibility with halogenation and improve the stability of their protection. More recently, supply chain constraints on azoles have presented unique challenges for the water treatment industry to offer this important component economically. This paper describes the development of a non-azole-containing corrosion and deposit control program for cooling water applications. The chemistries are halogen stable and offer an improved toxicity profile over conventional cooling treatment components. Comprehensive laboratory studies and field applications are presented in the paper.

Caroline Sui is an Advanced Senior Research Scientist in Veolia Water Technologies & Solutions. She has over 23 years of experience in water treatment developing products and programs to treat water for cooling, mining, membrane, geothermal, thermal desalination and upstream oil and gas applications, and in developing chemical additives for industrial processes. She holds Bachelor and Master Engineering Degrees from Beijing University of Science and Technology, China, and a Ph D. in Metallurgy from McGill University, Canada. Caroline has more than 30 papers published in peer reviewed journals and conferences and several issued patents and pending patent applications.

TP24-13 – An Overview of Mechanical Loads on Cooling Fans Operating in Different Applications
Jacques Muiyser, Howden Netherlands
2/05/24 – 11:30 AM

Cooling fans see use in a variety of industries and applications. Fans with diameters greater than 16 feet are most often used in cooling towers (CTs) and air-cooled condensers (ACCs). In this paper it is shown how, recently, a large amount of data was collected and analysed regarding fans that were supplied for ACC and CT projects. The analysis showed that, in general, CTs require higher fan static pressures that lead to higher power consumption and fan blade loads. However, the data also showed that the majority of cooling fan failures occur when installed in ACC applications. Measurement data, recorded from fans in operation and presented in this paper, show that ACC fans experience high dynamic blade loads as a result of distorted inlet airflow

conditions that may be further amplified by resonance. These high dynamic loads may, in some cases, lead to fatigue failure of cooling fan components.

Conversely, CT fans are typically operated in induced draft configurations where there exist fewer inlet air flow distortions. This results in lower dynamic blade loads, leading to a comparatively low number of failures when compared to ACCs. However, the paper also shows measurements that were recorded at a fan installed in a hybrid cooling tower where it can be seen that care still needs to be taken to ensure uniform inlet air flow to CT fans as well. Finally, this paper provides some recommendations for the best operation of cooling fans in both CT and ACC applications.

Jacques Muiyser has been researching and developing industrial cooling fans for more than 10 years. His work started with a Masters and PhD at the University of Stellenbosch, in South Africa, where he measured and simulated the vibration of cooling fans in some of the world's largest air-cooled condensers. In 2020, Jacques started work at Howden Netherlands as a development engineer primarily responsible for the analysis of measurement data collected on site and the mechanical testing of cooling fan components. During his time as a researcher and development engineer, he has presented at numerous turbomachinery conferences and co-authored several papers in the field of cooling fan simulation, vibration and air-cooled condenser wind mitigation.

TP24-14 – The Effect of Scale and Fouling on Heat Transfer Efficiency
Al Feltzin, Becht Inc.
2/06/24 – 8:00 AM

Heat exchangers in service are subject to mineral scale formation and fouling. This paper focuses on mineral scale and its effects on heat exchanger performance. Various thicknesses of scale from 1/64" to 1/8" are modeled and the resulting impact on key performance parameters are discussed. These include overall heat transfer coefficient, temperatures, flow, and pressure drop. The impact on fouling coefficients on both the process side and the water side are also discussed. Practical examples are provided to illustrate the maintenance economics, i.e., when is it time to clean the heat exchanger?

Al Feltzin has over 35 years' experience in process engineering, maintenance, project management, and problem solving in the industrial gases industry. For the last 8 years, he has been a consultant with Becht Inc. working with refineries and large chemical processing plants. He has built strong professional affiliations, written numerous papers in both the cooling tower and water treatment areas, and has a long association with CTI. He is currently serving as Chair of the CTI Water Treating Committee.

TP24-15 – Wind Effects on ACC's-Mitigating High Seasonal Winds
Jeff Ebert, Galebreaker
2/05/24 – 2:00 PM

High seasonal winds at speeds beyond the design specs dramatically affect the performance and reliability of an ACC. This is a study of the impact of unanticipated winds and a means for mitigation.

Jeff is a graduate of Virginia Tech. He has 40+ years of experience in the evaporative cooling and dry heat transfer industry supporting power, petrochemical and HVAC customers. In his career he has had leadership roles in construction, project management, sales and business development. With his operational and commercial foundation, Jeff is managing the growth and customer service of Galebreaker LTD for North America.

