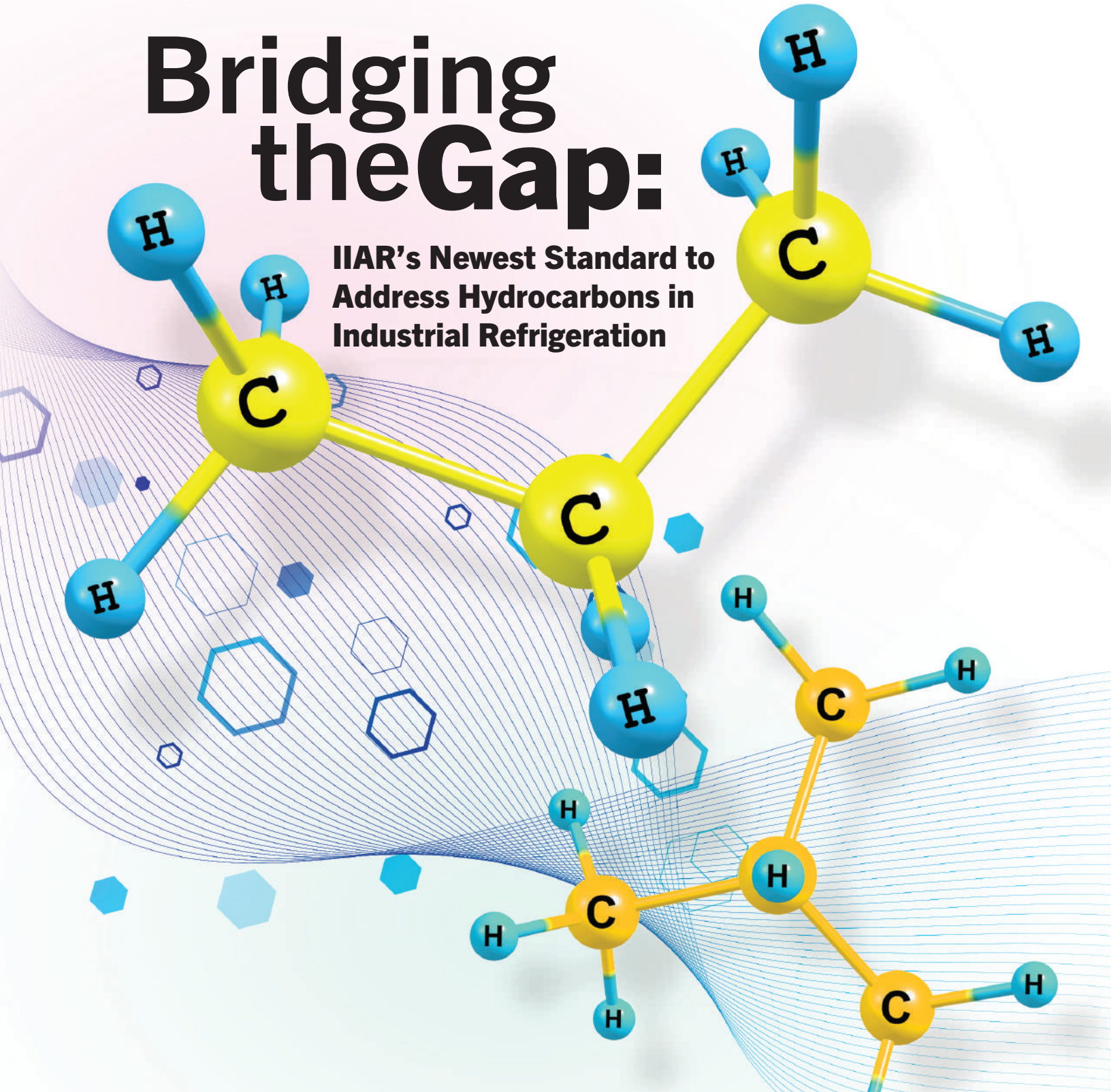
iiar®
THE OFFICIAL MAGAZINE OF THE AMMONIA REFRIGERATION INDUSTRY ■ **FEBRUARY 2022**

CONDENSER

Bridging the Gap:

IIAR's Newest Standard to Address Hydrocarbons in Industrial Refrigeration



iiar 2022 NATURAL REFRIGERATION CONFERENCE & EXPO

MARCH 6–9 • SAVANNAH, GEORGIA

WWW.IIAR.ORG/CONFERENCE

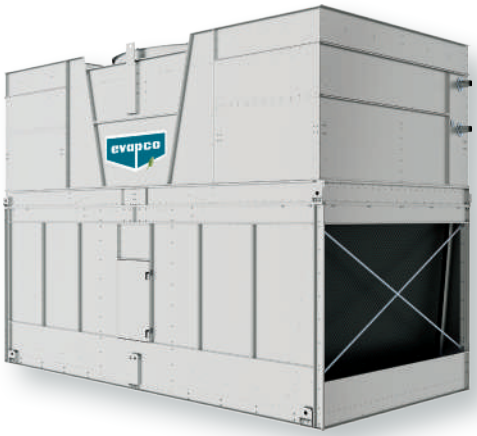
PHC-E Industrial Ammonia Evaporative Condenser

The PHC-E is EVAPCO's newest generation of high capacity, low-charge, hybrid evaporative condensers utilizing EVAPCO's latest coil and crossflow fill technologies. The PHC-E is designed for maximum maintainability with features such as oversized access door, internal walkway, elevated service platform and internal motor davit.

We are EVAPCO – the team you can count on for life.

Visit **evapco.com** to learn more.

Single Coil Models



Dual Coil Models

evapco® for **LIFE**

Since 1976
An Employee-Owned Company
Commercial HVAC | Process Cooling | Industrial Refrigeration | Power

INNOVATIVE
REFRIGERATION SYSTEMS, INC

ePSM | eCompliance | eConserve | eService | eIntranet | eTraining

DESIGN, BUILD, & SERVICE
OF CUSTOMIZED TURN-KEY
INDUSTRIAL REFRIGERATION SYSTEMS

373 MOUNT TORREY RD, LYNDHURST, VA 22952 (540) 941.1999 WWW.R717.NET

IRTC | iar International Institute of Ammonia Refrigeration | GLOBAL COLD CHAIN ALLIANCE® | RETA

FEBRUARY 2022

contents

CONDENSER STAFF

Publisher
Gary Schrift

Editor-In-Chief
Andrea Fischer

Staff Writer
Mindy Long

Creative Director
Bill Ellis

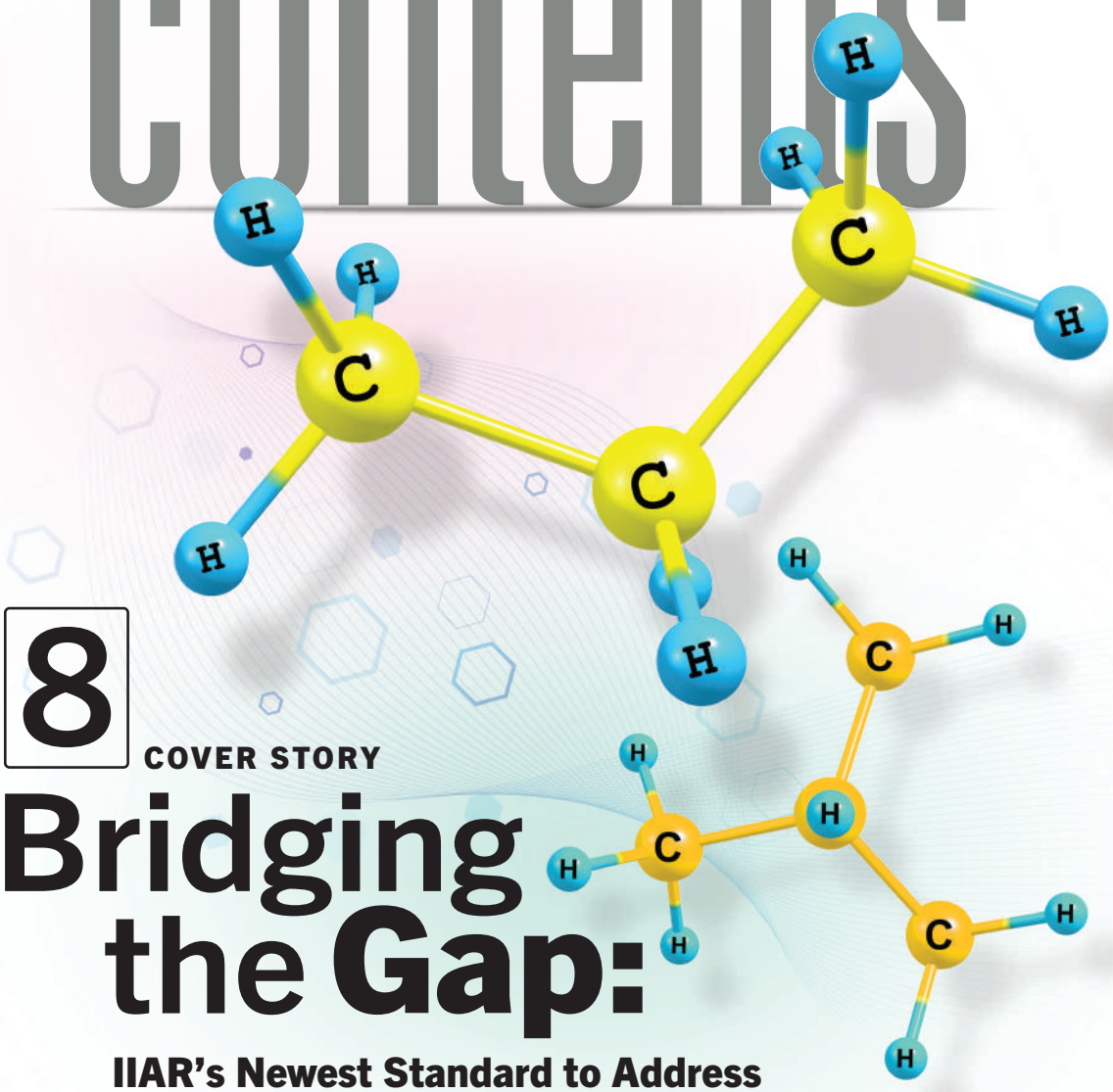
V.P. Marketing and Sales
Eileen McKeown

V.P. and Technical Director
Eric Smith

International Institute of Ammonia Refrigeration

1001 North Fairfax Street, Suite 503
Alexandria, VA 22314
www.iiar.org

Phone: 703-312-4200
Fax: 703-312-0065



president's MESSAGE

BY GARY SCHRIFT

It's that time of year again, and I'm happy to welcome all IIAR members back to our most important event – the IIAR annual conference and exhibition! After years of pandemic travel restrictions and necessary safety measures, it feels good to be looking forward to an in-person conference again. And before I get into the exciting things we've got in store for you as an organization this year, I'd like to take a minute to recognize all our sponsors and exhibitors. It is their support that provides the backbone for this annual event, sponsoring food and coffee breaks, not to mention our exhibit hall – and everything else that makes this one of the premier events in our industry.

And I'd also like to thank you, as an IIAR member or attendee. Our technical program is the most central element of our conference work as an industry, and your participation is crucial. Special thanks go out to all our tech paper authors, workshop, and panel contributors. Your leadership and enthusiasm have made the IIAR annual conference the top-notch technical event it is today.

I'd also like to encourage everyone to take advantage of the opportunities to participate in IIAR's continuing education in Savannah at our annual conference this year. It's a great chance to expand your technical knowledge and grow your professional credentials while making our industry a safer place to work. And finally, don't forget to attend the many planned social gatherings to network and catch up with old friends!

For the first time since 2006, IIAR has made changes to its membership structure, bringing new value and opportunities to those in the refrigeration industry. IIAR's new membership structure will take effect on July 1, and the changes will increase the value of IIAR membership, promote recruitment and retention of members, and create financial balance and sustainability for IIAR.

As you may read in this issue of the Condenser Magazine, IIAR is announcing a major new membership change.

For the first time since 2006, IIAR has made changes to its membership structure, bringing new value and opportunities to those in the refrigeration industry. IIAR's new membership structure will take effect on July 1, and the changes will increase the value of IIAR membership, promote recruitment and retention of members, and create financial balance and sustainability for IIAR.

The IIAR board came to its decision to change the membership structure after convening a group of 23 IIAR members, and later, an executive committee task force who came together to discuss the issue and delve into ways membership could add value. Ultimately, a simpler IIAR rate structure was developed encompassing many new member benefits.

As part of the change, members will receive free access to one IIAR training video set (Series I, II, or III), one free ANR course annually, free access to online and PDF versions of the ANSI/IIAR standards, and free access to virtual conference content.

Meanwhile, IIAR continues to focus on regulatory initiatives, international outreach, standards development, and educational programs, in recognition that our organization has taken a leadership role in the global cold chain.

In closing, these advocacy efforts, membership changes, and educational programs, including our annual conference, represent the future of our industry, and your support of them is essential. Every IIAR program and initiative is made possible by your membership, and additionally, by your leadership as a volunteer.

I'd like to encourage everyone to use this conference to enjoy a return to "business as usual," and get involved in the work of your organization. Or if you couldn't join us this year, be sure to renew your membership. It's the best way to make sure you connect with this ever-growing community of friends and colleagues who are passionate about natural refrigerants.

MAYEKAWA MYCOM

mCHILLER

FUGU

standard water-cooled ammonia chillers

The mCHILLER FUGU is Mayekawa's compact standard solution with a strong focus on sustainability and energy consumption. With its reliable industrial design and low ammonia charge, FUGU is easy to install and operate, while ensuring maximum safety.

MAYEKAWA MYCOM info@mayekawausa.com | 615-773-2859 | https://mayekawa.com/americas/mna

Mayekawa USA Sales Reps:

Clark Johnson Company, Inc. | FREEZE-PRO, Inc. Industrial Refrigeration Equipment | STANTON & ASSOCIATES | IREP INDUSTRIAL REFRIGERATION | SWR | Refrigeration Technology Solutions, LLC

chairman's MESSAGE

BY ERIC JOHNSTON

A new year is upon us and with it has come so many exciting changes for IIAR. As we look forward to the first in-person annual conference in years, I'm looking back on all the wonderful achievements our organization has made in 2021. Despite a global pandemic and the inability to meet in person, our members and committees have moved forward several important initiatives, our staff has grown our member services, and we've continued to do the essential standards development work our organization is known for.

As I wind up my year as chairman of our International Association of Industrial Refrigeration, I'd like to take this opportunity to thank you all for a job well done during my term and look forward together to the exciting years ahead.

Among IIAR's significant accomplishments in the past year has been the update and addition of two separate marquee standards. The association released its latest update to IIAR-2, which was first released in 1974, and its first-ever safety standard for carbon dioxide, IIAR CO_2.

The release of the updated IIAR-2 Standard in September was the culmination of several years of effort, collecting and addressing nearly 200 individual comments. The work of our standards committee to get this done was intense, involving bi-weekly meetings and the serious dedication of individual members to work through discussing and resolving each comment.

That work has paid off with an updated standard that sets IIAR members up for the next five to ten years and continues to establish IIAR as a critical resource for the future of natural refrigerants and a central part of the cold chain infrastructure.

The recent publication of the IIAR CO_2 2021 standard is also part of a long progression of efforts that started over 20 years ago, and a recognition of CO_2's more central role in the world of natural refrigerants.

Meanwhile, IIAR is nearing completion of IIAR's first hydrocarbon standard, a natural extension of our mission to offer safe practice standards as the refrigeration industry turns to low global-warming-potential solutions.

I'm proud of IIAR's significant output of these new and revised standards. These efforts further solidify our organization as the authority on all natural refrigerants, and they also lay the groundwork for a host of other member benefits and services like educational guidelines and classes offered through the Academy of Natural Refrigerants.

IIAR introduced two new guidelines in 2021 – the Insulation Installation Guideline and the Critical Task Guidance for Ammonia Refrigeration System Emergency Planning. In addition, five new or revised classes were added to the Academy's offerings in 2021 including an ANR IIAR-4 course, an ANR course on the new Ammonia Refrigeration Management Guideline, and three ANR Spanish courses including IIAR-5, IIAR-6, and IIAR-8.

IIAR's greatest asset is the vibrancy and engagement of its various committees. It has been encouraging to experience first-hand how well our committees are attended by volunteers, how active our membership is in advancing and supporting the work of IIAR's committees, and how dedicated our staff has been in developing new services.

All of these achievements are the result of everyone's hard work. I would like to thank you all for volunteering your time and actively committing to IIAR– your effort is continuing to pay off.

I'd like to take this opportunity to call for your renewed membership, for your increased participation and leadership in IIAR's committees, and development of technical materials, like standards, technical papers for the annual conference, or any other work product IIAR produces. Whether you get involved as a committee member or as a tech paper author, or in some other way, your involvement is what makes IIAR a great organization.

Our publications are second to none, addressing new trends and introducing new technologies, and you, as an IIAR member have the opportunity to contribute to them directly.

You have an unparalleled opportunity to influence the policies, codes, and standards that shape our industry. Our committees span all of these areas and beyond, and they all depend on your help and support. To that end, we'll be focused once more on the work of our committees this year, especially in the regulatory arena, where we've continued to build relationships on behalf of our industry. As chair of IIAR, I have a new-found respect for how important this work is, as well as how rewarding it can be.

This year's Natural Refrigeration Conference and Expo will feature for the first time an in-person and virtual component. IIAR will record each session and make recordings available online about a week later for those who can't attend in person, just one more example of how we've evolved and met some unique challenges over the last several years. Of course, if you can attend, I'm looking forward to seeing you in person as we return to a non-virtual meeting this year in Savannah, Georgia, March 6-9.

As always, we invite and look forward to everyone's participation as well as the new accomplishments in the year ahead.

Republic Refrigeration, Inc.

We Have the Solution

For Your Business

Republic Refrigeration's

custom penthouse units are resetting the refrigeration industry. Each penthouse is designed and engineered to fit your facility's specific needs. Our units have maximum versatility to met your facility requirements for CO_2, Ammonia, Glycol or Freon applications.

Our units are competitively priced to meet your specific needs for cold-storage facilities or food-processing plants.

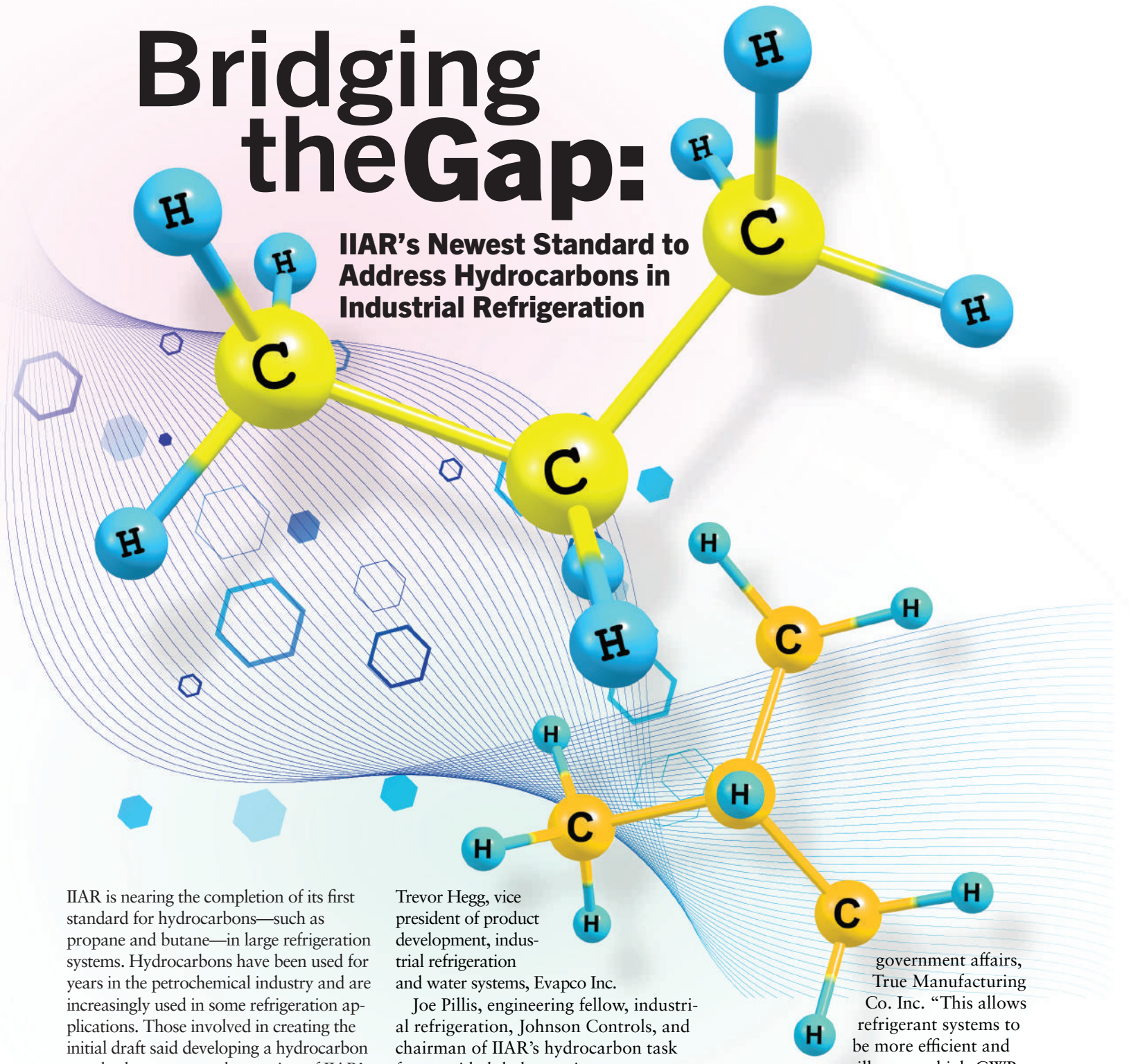
CALL US NOW!