TP24-16 – Toward Phosphorus-Neutral Cooling Tower Treatments Using a Carbon-Negative Environmentally Friendly Additive
Matheus Paschoalino, Solugen
2/06/24 – 8:30 AM

The "Stabilized Phosphate" category of cooling water treatments has become an industry standard since the banning of chromate inhibitors in the late 1970's. They combine good performance, moderate cost and a reasonable environmental profile. However, these programs have their limitations. They represent a balancing act between adequate mild steel corrosion inhibition and calcium phosphate scaling. They also represent a significant environmental lability because of the relatively high inorganic phosphate content which contributes to eutrophication of water supplies. Other ingredients such as MoO4-, Sn+2, or Zn+2 are often added to bolster corrosion inhibition and more advanced polymer technology extends the solubility limits of calcium phosphate. However, these measures introduce environmental and economic costs. A new carbon negative, environmentally friendly organic inhibitor is now available which can expand the application profile of stabilized phosphate programs in various dimensions, at modest cost and without environmental baggage. With further

development a “Phosphorous-Neutral” program which operates without adding to the phosphorous already in the environment appears to be feasible. Laboratory and pilot testing data are presented to demonstrate the effectiveness of this approach.

Matheus Paschoalino is the IWT Tech. Support Manager for Solugen. He received his PhD in Analytical Chemistry from UNICAMP (Brazil) & UCM (Spain). He has nineteen years of experience in R&D, and Technical Support on IWT technologies focusing on asset integrity and microbial control. He is author of six patents, one book chapter and 30+ published papers and presentations from various international conferences.

TP24-17 – High Performing Cooling Tower Fill
Zackary Steffen, Trackonomy Systems
2/05/24 – 2:30 PM

Wireless Industrial Internet of Things sensors have become smaller, more powerful and easier to deploy. For cooling towers, these solutions can act as an advanced warning system to improve operations and reduce the risk for safety incidents. For $300, it is now possible to monitor key assets to cooling towers such as water feed pumps and fans and to be alerted in real-time when potential issues such as fan unbalance or pump cavitation may threaten the shutdown of a cooling tower. Actual client case studies to be presented. Zackary Steffen is Head of the Industrial Automation group at Trackonomy.

TP24-18 – An Ocean Apart: How the UK & US Regulate and Respond to Legionella
Adam Green, Baker Donelson
2/06/24 – 9:00 AM

Legionella is universal and Legionellosis is a global health concern. Nonetheless, the approach and response to the bacterium and disease by two of the most scientifically advanced and jurisprudentially developed nations in the world, England and the United States, are distinct in important respects. This paper, written and presented by experts from both sides of the Atlantic, compares some material differences in the regulation of Legionella bacteria while examining the disparity in the consequences for incidents of disease. The primary concern for US defendants in cases involving Legionella related injuries, has been civil liability and the prospect of monetary damages. In the UK, building managers and owners fear criminal prosecution and the possibility of incarceration. The varied approach and response to Legionella will be illustrated through noteworthy case studies including the Bellevue-Stratford Hotel in Philadelphia (July 1976), the Forum 28 Theatre in Barrow-in-Furness in northwest England (August 2002), the Hotel Chester in Starkville, Mississippi (2010) and New York City’s historic Opera House Hotel (July 2015). For instance, in the UK, where Legionella has come under criminal regulation since the 1980s, the Forum 28 case resulted in a building manager facing manslaughter charges in a criminal court, losing her livelihood, and having her reputation destroyed in the media, while the New York Opera House Hotel outbreak triggered the introduction of regulations targeting evaporative cooling towers throughout the city but without any comparable criminal consequences. Why do two of the most scientifically advanced nations in the world, each with highly developed systems of jurisprudence, address the same problem differently? Why do the legal repercussions for Legionnaires’ disease in the US, which has derived its common law from England, differ from those in the UK? Which approach is more effective? Is the US sleepwalking into British style over-regulation? What can the two nations learn from each other? This publication will provide a comparative, though not comprehensive, legal, and technical analysis as it relates to Legionella in the UK and US while making the case for a measured and flexible approach that is reasonably proportionate to the unique facts of each case.

Adam Green, ASSE 12080, is an attorney and the Chairman of Baker Donelson’s Water Technology and Water Treatment Group. Over the past 20 years, he has successfully consulted and defended water treatment related claims and litigation on a national scale over wide array of matters ranging from Legionellosis related wrongful death and personal injury lawsuits to high value property damage claims arising from catastrophic system failures incident to a myriad of operational, design, maintenance and treatment related issues. He is a frequent author and speaker at the Association of Water Technologies, Cooling Technology Institute, International Association of Defense Counsel and others. He has published numerous technical papers on water treatment in the CTI Journal, the AWT Analyst and the National Engineer. Adam frequently ponders how his parents raised him to have confidence that is disproportionate to his looks and abilities.