(800) 779-0399

www.RepublicRefrigeration.com

Bridging the Gap:

IIAR's Newest Standard to Address Hydrocarbons in Industrial Refrigeration



IIAR is nearing the completion of its first standard for hydrocarbons—such as propane and butane—in large refrigeration systems. Hydrocarbons have been used for years in the petrochemical industry and are increasingly used in some refrigeration applications. Those involved in creating the initial draft said developing a hydrocarbon standard was a natural extension of IIAR's mission to offer safe practice standards for other natural refrigerants, such as CO_2, as the refrigeration industry turns to low global-warming-potential solutions.

"IIAR has been recognized as a leader in the ammonia refrigeration industry with respect to standards development, education and advocacy, but we are expanding our outreach to natural and sustainable refrigeration in support of the Montreal Protocol and Kigali Agreement," said Trevor Hegg, vice president of product development, industrial refrigeration and water systems, Evapco Inc.

Joe Pillis, engineering fellow, industrial refrigeration, Johnson Controls, and chairman of IIAR's hydrocarbon task force, said global warming concerns are bringing considerable regulatory pressure to reduce the global warming potential of refrigerants used in refrigeration systems.

Hydrocarbons in refrigeration systems can help fill gaps where other refrigerants are not allowed, difficult to use, or inefficient. "Many of these gaps could be filled using hydrocarbon refrigerants," said Charles Hon, manager, engineering, sustainability and government affairs, True Manufacturing Co. Inc. "This allows refrigerant systems to be more efficient and still not use high-GWP refrigerants or fluorinated refrigerants."

The use of ammonia in some locations is not allowed due to the proximity to residential areas. The use of CO_2 in warm climates is an issue because the energy required and reliability can be questionable. The use of the ultra-low GWP F-gases is being questioned because of cost and the decomposition by-products are under serious scrutiny. "Propane fills the gaps where ammonia and CO_2 do not fit," Hon said.

Comprehensive Cold Chain Solutions

Vilter offers the most innovative products and solutions for industrial refrigeration compression. As experts in streamlining cold chain efficiencies, our solutions can effortlessly be integrated into your business processes. Backed by Emerson reach and support, we are certain to have a solution for your needs in every corner of the globe.

VILTER™

EMERSON™

EMERSON. CONSIDER IT SOLVED.™

New California Air Resources Board (CARB) regulations that took effect Jan. 1 require the GWP used in cold storage warehouses and industrial process refrigeration facilities containing over 50 lbs. of refrigerant to be below 150 GWP, Pillis said. The AIM act regulations promulgated by EPA will also restrict the allowable GWP used throughout the United States. The final GWP limits by sector are still under discussion but will undoubtedly rule out most, if not all, HFC gases and blends in the near future.

HFO refrigerants can meet the GWP limit of the new rules, but they come at a cost. The new HFO refrigerants are either flammable or operate in a deep vacuum at refrigeration temperatures making systems large and expensive, Pillis said.

Additionally, there are remaining concerns that the breakdown of fluorine containing refrigerants produces polyfluoroalkyl substances (PFAS) and trifluoroacetic acid (TFA) creates several dangerous and persistent by-products.

"These are likely to come under further attack once the GWP issue is addressed," Pillis said. "Considering the issues around HFOs the only good refrigerant options left for low-temperature systems are ammonia, CO_2 and hydrocarbons."

DEVELOPING A STANDARD

IIAR has been focusing on various refrigerants, and moving into hydrocarbons has been a natural extension of the association's work. "We know standards, and we write standards," said Peter Jordan, senior principal engineer at MBD Risk Management Services Inc.

When Jordan first got involved with IIAR in 1991, it was 100 percent ammonia. "There wasn't even a glint in anyone's eyes about any other refrigerant. That has changed over the years," he said, adding that additional guidance on hydrocarbons is needed. "The model codes address them, but in terms of a standard out there dedicated to them, we felt it didn't exist."

The IIAR Board of Directors commissioned a task group that first met in June of 2018 to investigate if the association should undertake a hydrocarbon refrigerant standard. The group determined there was significant interest. "A committee was assigned, and an ANSI PINS obtained to begin work on a standard shortly thereafter," Pillis said.

The standard will follow a similar framework as the IIAR CO_2 standard with sections on design, installation, startup, inspection, testing, and maintenance as well as general safety and training needs. Plus, it is a complementary standard to ammonia and CO_2. "It can be used in areas that other natural refrigerants are problematic," Hon said. "It is very efficient and easy for trained technicians to use since handling and repairs are very similar to the high GWP refrigerants used today."

Hegg explained that the purpose and benefit of IIAR developing these standards and other educational material is consistency. "The Standards Committee applies the same thought processes to ensuring refrigeration systems, regardless of the natural refrigerant being used, are all safe," he said.

The committee is nearing the end of its initial draft standard, which will be reviewed by the rest of the Standards Review committee in the coming months. After that, it will be open for public review and a review by the consensus body. "I am certain there will be multiple rounds of public review, but I think we might have an approved standard by this time next year if all proceeds well," Pillis said.

ADDRESSING SAFETY

Hydrocarbons are allowed today in self-contained systems with less than 150 grams of charge per circuit. 150 grams of propane is sufficient to produce approximately ½ ton refrigeration effect. ISO 60335-2-89 covers international requirements for use of HCs in refrigeration systems and has voted to raise the charge limit to 500 grams per circuit in self-contained units with some limitations.

"The IIAR standard will generally defer to existing limitations for those systems covered by the ISO standard," Pillis said. "The IIAR standard is intended to address safe practice in designing and operating HC refrigeration systems above the current allowed charge limits."

Pillis said there are many existing safety codes and standards in the U.S. that have requirements around the use of HCs in refrigeration systems. "We are working to incorporate those requirements into our standard not compete with them," he explained.

Jordan examined model codes and their requirements for class A3 refrigerants, including the type of chemicals for these standards. "One would think they would all have the same requirements, but we don't live in an ideal world," he said, adding that he summarized all the requirements for the model codes and those formed, in some sense, the basis of the standard. "We try to have a harmonized standard that will allow people to comply with these codes and have practical guidance. In an ideal world, the codes would refer to us like they currently do with ammonia."

The existing codes have fairly strict requirements, and the committee has taken a conservative approach to the hydrocarbon standard. "When we're looking at model codes, in general, we took the requirements from the strictest," Jordan said.

The hydrocarbon standard will feature some requirements members may not have been exposed to in the past, such as treating vapor that leaves the system.

The standard also includes a separate chapter on health and safety because of the unique requirements of hydrocarbons. "This is above and beyond anything we've dealt with before," Jordan said, adding that, as an example, static-safe foot ware and non-sparking tools are necessary. "These are the kind of precautions and requirements we want to try to make standardized through the industry."

Hydrocarbons are very efficient, low-cost and well-known natural refrigerants, but they are highly flammable. "Designing and using HC systems will require adherence to safe practices throughout the life of the HC refrigeration systems," Pillis said.

Once the standard is released, Hegg encouraged IIAR members to participate in the public review. "It will make the document better," he said.

Built for Harsh Environments | Designed to Prevent False Alarms

CTi GAS DETECTION SPECIALISTS

We're looking forward to seeing you at the IIAR Conference in Savannah!

Stop by booth 623/625 to catch up on the latest news from CTI.

www.ctigas.com | sales@ctigas.com | 866-394-5861

Membership Dues Changes Bring Additional Value to Members

For the first time since 2006, IIAR has made changes to its membership structure, bringing new value and opportunities to those in the refrigeration industry. IIAR's new membership structure will take effect on July 1, 2022, and the changes will increase the value of IIAR membership, promote recruitment and retention of members, and create financial balance and sustainability for IIAR.

As part of the change, members will receive free access to one IIAR training video set per year (Series I, II or III), one free Academy of Natural Refrigerants (ANR) course annually, free access to online electronic versions of all ten of the ANSI/IIAR standards, and free access to virtual conference content, said Eric Johnston, director of PSM for American Foods.

Eileen McKeown, vice president for marketing and sales for IIAR, said changing the membership structure was not an easy decision, but it will bring additional opportunities. "Members will have access to all of the member benefits they had before, but they can also access the education as part of their membership," she said.

The IIAR board came to its decision on membership dues after initially focusing on ways to balance the budget. "We were so heavily dependent on the revenue from the conference that when we have a pandemic as we had, it put a strain on the organization's finances," said Trevor Hegg, vice president of product development, industrial refrigeration and water systems, Evapco Inc. "We said, 'How do we get that financial balance and stability?'"

As part of the change, members will receive free access to one IIAR training video set per year (Series I, II or III), one free Academy of Natural Refrigerants (ANR) course annually, free access to online electronic versions of all ten of the ANSI/IIAR standards, and free access to virtual conference content.

Johnston said IIAR's mission 'is to provide advocacy, education, and standards.' "The modifications to the membership dues and benefits greatly promotes this mission by expanding the free benefits provided with membership to include educational videos, training, standards, etc., for our members," he said.