TP24-19 – Aero-Acoustics Analysis of Industrial Axial Fans and Resulting Ultra-Low Noise Solutions
Carlo Gallina, Cofimco SRL
2/06/24 – 8:00 AM

Nowadays, noise is one of the main aspects of modern pollution. In this regard, a lot of efforts have been done to reduce the noise generated by industrial axial fans trying to keep the resulting silent solutions in a reasonable range of cost. This is pushing designers to continuously develop new types of profiles or optimize the existing ones. In this regard, being the noise generated by fans strictly connected to the airflow turbulence around the blades, it is important to understand, how the blade shape affects the amount of air vortexes produced and, consequently, the noise. Scope of the present study is to show how it was possible to address Cofimco research and laboratory tests to the development of new ultra-low noise solutions for industrial axial fans used on Cooling Towers and Air-Cooled Heat Exchangers in general, starting from a well consolidated fan blade design, through fluid dynamic simulations and aero-acoustic analysis.

He received his master's in aerospace engineering at Politecnico of Milan – Italy, in 2004. His studies were focused on structural analysis and turbo machines in general. Since 2005 he has been working in the technical department of Cofimco S.r.l., a leader in aluminum and fiberglass axial fans manufacturing. He is now Director of the Aftermarket Engineering division of the company and still deeply involved in Research & Development of high-performance axial fans.

TP24-20 – Automating Structural Inspections of Concrete Cooling Towers
Mark Williams, Walter P. Moore
2/06/24 – 9:00 AM

Observing, analyzing and monitoring the structural condition of concrete cooling towers over time has long been a challenge for owners and operators. The structural elements of cooling towers are mostly obscured during operation and often inaccessible due to limited access options during brief outages. As a result, structural site conditions can be overlooked and the progression of deterioration may not be fully recognized, prompting unscheduled outages. Technology now exists to automate the cumbersome structural inspection process to obtain a more holistic condition assessment of concrete cooling towers. This paper presents a three-step automated methodology for imaging, analyzing, and monitoring structural deterioration in concrete cooling towers using autonomous drone imaging, machine learning, and 3D visualization. In Step 1 drones capable of autonomous flight collect enough overlapping images to fully capture a cooling tower structure. These images can be stitched together to create a digital twin of a cooling tower using a process called photogrammetry. In Step 2 the collected photos are analyzed by machine learning algorithms to identify and quantify the most common structural concrete defects. In Step 3 structural defect information is transferred to a 3D model and displayed in an asset management portal (or 3D AMP). Having the condition data available in a 3D visualization format enables engineers, owners, and operators to quickly see and understand the magnitude of structural issues. By automating the concrete cooling tower inspection process, observations can be performed at higher frequency (even during shorter outages) allowing tracking of deterioration progress and development of customized maintenance and repairs while minimizing impact on cooling tower operations.

Mark is Managing Director for the Diagnostics Group and is the Practice Leader for Restoration and Renovation. He has 25 years of experience in structural engineering analysis, design, and management. Mark specializes in the evaluation and repair of aging infrastructure. His effective application of nondestructive evaluation (NDE) methods results in minimally invasive and efficient development of appropriate repair designs and specifications.

TP24-21 – 1D and CFD Numerical Models Applied to Assess Natural Draft Cooling Tower Thermal Performance Evolution Under Heterogeneous Fill
Kevin Deutz, EDF
2/06/24 – 8:30 AM

This study aims to give feedback on the use of several numerical modelling techniques applied to assess the evolution of the thermal performance of natural draft cooling towers and guide maintenance decision makers. It presents the results of numerical simulations realized to assess the thermal performance of a cooling tower on the 900 Mwe Cruas pressurized Nuclear Power Plant (NPP) situated on the Rhone River in France. Several models are developed using either a 1D, 2D axisymmetric or 3D CFD approaches in steady state conditions using the Mistral reduced test bench data. All models are compared with data on a 10-year time period covering periods starting from a very homogeneous fill configuration (same fill all over the cooling tower) to heterogeneous fill material cooling tower (covering several references and thicknesses of fill material). Although 2D and 3D models give clear results on the local aeraulic and thermal performance of the tower, it is shown that 1D models perform close to the 3D reference in most cases given a proper calibration of the full-scale Merkel

number correction factor. It is only when the fill configuration becomes highly heterogeneous that a discrepancy in the results appear. A second part of the paper applies the same models on a case where the hot rain dispersers suffer real life clogging combined with heterogeneous fill material configurations. It is shown that in this case of high heterogeneous flow, 1D models are clearly not relevant to model this situation.