In November 2020, 23 IIAR members came together to discuss the issue and

delved into ways membership could add value. "What was interesting was they all had different thoughts on what benefited them. End users had a different perspective than engineers, contractors, manufacturers," Hegg said.

The executive committee created a task force that met for more than a year. Members looked at membership modifications that could increase non-conference revenue, add or enhance member benefits, and increase education and access to IIAR standards.

> **"I think that it is extremely important and beneficial for the members to understand all the existing and new benefits that they are gaining in conjunction with this membership dues change."**
>
> **Eric Johnston, director of PSM for American Foods**

"The rate is going up slightly for individual members, but you're getting more value than we're raising the prices. You're getting something more from your membership, which will hopefully attract new members," Hegg said.

The committee started creating financial models based on different rate structures and ultimately created a simple rate structure. "If you're an individual, you pay $1,000, but for another $1,000, you can add four more members," Hegg said. "Then it is another $2,000 for another five members, up to 25."

Once locations reach 25 members, which is $10,000, there is a $100 fee for each additional member. "For $100, they have access to the standards, they get a training video and the ANR class included in their membership," Hegg said.

A lot of companies have budgets for training, and now they can use that to access professional development through IIAR membership. "The thought was that this does help offset some company's budgets for training," Hegg said, adding that growing membership and providing training and educational content benefits the industry. "We'll be making our industry stronger because this content will get to a bigger group of people."

Johnston hopes the educational component will draw members into the association. "I think that it is extremely important and beneficial for the members to understand all the existing and new benefits that they are gaining in conjunction with this membership dues change," Johnston said.

For many end-users, their management wants to understand what benefits their company/personnel will be receiving with this membership. Having a simple breakdown showing what the costs are for non-members versus free for members will help them to 'sell' this to their upper management, Johnston explained.

IIAR has been growing membership year over year. "Our growth has been very encouraging and we're trying to change our membership structure to attract more people and grow the membership even more," McKeown said. "As we grow as an organization, we expand our membership base into new verticals."

Membership Frequently Asked Questions

Gary Schrift, IIAR's president, said members have had questions about the upcoming membership dues changes. Some frequently asked questions include:

Q If my company has four locations, do I purchase a group membership for all four locations?

A No, the group membership is a company membership. Regardless of where your company's employees are located, you can include all in a group. For example, if a company decides to buy a $10,000 membership that provides them 25 members, those members can come from multiple plant or office locations throughout the U.S. and the world. Because many companies in our industry are multi-national, this is an important caveat and should also continue to drive up international membership.

Q We have high turnover. If one of my employees is a member and leaves and I replace them, do I buy a new membership?

A No, using the same example, if the company has 25 members, the company paid for and owns the membership. So, the main company IIAR members who controls their membership list can contact IIAR and have the individual membership of the employee who left changed to a new person. That new person's membership will expire when the previous employee's membership was to expire.

Q Can I add new members to my group during the membership year?

A Yes. Using the same example, if you wish to add a new member, it would be $100. But note that this new membership and its benefits for that employee expire June 30 of the current membership year. In another example, suppose a company purchased a five-membership group for $2,000 and provided individual names for all five. If they wish to add a sixth employee, their only option is to purchase a 10-member group purchase, adding 5 more members for an additional $2,000. Their sixth employee gets all the benefits, and they are free to add four more employees to fill out the 10-member purchase for the remainder of the membership year.

Q Can I monitor the status of our company's employees' training progress?

A Yes. The IIAR training videos and online Academy of Natural Refrigerants (ANR) classes are delivered via an online learning management system. Individual members can see the training programs for which they are enrolled and their progress and quiz and test status. The main contact can see the status for all employees of the group membership.

IIAR Annual Conference Returns with In-Person and Virtual Learning Opportunities

The International Institute of Ammonia Refrigeration 2022 annual Natural Refrigeration Conference & Expo will return to an in-person meeting this year in Savannah, Georgia, March 6-9, with a Foundation Golf Outing on March 5th. The event provides four days of technical knowledge, networking and industry-sponsored events for those involved in the natural refrigeration industry. IIAR will also record each technical session and make recordings available online about a week later for those who can't attend in person.

"Conference registration is looking strong, and exhibit registration is strong as well," said Eileen McKeown, vice president for marketing and sales for IIAR. "We've seen a lot a lot of interest in the event this year, and we have signed on some new exhibitors."

Attendees can obtain professional development hours for both in-person and online attendance. Each technical session will earn attendees PDH credits related to the session topic.

There will be several educational opportunities throughout the conference. They get started on Sunday with the Refrigeration Controls Education Program, which will feature four industry speakers focusing on refrigeration controls and automation. They will cover everything from control system basics to end-user applications of controls and end-user expectations.

"This topic has not been a focus of IIAR technical programs for some time, and everyone needs controls and automation for their natural refrigeration systems," said Gary Schrift, president of IIAR.

Eric Smith, IIAR's vice president and technical director, said the session will also cover developments as they apply to the future of controls, including the use of trending technologies for predictive maintenance, the use of applications such as 5G remote opportunities, and when or whether such applications are appropriate.

Several technical papers will be presented during the conference (learn more on page 20).

Additionally, Bent Wiencke, Nestle USA (retired), will present the workshop Determining Leak Rates in Ammonia Refrigeration Piping. The workshop will review the fundamental elements of a forthcoming guideline and computer program that have been developed at the request of the IIAR government relations committee and supported by other committees to aid end-users in their reporting requirements.

"We recognize that in our industry, we want to neither under report nor over report the amount of ammonia that gets released in an incident," Smith said. "These tools will help end-users to quickly and more accurately determine the amount of ammonia that has been released in an incident. These results would be used for reporting purposes, and the guideline and computer program will provide a consistent methodology for the industry to use."

There will also be several panels, including an IIAR Regulatory and Code Update Panel, an ARF/IIAR Research Committee Panel, and a Closing Panel on recent IIAR publications and the new IIAR membership structure.

Attendees can participate in several technomercials, which cover updates to equipment and services. "Technomercials are a benefit because the content comes directly from the industry. The sessions are commercial in nature and allow vendors to incorporate technical information and training into a program that promotes a product or service," McKeown said.

This year's keynote speaker, Jack Uldrich, is a well-recognized global futurist, speaker and author. He frequently speaks on technology, change management and leadership. His most recent book is Foresight 20/20: A Futurist Explores the Trends Transforming Tomorrow, and his forthcoming book is *Business as Unusual: How to Future-Proof Yourself Against Tomorrow's Transformational Trends, Today*.

Networking opportunities will take place throughout the event. They include a First Timer's Reception, Chairman's Reception and several coffee breaks. On Monday, attendees can take part in A Night in Savannah, which will take place in Johnson Square, the oldest and largest square in Savannah. "Barring bad weather, rather than having entertainment inside a building, our drinks, music and snacks will occur outside in a park in downtown Savannah," Schrift said.

McKeown noted that IIAR is focused on attendees' safety and is abiding by all CDC, state and local rules. "We are not going to be mandating vaccines and masks, but we will be working with local states and jurisdictions to ensure we're following all requirements," she said.

Register for the conference online at http://www.iiar.org.





conference chair's MESSAGE

DAVE MALINAUSKAS

Welcome to Savannah and the 2022 IIAR Industrial Refrigeration Conference & Exhibition!

Welcome to the 2022 IIAR Natural Refrigeration Conference & Exhibition! It's the beginning of a new membership year for all of us at IIAR, and most importantly, it's our first year "back" to normal in-person meetings. That means it's time to meet new colleagues, network, and catch up with friends and business partners at our industry's largest conference and expo event.

I would like to take this opportunity to talk about how this event, and especially your membership in this organization is making an important contribution to our everyday lives and the lives of others.

Making the world a safer place is IIAR's first mission. We do that by addressing climate change through the promotion of natural refrigerants, looking for better ways to improve energy efficiency, and by developing safety standards and training programs that ensure the wider adoption and safe application of natural refrigerants.

Embracing the many applications of natural refrigerants means we're making the environment safer for ourselves and our future generations.

Another part of our mission is to extend the reach of natural refrigerants to all sorts of refrigeration applications. That's a goal that our membership and our board are embracing, as evidenced by our focus on producing and maintaining safety standards for not only ammonia but now carbon dioxide and soon, hydrocarbons.

Our industry has a long record of safety to be proud of, and our standards activity is at the core of that. We're making refrigeration facilities safer through the development of PSM, RMP programs, and the education and training that happens right here at our annual conference.

The work of our committees is the cornerstone of our organization and activities. I'd like to use this message to not only welcome you to this year's conference but also to encourage you to find a committee whose work you can participate in and become passionate about.

That sense of volunteer leadership just keeps growing every year. If you're a longtime IIAR member, welcome back. And if you're new here, I hope you enjoy the energy and enthusiasm of your colleagues. Welcome to Savannah and enjoy the conference!

Best Regards,

Dave Malinauskas
2022 Conference Chair

2022 IIAR Conference Schedule

Thursday, March 3, 2022

6:30 PM – 8:30 PM
IIAR Executive Committee
Dinner – Invitation Only

Friday, March 4, 2022

8:30 AM – 9:00 AM
IIAR Executive Board Meeting
Breakfast – Invitation Only

9:00 AM – 12:00 PM
IIAR Executive Board
Meeting – Invitation Only

12:00 PM – 1:00 PM
IIAR Board Lunch – Invitation Only

1:00 PM – 5:00 PM
IIAR Board Meeting –
Invitation Only

6:30 PM – 8:30 PM
IIAR Board Dinner – Invitation Only

Saturday, March 5, 2022

7:30 AM – 9:15 AM
ARF Golf Breakfast

9:30 AM – 3:00 PM
ARF Golf Outing Tee
Time – Paid registration required

3:30 PM – 4:30 PM
ARF Golf Lunch – Awards Ceremony

8:30 AM – 5:00 PM
IIAR Registration Open

9:00 AM – 5:00 PM
Exhibitor Setup

6:00 PM – 7:00 PM
IIAR VIP Reception – Invitation Only

Sunday, March 6, 2022

7:30 AM – 5:00 PM
Registration Open

8:00 AM – 5:00 PM
Exhibitor Setup

8:00 AM – 10:00 AM
International Committee
Chair Max Duarte, EVAPCO, Inc.