I am an energy engineer holding a PhD in the field of numerical modeling applied to thermal systems and a 10-year experience in the industrial utility sector both in R&D and engineering departments. My field of expertise is composed of multiphase flow, thermodynamics and fluid mechanics applied to thermal system design using multi factorial optimization. I am actually working since two years in the field of natural draft cooling towers where I am extending my knowledge in a new world made of droplets, natural convection and combined heat and mass cooling.

TP24-22 – Modeling Deterioration and Predicting Service Life of Concrete Cooling Towers
Matt Gries, Wiss, Janney Elstner Associates
2/06/24 – 9:30 AM

Hyperbolic natural draft cooling towers and other concrete structures can experience various types and degrees of concrete deterioration caused from years of service in industrial operating environments. Concrete erosion, corrosion of embedded reinforcement, and other deterioration mechanisms can introduce operational risks and significantly reduce the integrity of the structure, ultimately leading to the end of service life. To manage cooling tower assets and plan effective maintenance and repair strategies, the expected condition of the tower over time and its remaining service life must be considered. This paper introduces common deterioration mechanisms that affect concrete cooling towers and provides examples of how such mechanisms can be modeled with calibration specific to the subject asset. A framework is presented describing how deterioration predictions can be used to inform estimates of the remaining service life of the structure.

Matt Gries is a structural engineer experienced in condition assessments and structural evaluation for buildings, bridges, towers, and utility structures. Since graduating with an M.S. in structural engineering from the University of Illinois at Urbana-Champaign in 2010, he has worked full time at Wiss, Janney, Elstner Associates, Inc. based out of Northbrook, Illinois, USA. He has experience in evaluation of deterioration and distress of reinforced concrete and steel structures and has had the privilege of working on many signature structures and critical infrastructure. For the last thirteen years, he has been integrally involved with WJE's engineering services for evaluation and repair of natural draft cooling towers and serves as the project manager for such projects at power generating facilities in the United States and abroad.

TP24-23 – High Performing Cooling Tower Foil Film
Dr. Andreas Streng, Cooling Tower Solutions
2/06/22 – 10:00 AM

The paper presents new developments of high performing cooling tower fill. The fill is of the foil type which creates the advantageous film flow for the counter flow princi-pal. For an overall high cooling tower performance, an excellent fill and a well performing water distribution system is the key. The best water distribution covers the complete cross sectional area of installed fill and creates evenness over this fill area which is mainly achieved by applying full cone nozzles. For further improvements, R&D has to be concentrated again on the fill design. There a various different fill types on the market. The foil film type for the mainly required counter flow towers performs best. For a higher fill and tower performance the foiling behavior suffers usually. This is especially the case, if more fill sheet surface is designed. This obvious and easy way to go results usually in smaller channel or flute sizes and in a cross corrugated fill sheet design. Both design features create directly a higher air pressure drop. Smaller flutes and cross corrugated channels tend to more settlement of dirt and debris at fill surfaces and lead generally to a bad foiling performance. Even higher air pressure drops by increased foiling, higher fan performance and motor power and a frequent change of fill are further negative results. This is all costly for the permanent cooling tower operations and the repeated fill investments. The way out of this conflict of required high cooling performances, acceptable fan power consumption and a reasonably foiling behavior has been found by focusing the details of fill sheet design. An improved micro structure formed out of each fill sheet is the key element of the patented new fill design. The intensified turbulences at the fill sheet surfaces improves significantly the heat and mass transfer by evapo-ration process from warm water to the air stream. The paper presents the features of the new fill design and the performance results measured at an outdoor test facility. Merkel-number (KaV/L-numbers) over L/G-numbers are presented in diagrams. Measured pressure drops and its coefficients over air flow velocities are calculated and presented. Evaluations and comparisons are made with other available publications to verify the own test results. The important influence of different spray and rain zones to the overall Merkel numbers are described and evaluated. Considering correctly the con-tribution of the droplet evaporation in the rain zones to the overall evaporation taking place within a wet cooling tower results in a

better physical understanding of the evaporation cooling process. It eases the comparison of test results coming from dif-ferent test rigs with different rain zone heights. Best thermal performances by the new fill design enables the design of less channel inclination and wider flute sizes which reduces the foiling, air pressure drop and fan power consumption. It also saves material quantities by less fill sheets per meter or feet and overall fill cost. New towers have been fitted as well as existing large towers have been retrofitted successfully to the full satisfaction of clients by applying this best performing fill.

I am thermal process and cooling tower engineer for more than 30 years. I hold the academic title of doctor (Ph) of engineering. I am the director of a German cooling tower company which is designer and supplier of tailer-made cooling towers. We hold a number of innovative patents on our subjects.