8:00 AM – 12:00 PM
Education Committee
Chair Mark Stencel, Bassett Mechanical

8:00 AM – 12:00 PM
Government Relations Committee
Chair Jeff Carter, General Mills, Inc.

8:00 AM – 12:00 PM
Piping Committee
Chair Gordon Struder, EVAPCO, Inc.

8:00 AM – 12:00 PM
Energy Sustainability Committee –
First in Person Meeting

Chair Stefan Jensen, Scantec Refrigeration Technologies

8:00 AM – 12:00 PM
Research Committee
Chair Wayne Wehber,
Vilter Manufacturing LLC

8:00 AM – 12:00 PM
Standards Committee
Chair Don Faust, FRICK Industrial Refrigeration

9:00 AM – 10:30 AM
Safety Committee
Chair Joe Fazzari, Colmac Coil Manufacturing Inc.

9:00 AM – 11:00 AM
Marketing Committee
Chair Beth Fox, EVAPCO, Inc.

9:00 AM – 12:00 PM
CO_2 Handbook Committee
Chair Luke Facemyer, Clauger

10:15 AM – 1:00 PM
International – LATAM
Chair Max Duarte, EVAPCO, Inc.

10:30 AM – 11:30 AM
Committee Meeting
Rooms Coffee Break
Sponsored by Isotherm

1:00 PM – 5:00 PM
Education Program: Fundamentals and Future of Industrial Refrigeration Controls –
Paid Pre-Registration Required
Presenters: Roberto Mendoza, Logix Controls; Jeff Henness, Vacom; David Jametsky, Danfoss





3:00 PM – 4:00 PM
ARF Scholarship Students Orientation – Invitation Only

4:30 PM – 5:30 PM
Women in Refrigeration Reception

5:30 PM – 6:00 PM
First Timer's Reception
Sponsored by Shambaugh & Son

6:00 PM – 7:00 PM
Chairman's Reception
Sponsored by Republic Refrigeration

Monday, March 7, 2022

7:00 AM – 5:00 PM
Registration Open

7:00 AM – 7:30 AM
Breakfast Business Meeting
Sponsored by Mayekawa, MYCOM

7:30 AM – 8:00 AM
IIAR Business Meeting

8:00 AM – 9:15 AM
Keynote Speaker – Jack Uldrich

8:00 AM – 10:30 AM
Spouse/Guest Breakfast – Mimosas Meet and Greet – Invitation Only

9:15 AM
Exhibit Hall Opens

9:30 AM – 10:00 AM
Technomercial #1
Baltimore Aircoil Company

10:00 AM – 10:30 AM
Coffee Break Expo Hall

10:30 AM – 11:00 AM
Technomercial #2
Frick Industrial Refrigeration

11:15 AM – 11:45 AM
Technomercial #3
Vilter Manufacturing

12:00 PM – 1:00 PM
Lunch on Exhibit Hall floor

12:00 PM – 12:30 PM
Technomercial #4
Danfoss

12:45 PM – 1:15 PM
Technomercial #5
Refplus, Inc.

1:45 PM
Exhibit Hall Closes

1:45 PM – 3:30 PM
Panel: Research Panel
Presenters: Wayne Wehber, Vilter Manufacturing; Scott Davis, PhD, Gexcon; Bent Wiencke, Nestle (ret.); Chidu Narayanan, AFRY Switzerland , Bill Greulich, Kensington Consulting

1:45 PM – 2:35 PM
Tech Paper: Proper Installation Practices for VFDs
Presenter: Paul Jascynski, Logic Technologies

1:45 PM – 2:35 PM
Tech Paper: CFD Modelling of Condensate Induced Hydraulic Shock Events
Presenter: Chidambaram (Chidu) Narayanan, AFRY Switzerland

2:40 PM – 3:30 PM
Workshop: Refrigeration Pump Applications – Presented in English
Presenter: Ernesto Rodriguez, Hermetic-Pumpen

2:40 PM – 3:30 PM
Tech Paper: Managing Your Energy Costs – It Can Be Done!
Presenter: James Majsak and Benny Phillips, CrossnoKaye

3:30 PM – 5:00 PM
ARF Board Meeting – Invitation Only

3:30 PM – 4:00 PM
Coffee Break Technical Program
Sponsored by Colmac Coil Manufacturing

4:00 PM – 4:50 PM
Tech Paper: Transcritical CO_2 Compressors: Technical Challenges in Industrial Refrigeration Applications
Presenter: Giacomo Pisano, Dorin

4:00 PM – 4:50 PM
Tech Paper: Don't Curse the Purger
Presenter: Don Tragethon, Western Precooling

4:00 PM – 4:50 PM
Tech Paper: Liquid Overfeed

2022 IIAR Conference Schedule

Ammonia Refrigerating Plant and Energy Efficiency – Virtual presentation onsite with Live Question and Answer
Presenter: Stefan Jensen, Scantec Refrigeration Technologies

4:00 PM – 4:50 PM
Tech Paper: Benefit of Ammonia Heat Pump Implementation in the Industry and in District Heating
Presenters: Kenneth Hoffman, David Blankley, and Larry Bradley, GEA

4:55 PM – 5:45 PM
Tech Paper: Simple Equations for Determining Mass Flow in Ammonia Refrigeration Systems
Presenter: Don Faust, Johnson Controls

4:55 PM – 5:45 PM
Tech Paper: Oil Management Design Considerations for Industrial Transcritical CO_2 Systems
Presenters: Alessandro Silva and Joe Sanchez, Bitzer

4:55 PM – 5:45 PM
Tech Paper: Absorption Applications for Residential/Light Commercial Space Conditioning and Water Heating
Presenter: Mike Garrabrant, Stone Mountain Technologies

6:30 PM – 9:30 PM
A Night in Savannah at Johnson Square
Sponsored by EVAPCO, Inc.

Tuesday, March 8, 2022

7:30 AM – 8:30 AM
Breakfast Expo Hall
Sponsored by Delta Tee

7:30 AM
Exhibit Hall Opens

8:00 AM – 9:30 AM
Compliance Guidelines Committee
Chair Jeanna Emmons, PSM RMP Solutions

8:00 AM – 8:30 AM
Technomercial #6
Bacharach

8:30 AM – 9:30 AM
Finance Committee – Invitation Only
Chair Jeff Carter, General Mills, Inc.

8:45 AM – 9:15 AM
Technomercial #7
M&M Carnot

9:30 AM – 10:00 AM
Technomercial #8
EVAPCO, Inc.

10:00 AM – 11:00 AM
Coffee Break Expo Hall
Sponsored by Polyguard Products

10:30 AM – 11:30 AM
Exhibitor Meeting

10:30 AM – 11:00 AM
Technomercial #9
Colmac Coil Manufacturing, Inc.

11:15 AM – 11:45 AM
Technomercial #10
GEA Group

12:00 PM – 12:30 PM
Technomercial #11
Frascold

12:15 PM – 1:15 AM
Lunch on Exhibit hall floor
Sponsored by Vilter Manufacturing

1:15 PM
Exhibit Hall Closes

1:10 PM – 2:00 PM
Tech Paper: CFD Modelling of Condensate Induced Hydraulic Shock Events
Presenter: Chidambaram (Chidu) Narayanan, AFRY Switzerland

1:10 PM – 2:00 PM
Tech Paper: Managing Your Energy Costs – It Can Be Done!
Presenters: James Majsak and Benny Phillips, CrossnoKaye

1:10 PM – 2:00 PM
Tech Paper: Simple Equations for Determining Mass Flow in Ammonia Refrigeration Systems
Presenter: Don Faust, Johnson Controls

1:10 PM – 2:55 PM
Panel: Code and Regulatory Panel
Presenters: Jeff Shapiro and Lowell Randel

1:15 PM – 2:00 PM
IIAR Board Photographs – Invitation Only





2:00 PM – 4:00 PM
IIAR Board Meeting – Invitation Only

4:00 PM – 5:00 PM
IIAR Committee Chairs Meeting – Invitation Only

2:05 PM – 2:55 PM
Como Conducir un Análisis PHA
Presenter: Juan Zeledon, Cargill Nicaragua

2:05 PM – 2:55 PM
Workshop: Review of Newly Published Release Calculation Guideline
Presenter: Bent Wiencke, Nestle (retired)

2:05 PM – 2:55 PM
Tech Paper: Transcritical CO_2 Compressors: Technical Challenges in Industrial Refrigeration Applications
Presenter: Giacomo Pisano, Dorin

2:55 PM – 3:25 PM
Coffee Break Technical Program

3:25 PM – 4:15 PM
Tech Paper: Don't Curse the Purger
Presenter: Don Tragethon, Western Precooling

3:25 PM – 4:15 PM
Tech Paper: Proper Installation Practices for VFDs
Presenter: Paul Jascynski, Logic Technologies

3:25 PM – 4:15 PM
Workshop: Refrigeration Pump Applications – Presented in Spanish
Presenter: Ernesto Rodriguez, Hermetic-Pumpen

3:25 PM – 4:15 PM
Tech Paper: Absorption Applications for Residential/Light Commercial Space Conditioning and Water Heating
Presenter: Mike Garrabrant, Stone Mountain Technologies

4:20 PM – 5:10 PM
Workshop: Global Natural Refrigerant Market Data – Latest Trends and Expected Impact
Presenter: Marc Chasserot, Shecco

4:20 PM – 5:10 PM
Tech Paper: Oil Management Design Considerations for Industrial Transcritical CO_2 Systems
Presenters: Alessandro Silva and Joe Sanchez, Bitzer

4:20 PM – 5:10 PM
Tech Paper: Benefit of Ammonia Heat Pump Implementation in the Industry and in District Heating
Presenters: Kenneth Hoffman, David Blankley, and Larry Bradley, GEA

4:45 PM
Exhibit Hall Opens

5:00 PM – 5:30 PM
Technomercial #12

5:45 PM – 6:15 PM
Technomercial #13

6:00 PM – 7:00 PM
Exhibitors Reception

7:00 PM
Exhibit Hall Closes

Wednesday, March 9, 2022

7:00 AM – 10:00 PM
Registration Open

7:30 AM – 8:30 AM
Breakfast Expo Hall
Sponsored by Bitzer

7:30 AM
Exhibit Hall Opens

8:00 AM – 9:00 AM
ARF Scholarship Students Feedback and Goodbyes – Invitation Only

9:30 AM
Exhibit Hall Closes

10:50 AM – 11:30 AM
Coffee Break
Sponsored by Airgas Specialty Products

11:00 AM – 12:30 PM
Closing Forum: Review of IIAR Guidelines

12:30 PM
Conference Adjourns

Technical Papers Provide In-Depth Thought Leadership at the IIAR Conference

During the annual IIAR Industrial Refrigeration Conference & Exhibition, industry experts will come together to present technical papers at the IIAR Technical Program. This year, the session will feature a dozen papers covering a broad range of topics.