I made a number of presentations at CTI about cooling tower design over the years and come regularly to the annual CTI conferences.

TP24-24 – The Association of Water Technologies
Michael Bourgeois, Chemco Products Company
2/05/24 – 11:30

The Association of Water technologies is an international trade association committed to assisting water treatment professionals in their efforts to serve their owner customers. The Associations provides the training and technical resources so that their members can optimize their customers processes to minimize water usage, minimize corrosion, and improve safety and health outcomes. The AWT and the CTI are developing ways to align our efforts so that we can maximize the benefits for the public common good. The paper will discuss these common objectives and how we are working together to improve owner outcomes; especially in the areas of Legionella control, Code and Guideline Development, and Certifications.

- B.S. Physics, University of San Diego
- Vice President, Technical Operations for Chemco
- 41 years of experience in water and wastewater treatment
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- 15 years of experience in formulating and blending corrosion inhibitors, scale inhibitors, biocides, and cleaners.
- Certified Water Technologist (CWT) through the Association of Water Technologies (AWT)
- Member of Association of Water Technologies (AWT). Served on the AWT Board of Directors, as well as President, Treasurer, Secretary. Serving on the Certification Committee, Legislative and Regulatory Affairs Committee, Boiler Water Technical Committee and ANSI/CWT Task Force and as AWT Liaison to CTI
- Member of Cooling Technology Institute (CTI). Serving on the Water Treatment Committee, GDL-159 Committee; Legionellosis Guideline Practices to Reduce the Risk of Legionellosis from Evaporative Heat Rejection Equipment. CTI Task Group 141; Oxidizing Biocide Guidelines. Designated as AWT Liaison to CTI.

TP24-25 – From Pump to Plume: CFD Modeling to Enhance Cooling Tower Performance
Dr. Stuart Cain, Alden Research Laboratory
2/05/24 – 3:00

Computational Fluid Dynamics (CFD) is a powerful tool for troubleshooting and optimizing cooling tower performance. In this paper, we highlight two important case studies which showcase its applicability in solving challenging problems related to cooling tower fluid flow and heat transfer. The first study utilizes CFD modeling during the initial design process to evaluate the extent to which the high temperature, high humidity cooling tower exhaust plume is re-circulated into the proposed cooling tower ambient air inlet and suggest modifications to ensure favorable plume dynamics. The second study employs a combination of CFD and physical modeling to determine the cause of reduced condenser flow (and subsequent increase in plant heat rate) in a ring header following a cooling tower upgrade project and develops a piping modification which restores full flow.

As Associate Vice President and Technical Lead, Dr. Cain collaboratively develops the future direction of the company. Dr. Cain also brings significant technical expertise and project management experience to the Alden Area. For 30 years,

he has utilized CFD and physical modeling to solve complex two and three-dimensional fluid flow problems involving civil hydraulic and mechanical structures, nuclear and fossil power plant systems and components, and process gas flow systems. He has managed large, multifaceted, projects including safety-related nuclear power plant system modifications involving extensive utility/regulator interface and management. He has written and developed numerous computer codes for studying both internal and external flows and has experience using the commercial codes Fluent and Flow 3D.

TP24-26 – Lessons Learned in Cooling Tower Pump Intake Design
David Werth, Clemson Engineering Hydraulics/Verdantas
2/05/24 – 3:30

Physical modeling has long been used for final design, optimization and Hydraulic Institute compliance of pump intake structures. Cooling water pumps are a critical component of any cooling tower design and they are particularly sensitive to the transition from basin to intake. This paper shares our experience in modeling hundreds of cooling tower pump intakes and discusses the pros and cons of several different types of transitions including vertical step, sloped floors and recessed configurations. Case studies are presented which show the sensitivity to minor details and the importance of considering the intake transition early in the tower siting and design and how these minor details can significantly impact pump performance.

Dr. Werth has over 30 years of hydraulic modeling experience and specializes in physical hydraulic modeling, pump station and intake design, hydraulic structure analysis, pipeline hydraulic studies and energy losses in both open and closed conduit flow regimes. Dr. Werth has conducted over 1000 physical hydraulic model and lab studies including pump intake structures for water & wastewater, the power industry, control structures, mixing systems, diversion works, closed conduits, river works and erosion control structures, cavitation, transients, energy loss, and dissipation and efficiency.

TP24-27 – Abstract Improving the Efficient of Pumping Systems through Pump System Optimization
Matthew Derner, Hydraulic Institute
2/06/23 – 7:30

The Hydraulic Institute (HI) and their Educational Foundation Pump Systems Matter (PSM) designed the Pump System Optimization (PSO) course to target individuals that interact with pump systems but may not be responsible for designing or upgrading them. The course prepares energy efficiency program implementers, pump system owners, pump system operators, and pump sales personnel to collaborate with the broader set of actors in the pump industry to make coherent and actionable recommendations to achieve energy efficiency goals. Utilities can sponsor a PSO course to drive the industry focus on energy efficiency and prepare individuals to better understand pump system energy consumption. Attendees will be able to communicate system efficiency concepts, collaborate with pump professionals, and identify opportunities to implement energy conservation measures.

Matthew Derner is the Manager, Business Development, Pump System Products. He holds a leading role in promoting pump system related programs that deliver energy efficiency in commercial and industrial settings. Additionally, he is responsible for managing Pump Systems Matter (PSM), HI's training subsidiary, and for the overall promotion and growth of the Hydraulic Institute's portfolio of training and certification programs that focus on pump system optimization, and efficiency. Matthew has a strong background in global sales of pumps, drives and various rotating equipment in both the manufacturing and distribution segments, with an emphasis on energy efficiency and total cost of ownership.

PRESIDENT ELECT 2024 - 2025 | Jim Baker - Galebreaker Industrial Ltd.

Jim Baker brings a unique diversification to the industry, through his 40 years of involvement throughout the Cooling Tower Industry. Mr. Baker worked from 1980 through 1992 for Phillips 66 as their Cooling Tower Specialist. This role enabled him to acquire experience on the Owner and Operations side of the business. From 1992 through 2016, Mr. Baker worked for Marley Cooling Tower Company, SPX Cooling Technologies, Composite Cooling Solutions, and Texas Air Systems. Since 2016, he has worked as an Independent Consultant and presently for Galebreaker Industrial. Jim has served as an active delegate in CTI with all of these companies.

Jim currently serves as Chairman and Moderator of the "Ask the Expert Seminar". He has also chaired the Engineering Standards & Maintenance, Performance and Technology, Program, Education, and Past President's Council committees. Mr. Baker served as President and Chairman of the Board of CTI in 2004 and 2005 and is currently Treasurer of the Board of Directors. Mr. Baker holds an Associate Degree in Engineering from Northern Oklahoma College and a Bachelor of Science in Human Resource Management from Oklahoma Wesleyan University.

Jim has been married to his wife Linda for 41 years and has 2 children and 4 grandchildren. Linda and Jim currently reside in Denton, Texas.

2023 SCHOLARSHIP WINNERS

Eliot Beaver is an adventurous and enthusiastic individual who recently graduated from Cheyenne Mountain High School, excelling in math and science. With a passion for outdoor sports, Eliot finds joy in both snowboarding down powdery slopes, conquering rugged mountain biking trails, and scaling vertical rock faces through his love for rock climbing. Whether it's the rush of adrenaline or the sense of accomplishment that comes with reaching new heights, Eliot is always eager to push his physical and mental limits in the worlds of academics and sports. As he embarks on the next chapter of his journey, Eliot is excited to bring his love for adventure to The Colorado School of Mines, where he will pursue his academic goals in engineering while immersing himself in the vibrant outdoor community of Colorado.

My name is Joel Edland from Century High School in Bismarck, North Dakota. I am honored to have received the CTI scholarship for the class of 2023. While in high school I played football, basketball, track and field, participated in Missouri River Clay Target League, was a co-founder and the vice-president of the Century Chess Club, and a member of National Honors Society. I will be attending the University of North Dakota and will major in the field of engineering. I do not have a specific field of engineering in mind, but hope to choose one as I am taking the class Intro to Engineering first semester. I do not have a specific career goal in mind either, but I plan to work hard, keep an open mind, and take life one step at a time.

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Cooling towers are used extensively wherever water is used as a cooling medium or process fluid, ranging from HVAC to a natural draft cooling tower on a power plant. Sound emanating from a cooling tower is a factor in the surrounding environment and limits on those sound levels, and quality, are frequently specified and dictated in project specifications. The project specifications are expected to conform to local building codes or safety standards. Consequently, it may be in the interest of the cooling tower purchaser to contract for field sound testing per CTI ATC-128 in order to insure compliance with specification requirements associated with cooling tower sound.