The papers will address several key categories, including commercial refrigeration applications, industrial use, energy efficiency, and safety and regulatory issues. Eric Smith, IIAR's vice president and technical director, said the papers provide breadth and depth that isn't available in any other refrigeration-specific conference. "Our members and technical paper authors provide not only practical insight, but also contemplate academic and engineering analysis that is the basis for refrigeration technology.

Several papers stand out within this year's lineup. "Benefits of Ammonia Heat Pump Implementation in the Industry and for District Heating" is interesting due to the current push in low global-warming-potential alternatives and a push for lower greenhouse gas emissions. "Ammonia heat pumps can be very beneficial because of favorable coefficients of performance. A group of gentlemen from GEA who have experience with large-scale heat pump projects have developed an informative paper about this topic," Smith said. "Using ammonia heat pumps for college campuses, hospitals or large industrial applications with a need for heat could gain in popularity, and this paper will demonstrate advantages that can be attained and bolster further interest."

The favorable thermodynamic properties of ammonia and good system design leads to high efficiency and short payback, and over the last 15 years, the market for high temperature ammonia heat pumps has been growing in Europe and is taking off in North America. Kenneth Hoffmann, application manager heat pumps, GEA Heating and Refrigeration Technologies, will present the paper, which shares examples and lessons learned through three case stories.

The paper "Oil Management Design Considerations for Industrial Transcritical CO_2 Systems" is timely given that carbon dioxide as a refrigerant is becoming increasingly more popular on a global scale. "At this phase of their implementation and use, it is worthwhile to drill into the more detailed aspects of these types of systems and oil management is one of those topics that nearly everyone will benefit from a better understanding," Smith said. "As more and more of these systems become prevalent, people need to know about the ins and outs of how to design and manage them."

Unlike in ammonia systems, oil in CO_2 systems is miscible and can create unique challenges in its management. In this paper, Alessandro Silva, senior application engineer, BITZER US, and Joe Sanchez, vice president of engineering, BITZER US, explore a comparison to commercial systems as a baseline of tried-and-true oil management. They then explain some of the unique challenges that an industrial system might find and offer potential solutions in how to solve these challenges.

Two papers being presented are the result of IIAR research projects. The first is CFD Monitoring of Condensate Induced Hydraulic Events. "This is a report on research done that implements the use of computational fluid dynamics modeling to aid in the design of systems to help prevent hydraulic shock events," Smith said.

The next one is Machinery Room Ventilation Study, which implements CFD modeling of ammonia releases in machinery rooms to examine ventilation effects. "What the researcher has found is that release rates are quite high for the assumed type of leak, Smith said, adding that the nature of the release is affected by many factors, such as impingement of flume by equipment within the room, pooling effects of liquid ammonia on the floor, and buoyancy effects. "Now that we further understand the nature of releases in a machinery room, we must next analyze the risks versus the benefits of more or less ventilation flow rate."

Given the increase in COVID cases, Smith said there are some concerns about presenters not being able to travel in for the meeting. IIAR is making arrangements to have tele-presentations, if necessary, or alternative speakers. "There will be a full program and the audience will be given a presentation in any case," Smith said.

Technical Papers at a Glance

Each technical paper presented at IIAR's annual conference is full of specific, actionable information about the refrigeration industry. Here is a full list of the available papers as well as the presenters.

CFD Modelling of Condensate Induced Hydraulic Shock Events by Chidu Narayanan

Proper Installation Practices for VFDs by Paul Jascynski, Logic Technologies

Managing Your Energy Costs – It Can Be Done! By James Majsak, CrossnoKaye

Benefit of Ammonia Heat Pump Implementation in the Industry and in District Heating by Kenneth Hoffman, David Blankley, Larry Bradley, GEA

Oil Management Design Considerations for Industrial Transcritical CO_2 Systems by Alessandro Silva, Bitzer

Absorption Applications for Residential/Light Commercial Space Conditioning and Water Heating by Mike Garrabrant, Stone Mountain Technologies

Transcritical CO_2 Compressors: Technical Challenges in Industrial Refrigeration Applications by Giacomo Pisano, Dorin

Simple Equations for Determining Mass Flow in Ammonia Refrigeration Systems by Don Faust, Johnson Controls

Don't Curse the Purger by Don Tragethon, Western Precooling

Liquid Overfeed Ammonia Refrigerating Plant and Energy Efficiency by Stefan Jensen, Scantec Refrigeration Technologies

Como Conducir un Análisis PHA by Juan Zeledon, Cargill Nicaragua

Machinery Room Ventilation Study by Scott Davis, Ph.D., Gexcon

WILLIAM E. KAHLERT MEMORIAL GOLF TOURNAMENT

March 5, 2022

The Club at
Savannah Harbor

AMMONIA REFRIGERATION FOUNDATION

The Ammonia Refrigeration Foundation is a 501(c)(3) education and research organization supporting the natural refrigeration industry.

All proceeds from this annual tournament are used to support the Foundation's scholarship, research and outreach programs.

For more information email us at golf@nh3foundation.org

With the 2022 IIAR Natural Refrigeration Conference & Expo March 6-9, 2022 Savannah, GA

IIAR's Global Reach Promotes Standards, Safety and Education Worldwide

[global VIEW]

As a global organization with members across the world, IIAR gives members the opportunity to learn from those with different experiences and points of view as well as improve the overall safety of the industrial refrigeration industry.

"Our industry is dependent on good engineering practices, and it will not grow if we do not have those implemented across the globe," said Yesenia Rector, IIAR's international director. "As a standards-writing organization, it makes sense for us to have that global reach and influence."

The refrigeration industry is one of the safest industries within the United States. "Since we are creating these standards that are recognized in the United States as best practices, our friends in Latin America, for example, want to also emulate these practices."

Having a broad membership also leads to richer and better discussions. "It is not a one-way street. It gives us in the U.S. the opportunity to learn from the experiences in other countries," Rector said.

Additionally, the global reach makes it easier for members to expand and do business in other countries.

It is easier for a manufacturer in Germany, for example, to do business in Latin America or the United States if they know the equipment is compliant and will work as it should, Rector explained.

"The standards that we write and the education we provide helps that interconnectivity throughout the industry and the globe. Not only that, with the global work that is being done to combat climate change and help with the environment, natural refrigerants make sense," Rector said, adding that using natural refrigerants efficiently and sustainably benefits everyone.

GLOBAL EDUCATION

As part of its work, IIAR provides education globally. Which training is offered is often decided by the people in the country where it will be shared. "The IIAR Chapter chair in Costa Rica, for example, reached out and said, 'We adopted the standards, but we need training,'" she said.

Recently, the IIAR-GCCA Education Seminar for Latin America on cold chain and refrigeration provided education for 65 registrants who obtained their Certificate, which is valid for one year. IIAR will meet in November to decide if the association will repeat this event next year.

IIAR is also working on ANR courses with LATAM Chapters and IIAR 2 with Mexico, Colombia, Argentina, Peru and Chile.

IIAR has made several courses available in Spanish and the Spanish translation of the ANR IIAR 4 course has been recently completed. It is scheduled to be available by February. The next planned translations into Spanish are for ANR IIAR 9, and Standard ANSI / IIAR 2-2021. Plus, IIAR's Standard ANSI IIAR CO_2 is available for members and for purchase in Spanish.

MSA The Safety Company

BACHARACH®

NH_3 and CO_2 gas monitoring solutions designed to **detect and protect**

SAFETY COMPLIANCE

- **Mobile App**
  Configuration, calibration, & reporting
- **Minimize Wiring**
  Reduce wiring by up to 90% w/ Modbus
- **On-Board AV Alarm**
  Visual & audible alarm systems
- **Durable Design**
  Waterproof / -40° to 122°F (-40° to 50°C)

- **Remote Data Analytics**
  Connected solutions through Parasense
- **Continuous Calibration**
  Clean air sampling
- **Multi-Point Detection**
  4-16 sampling zones
- **Long Sensor Life**
  7-10 years

EMISSIONS REDUCTION

SAFEGUARDING
PEOPLE, PLACES, & THE PLANET

www.myBacharach.com/Ammonia

IIAR is also working with the AEFYT (Asociación de Empresas de Frío y sus Tecnologías) to translate Condenser articles into Spanish.

"There is a need for knowledge and understanding of natural refrigerants. When we provide that information, it is valid. They want to make sure they can also be part of it and make the industry in their countries grow," Rector said.

IIAR and ACAIRE are developing a joint Diploma in Ammonia Refrigeration. The syllabus and descriptions for the learning modules are currently being developed.

STANDARDS ADOPTION

As part of the association's work, IIAR allows countries to adopt and modify the standards for their use, and several countries have connected with IIAR as they work to establish standards.

"It has been kickstarted by the governments' need to comply with global changes. It has drawn attention to natural refrigerants," Rector said, adding that Argentina and Colombia are currently adopting IIAR standards. "Costa Rica is the most advanced in this process because they have already adopted all IIAR standards, and they are in the process of updating with the new versions of IIAR standards."

ACTIVITY AT A GLANCE

Here is a quick look at what is happening in countries worldwide:
Argentina: In Argentina, the Instituto Nacional de Technologia Industrial (INTI)/IIAR Chapter signed a confidentiality agreement in March 2021. A committee is working on the review and adoption of IIAR 1 and IIAR 2.

Australia: The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) is focusing on advocacy to have HVAC&R personnel classified as essential workers and the field given a unique professional designation. AIRAH is also exploring opportunities to share articles for major periodicals.

Brazil: IIAR has a newly formed chapter in Brazil, which is focused on working within the Brazilian industry to aid in the transition from high-global-warming-potential refrigerants to low-impact refrigerants and expand the use of natural refrigerants.

China: Currently, a memorandum of understanding with CAR is under review and being updated.