Licensed CTI Sound Testing Agencies

Clean Air Engineering
7936 Conner Rd.
Powell, TN 37849
800.208.6162 or 865.938.7555
Fax 865.938.7569
www.cleanair.com
khennon@cleanair.com
Contact: Kenneth (Ken) Hennon

Cooling Tower Test Associates, Inc.
15325 Melrose Dr
Stanley, KS 66221
913.681.0027 Fax: 913.681.0039
www.cttai.com
ctta@cttai.com
Contact: Kullin Elliott

McHale Performance
4700 Coster Rd
Knoxville, TN 37912
865.588.2654
Fax 865.934.4779
www.mchaleperformance.com
ctitesting@mchaleperformance.com
Contact: Shawn Goedeke

COOLING TECHNOLOGY INSTITUTE CERTIFICATION PROGRAM STD-201 FOR THERMAL PERFORMANCE

As stated in its opening paragraph, CTI Standard 201... "sets forth a program whereby the Cooling Technology Institute will certify that all models of a line of water cooling towers offered for sale by a specific Manufacturer will perform thermally in accordance with the Manufacturer's published ratings..." By the purchase of a "certified" model, the User has assurance that the tower will perform as specified, provided that its circulating water is no more than acceptably contaminated-and that its air supply is ample and unobstructed. Either that model, or one of its close design family members, will have been thoroughly tested by the single CTI-licensed testing agency for Certification and found to perform as clained by the Manufacturer.

CTI Certification under STD-201 is limited to thermal operating conditions with entering wet bulb temperatures between 12.8°C and 32.2°C (55°F to 90°F), a maximum process fluid temperature of 51.7°C (125°F), a cooling range of 2.2°C (4°F) or greater, and a cooling approach of 2.8°C (5°F) or greater. The manufacturer may set more restrictive limits if desired or publish less restrictive limits if the CTI limits are clearly defined and noted int he publication.

Those Manufacturers who have not yet chosen to certify their product lines are invited to do so at the earliest opportunity. You can contact Virginia A. Manser, Cooling Technology Institute at 281.583.4087, or vmanser.cti.org or PO Box 681807, Houston, TX 77268 for further information

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ctitesting@mchaleperformance.com
Contact: Shawn Goedeke

COOLING TECHNOLOGY INSTITUTE LICENSED TESTING AGENCIES

For nearly thirty years, the Cooling Technology Institute has provided a truly independent, third party, thermal performance testing service to the cooling tower industry. In 1995, the CTI also began providing an independent, third party, drift performance testing service as well. Both these services are administered through the CTI Multi-Agency Tower Performance Test Program and provide comparisons of the actual operating performance of a specific tower installation to the design performance. By providing such information on a specific tower installation, the CTI Multi-Agency Testing Program stands in contrast to the CTI Cooling Tower Certification Program which certifies all models of a specific manufacturer's line of cooling towers perform in accordance with their published thermal ratings.

To be licensed as a CTI Cooling Tower Performance Test Agency, the agency must pass a rigorous screening process and demonstrate a high level of technical expertise. Additionally, it must have a sufficient number of test instruments, all meeting rigid requirements for accuracy and calibration.

Once licensed, the Test Agencies for both thermal and drift testing must operate in full compliance with the provisions of the CTI License Agreements and Testing Manuals which were developed by a panel of testing experts specifically for this program. Included in these requirements are strict guidelines regarding conflict of interest to insure CTI Tests are conducted in a fair, unbiased manner.

Cooling tower owners and manufacturers are strongly encouraged to utilize the services of the licensed CTI Cooling Tower Performance Test Agencies. The currently licensed agencies are listed below.

Licensed CTI Thermal Testing Agencies

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7936 Conner Rd, Powell, TN 37849
865.938.7555
Fax 865.938.7569
www.cleanair.com / khennon@cleanair.com
Contact: Kenneth (Ken) Hennon

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ctitesting@mchaleperformance.com
Contact: Shawn Goedeke

MULTI AGENCIES

December 1, 2023 – The Cooling Technology Institute announces it annual invitation for interested drift testing agencies to apply for potential licensing as CTI Drift Testing Agencies. CTI Provides an independent third-party drift testing program to service the industry. Interested agencies are required to declare their interest by July 1, 2024, to the CTI Office at the address listed below:

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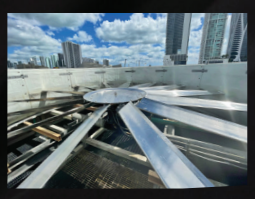