Colombia: In Columbia, ICONTEC (Colombian Institute of Technical Standards and Certification)/IIAR-ACAIRE (Asociación Colombiana De Acondicionamiento Del Aire Y De La Refrigeración) Chapter, a collaborative agreement was signed in 2020 to protect IIAR content. The (CTN 125) Committee was formed to review standards IIAR 1 (NTC 6572-1) and IIAR 2 (NTC 6572-2). Concurrently, the Ministry of Energy and Mines is studying IIAR 2 for adoption as a national norm under the newly created RETSIT law (Reglamento Técnico para Instalaciones Térmicas).

Costa Rica: Under INTECO (Technical Standards Institute of Costa Rica)/IIAR Chapter/CIEMI (Colegio de Ingenerieros Electricsitas, Mecánicos e Industriales - Allied Association), all IIAR (ammonia) standards have been identically adopted voluntarily with appropriate references to IIAR. INTECO translated ANSI IIAR CO_2 into Spanish and the standard is currently in public review.

Ecuador: A committee within the MP-CEIP (Ministry of Production) and IIAR Chapter began work in January 2022 to adopt IIAR 1 and IIAR 2.

Germany: Eurammon continues to collaborate with IIAR on Condenser magazine articles.

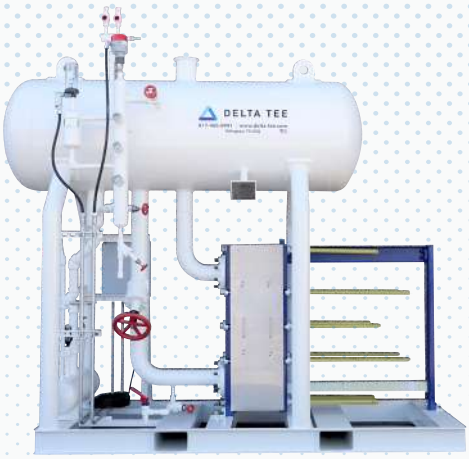
India: The Rotary International Project within India is still ongoing.

Spain: In Spain, the AEFYT (Asociación de Empresas de Frío y sus Tecnologías) has a memorandum of understanding in place with IIAR. Condenser articles are being translated into Spanish. Condenser Magazine 'Select' will start publication in early 2022. Plus, progress is being made on an education initiative, which is a 3D education program for ammonia refrigeration systems.

United Kingdom: The IoR (Institute of Refrigeration) IIAR is working on establishing a formal memorandum of understanding. IoR is studying the possibility of an ARF-funded Research project and ARF scholarship opportunities.

DELTA TEE

Meeting **All Your** Design And Fabrication **Needs**



Delta Tee International, Inc designs and manufactures a wide variety of Pressure Vessels, Shell and Tube Heat Exchangers, and Packaged Equipment designed for the Industrial Refrigeration and Petrochemical Industries.

WWW.DELTA-TEE.COM
1000 Commercial Blvd. S.

T +1 817 466 9991
Arlington, TX USA

Regulatory Outlook for 2022

iiar government RELATIONS

BY LOWELL RANDEL, IIAR GOVERNMENT RELATIONS DIRECTOR

As the Biden Administration enters its second year, agencies such as the Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) are preparing to take significant regulatory actions that will impact the industrial refrigeration industry. On December 15, 2021, the Biden Administration published its regulatory agenda, which outlines the plans of federal agencies across the government. The agenda includes proposals that will result in changes to several regulations impacting IIAR members. As a result, IIAR expects heavy rulemaking activity in 2022.

Below are descriptions of some of the most significant regulations scheduled for action in 2022:

EPA's Risk Management Program – "Accidental Release Prevention Requirements: Risk Management Program Under the Clean Air Act; Retrospection"

The EPA Risk Management Program (RMP) has been the subject of several rulemakings over the last 5 years. At the end of the Obama Administration, EPA published a final RMP rule known as the "2017 Amendments" which added compliance requirements for regulated facilities in areas such as emergency response planning, third-party audits, and information sharing. The Trump Administration executed a rulemaking to reconsider these amendments, resulting in a rule that rescinded many of the 2017 Amendments. The Biden Administration is now considering further revisions to the RMP program.

The EPA Risk Management Program (RMP) has been the subject of several rulemakings over the last 5 years. At the end of the Obama Administration, EPA published a final RMP rule known as the "2017 Amendments" which added compliance requirements for regulated facilities in areas such as emergency response planning, third-party audits, and information sharing.

On January 20, 2021, Executive Order 13990, Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis (EO 13990), directed federal agencies to review existing regulations and take action to address priorities established by the new administration including bolstering resilience to the impact of climate change and prioritizing environmental justice. The EPA is considering developing a regulatory action to revise the current RMP regulations. The proposed rule would address the administration's priorities and focus on regulatory revisions completed since 2017. The proposed rule would also expect to contain several proposed modifications to the RMP regulations based in part on stakeholder feedback received from RMP public listening sessions held on June 16 and July 8, 2021. IIAR participated in these listening sessions and suggested the recently finalized reconsideration rule took appropriate action and that no further rulemaking is needed.

The EPA currently plans to prepare a notice of proposed rulemaking that would provide the public an opportunity to comment on the proposal and any regulatory alternatives that may be identified within the preamble to the proposed rulemaking. According to the regulatory agenda EPA is expected to issue a Notice of Proposed Rulemaking in September 2022 and complete a Final Rule by August 2023.

IIAR has actively participated in previous RMP rulemakings and will continue to engage with EPA and like-minded partners to communicate the industry's positions on regulatory proposals and their potential impact on regulated entities.

EPA's HFC Phase Down – "Restrictions on Certain Uses of Hydrofluorocarbons Under Subsection (i) of the American Innovation and Manufacturing Act"

The American Innovation and Manufacturing (AIM) Act, enacted on December 27, 2020, provides EPA new authorities to address hydrofluorocarbons (HFCs) in three main areas: phasing down the production and consumption of listed

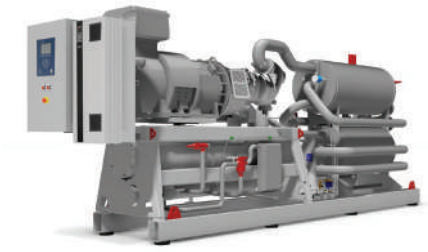
Frick

Lowest life cycle costs with lasting reliability

When your process or product is so important, why settle for less?

Your single-source industrial refrigeration partner

Compressor packages | Condensers and evaporators | Control panels and control systems | Hygienic air handlers | Plate heat exchangers Packaged ammonia systems | Replacement parts | Vessels



Coming soon

Our Inline Packaged Ammonia Chiller brings Frick reliability in a reduced footprint and a cost-effective skidded package. Just one more reason to specify Frick when selecting equipment.

Please visit us at Booth 337 of the IIAR Conference in Savannah between March 6-9 and come to our IIAR Technomercial, which takes place on March 7 at 10:30am.

For more info please visit **www.johnsoncontrols.com/frick**.

The power behind **your mission**

Johnson Controls

HFCs, maximizing reclamation, and minimizing releases of these HFCs and their substitutes in equipment (e.g., refrigerators and air conditioners), and facilitating the transition to next-generation technologies by restricting the use of HFCs in particular sectors or subsectors.

Since enactment, EPA has moved to implement the statute, including rulemaking in the Fall of 2021 that set the HFC baseline and schedule for phasing down consumption. The next step of the process will be establishing rules for various sectors and uses of HFCs. IIAR submitted a petition to EPA in 2021 suggesting policies for phasing down HFC use in refrigeration. EPA has granted IIAR's petition, along with a few other petitions requesting similar phasedown policies. EPA is expected to draw from these petitions as it moves to draft a Proposed Rule regarding HFCs and the refrigeration sector.

The December 2021 regulatory agenda states that EPA is considering a rule that will restrict, fully, partially, or on a graduated schedule, the use of HFCs in sectors or subsectors including the refrigeration, air conditioning, aerosol, and foam sectors. The rule will also establish recordkeeping and reporting requirements and address other related elements of the AIM Act.

According to the regulatory agenda, EPA is planning to publish a Notice of Proposed Rulemaking in June 2022. A Final Rule is expected to be completed in 2023. This regulation has the potential to impact industrial refrigeration systems using HFCs and presents an opportunity to promote the transition to natural refrigerants. IIAR will continue to work with EPA and update members as the rulemaking process moves forward.

OSHA's "Process Safety Management and Prevention of Major Chemical Accidents"

The Obama Administration initiated a rulemaking to "modernize" OSHA's Process Safety Management (PSM) regulation in response to the explosion in West, Texas. OSHA went through a Request for Information and convened a panel under the Small Business Regulatory Enforcement Fairness Act to review potential impacts to regulated small businesses. The Trump Administration placed the rulemaking on the "long-term agenda" effectively pausing any further considerations. The Biden Administration has since moved the rulemaking into the "pre-rule" stage and is planning to conduct a stakeholder meeting in 2022. After considering the input from the stakeholder meeting, OSHA is expected to develop a Notice of Proposed Rulemaking. OSHA rulemakings historically have taken multiple years to complete. IIAR has actively participated in this rulemaking and will continue to engage with OSHA throughout the process.

The Biden regulatory agenda shows aggressive plans to advance many regulatory initiatives that could impact IIAR members in 2022. IIAR has been and will continue to be, closely engaged with the agencies to promote the interests of the industrial refrigeration industry as each of these rulemakings moves forward.

Custom refrigeration solutions for your facility

Have a unique cooling challenge? We've got you covered.

Berg can help you build a comprehensive ammonia refrigeration solution to match your unique cooling needs. With a focus on safety, operational effectiveness, and energy efficiency, you can be assured that your refrigeration system is always at its best.

To learn more, call or visit:
416-755-2221
www.berg-group.com

BERG
CHILLING SYSTEMS

Expert thermal process energy management

Awareness and Attention

KEM RUSSELL, P.E

Being aware and paying attention to what's around you, where you are, and what's happening can be really important. Sometimes for whatever reason, we miss something that we may be looking right at, hearing, smelling, etc. I'm sure that we all have some lack of awareness and/or have not been paying attention at various times. Lack of awareness and attention can be caused by several factors such as exhaustion, sickness, demands on your time, stress, boredom, hunger, etc.

I have experienced a lack of awareness and attention myself on many occasions. These have been learning experiences that helped me be more aware and to pay better attention. The following are three examples:

EXAMPLE 1:

Besides spending a lot of time involved in the ammonia refrigeration industry I also volunteer a fair amount of time to Search & Rescue (SAR). This last Fall I was involved in a search for a missing person, who had been missing for about three years. As you can imagine we were searching for any "remaining" evidence. This person had left their car on a snowy mountain road during late January and disappeared. During the ensuing years, search attempts had been made to locate the missing person.