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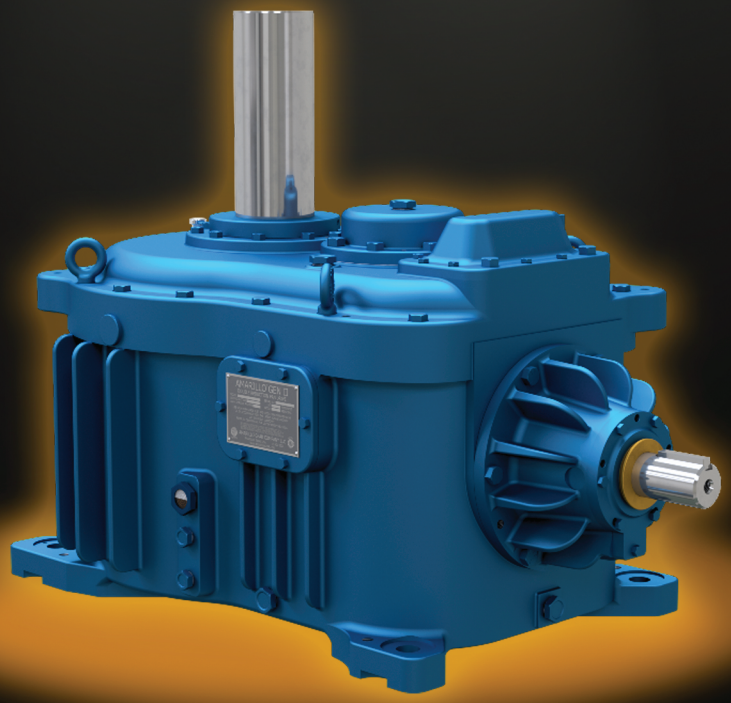

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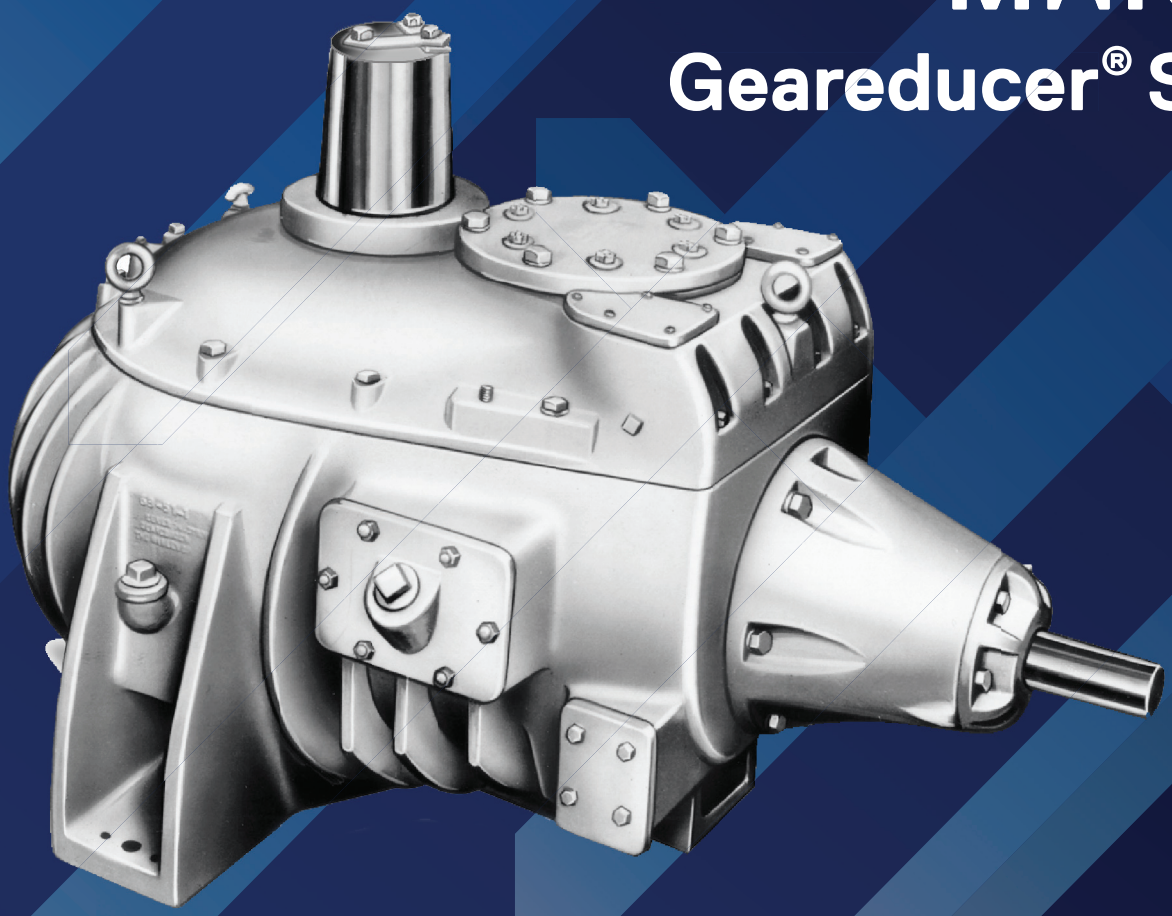

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