The search area was into a timbered area below the road. A previous search of some of that area was difficult, to say the least. A LOT of downed trees made it very difficult to see or find anything as you tried to navigate safely through the area.

A few weeks before our next search a father and son, while hunting, found a backpack sitting on a log. Fortunately, they realized a backpack sitting on a log in the forest, not near any trail was strange. Looking around the area they also noticed some clothing, one of which was a pair of pants laying over a branch like they were put there to dry. They searched through the pack but didn't find any positive identification. Fortunately, they turned the pack over to the Sheriff's office. The pack and its contains were preliminarily identified as belonging to the missing person.

With this possible "last known position" a search was planned for that area. A friend of mine and I laid out a grid pattern search for several teams to follow, looking for other evidence of the missing person.

Again, this search was in many places difficult, due to downed trees and bushes. Finding anything would take sharp awareness, so we were all looking closely trying to find anything that could be confirmed as human. It ended up that quite a number of bones were located that were later identified as belonging to wild animals. We searched the area where the clothing had been found for a few hours as carefully as we could in these challenging circumstances without success. Even though all of us were trained SAR personnel something surprising happened that showed us a person may not be as aware as they thought.

One of our lead SAR volunteers, who had been in the search area multiple times, was standing looking around in an area others had been through several times. His gaze drifted down to his feet and the ground he was standing on. Just a few inches from his foot among the short vegetation on the ground was a recognizable human bone. A small piece of the missing person had been found.

Being aware and attentive in the operation and/or maintenance of industrial ammonia refrigeration systems and their component parts is important. With increasing knowledge, experience, and awareness we can better understand the systems we work on and/or properly maintain them. Lack of awareness and not paying attention may result in missing something important, and/or doing something incorrectly, either of which could result in an undesirable situation.

EXAMPLES 2 AND 3:

Many years ago, I was working with my dad on a floating seafood processing ship in Alaska. One of my jobs was to make a hand drawing (this was before electronic drafting programs) of the ammonia refrigeration system. The other job was to help with re-piping part of the refrigeration system. Two interesting incidents happened.

First incident: I was a fair gas welder at that time and my dad showed me some of the pipe re-routing that needed to be done. After explaining what he wanted me to do, he left me to do my work while he went to work in another area of the ship. A few hours later he returned to see how I was doing.

"Well son those are pretty good welds, and the routing looks level and straight. However, things will be a whole lot better if we connect that ¾" liquid line to the liquid line over there instead of to the hot gas line you now have it welded to."

"Oops."

Although I had thought I had been attentive and understood the pipe re-routing explained by my dad, my lack of awareness of what lines were what and what that meant resulted in some of my work having to be corrected to avoid a significant system operational problem (liquid going someplace it wasn't meant to). I was learning to be more aware when I was told and/or shown something and to pay attention.

The second incident had a huge impact on the whole ship operation.

On the first day that we were on the ship, we toured through most of the relevant sections and systems. One of the areas we went through was the engine room. There was no shore power available, so a large generator was continuously running. As we went through the generator room I noticed a sound coming from the generator, kind of a "chirping" noise. I asked my dad about that sound, and he wasn't sure.

Over the next couple of days, we did our work, and the ship continued processing the large amounts of shrimp that were being delivered. One afternoon suddenly the lights went out and it got eerily quiet. We made our way

ATI has Replacement Ammonia Gas sensors for many Honeywell, Manning & Calibration Technologies models.

SENSOR OPTIONS

$195.00

MANNING/HONEYWELL REPLACEMENT

PORTABLE SENSOR

For over 15 years, ATI has manufactured the ammonia sensors used in your Manning Systems leak detectors. Now, you can buy direct from the source and save time & money.

- Economical, Dependable, and Direct from the Manufacturer.
- 18 Month "no hassle" warranty. New sensors supplied at half off if required less than 18 months from shipment.
- And, we offer our own gas transmitters and alarm systems for your expansion needs.

LOCATE NH_3 LEAKS

C16 PortaSens II Portable Ammonia Detector

ATI's C16 PortaSens II portable leak detector is used to check for gas leaks in storage areas, around process equipment and piping, and in confined spaces prior to entry.

FEATURES

- Interchangeable "Smart Sensors" for Over 30 Gases
- NH_3 Sensors from 0-50 to 0-2000PPM

Entech Design

www.entechdesign.com www.analyticaltechnology.com 800-959-0299

ATi ANALYTICAL TECHNOLOGY, INC.

up to the main deck and we could see a little smoke coming out past the gallery gangway door. I didn't have a clue what had happened, but my dad had an idea and headed toward the engine room.

What had happened is that the chirping sound the generator had been making was the indication of a problem that the engine room crew had ignored, though some of them may have been aware that sound wasn't right. No action had been taken to investigate and correct the reason. Unfortunately, whatever happened inside the generator resulted in a large hole in the side of the machine allowing oil to spray out, coating and setting on fire a primary electrical panel on the wall. Most of the ship's power was routed through that panel.

Fortunately, the CO_2 fire protection system activated quickly putting out the fire. After hours of work, the Chief Engineer along with my dad bypassed the destroyed power panel, and finally got another generator online. This ended up being an expensive problem in itself. An additional cost occurred because just before the power failure, a large amount of shrimp had been transferred to the ship for processing. After several hours sitting in the sun that shrimp had a smell I will not forget.

Awareness and being attentive can improve with experience but even someone with little experience can be aware and attentive enough to realize something might not make sense. With our sight, hearing, touch, smell, taste, and gut feeling potential problems can many times be avoided. Whether we are new to some activity or have a lot of experience, being continually aware and being attentive is a challenge. We should consciously strive to improve and maintain our awareness and ability to be attentive.

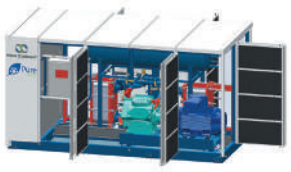
Something might be right at your feet that you should be aware of. Being aware and attentive to how piping is supposed to be correctly connected and function. Being aware and attentive to unusual sounds or other tips that may indicate things are going from running smoothly to not running at all. Working on improving your awareness and how attentive you are while increasing your knowledge and experience will be lessons learned of great value not only in refrigeration but in any part of your life.

Our 50 Years of designing and producing industrial refrigeration products, systems and controls are now available in packaged systems.

Pure CHILL™

Low Charge Ammonia Packaged Chillers

- 40 to 400 Tons at 5 to 50F Outlet fluid



Pure COLD™

Low Charge Ammonia Condensing Units

- 30 to 100 Tons at -20F to 45F SST

Pure FREEZE™

Packaged Cascade Ammonia/CO_2 Systems

- 40 to 200 Tons at -20 to -60F pumped CO_2

Aquilon CHILL™

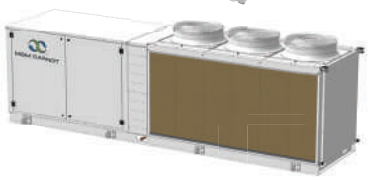
Transcritical CO_2 Industrial Chillers

- 50 to 500 tons at -40F to 40F outlet fluid

Aquilon DS™

Transcritical CO_2 Condensing Units

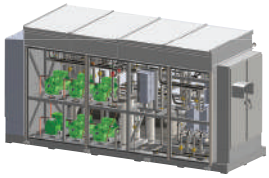
- 10 to 85 Tons at -40 to +40F SST



Aquilon INDUSTRIAL™

Transcritical CO_2 Industrial Racks

- 50 to 400 Tons at +40 to -50F SST or +50F to -40F fluid temperature



Pioneer and leader of Natural Refrigerant Based Refrigeration Systems that are safe, sustainable, and energy-efficient in all climates.

M&M CARNOT™

888 Bestgate Road Suite 212 • Annapolis, MD 21401 • 410-754-8005 • mmrefrigeration.com • carnotrefrigeration.com

euramon
refrigerants delivered by mother nature

BY MONIKA WITT, MANAGING DIRECTOR OF TH. WITT GMBH, GERMANY, EURAMMON BOARD MEMBER

Pandemic Pressure and Growing Acceptance of Natural Refrigerants in Europe

As in other regions of the world, the past months have been heavily influenced by the global pandemic. But despite or perhaps because of the pressures introduced by the pandemic, business in European industrial refrigeration has increased quite a lot, and as such, the difficulty has been and still is to maintain the human resources to continue working even with pandemic-related challenges.

Interestingly, business grew even without the ability to visit customers or exhibitions. On one hand, this may be because of the many networks and industry connections – formed over a long period pre-pandemic. The rather conservative industrial refrigeration industry may now be relying on those established relationships. But on the other hand, a decrease in business may still be on its way once the crisis has calmed.

For the time being, industrial refrigeration companies in Europe all seem to have more work than they can handle.

In addition to the pressures introduced by the pandemic, the supply of raw materials, components and electronic devices has narrowed, introducing increasing difficulty and slowing companies down.

Employees of purchasing departments have spent hours attempting to manage delivery times (if they get fixed delivery dates at all) and struggling to compensate for heavily increased prices.

We will have to see within the next month how the increased prices will affect the long-term projects. Nearly finished projects will have to be completed despite the higher cost, but new projects might be postponed when possible.

The actual supply situation has resulted in a renunciation of "just-in-time" processes, and a reversion back to the days of larger available stocks of materials. However, the tendency to stock more materials and components – for the majority of European companies – is deteriorating the situation by increasing the demand even further.

It will be interesting to see how the market is reacting once everybody has stocked the maximum capacity possible. Will we then see falling prices and shorter delivery times? Will we ever get back to a pre-pandemic situation? Nobody knows…

The trend towards more sustainable and resource-efficient refrigeration has started some years ago and is in full swing. Particularly in Germany, where the Green Party is now part of the government, political motivation will push green technology further.

Michael Freiherr, chairman of euramon, observed that supermarket chains are now moving towards "net-zero" operation by using waste heat to cool the market, and they are working with propane heat pumps. Lidl has recently commissioned a net-zero prototype, and when this is successful, more "net-zero" markets may soon follow.

Thomas Spänich, a member of the eurammon board, confirms Michael's observation and sees that overall heat pump demand has increased heavily and predicts it will continue to grow.

He states that industries and communities are developing or already have specific plans to become carbon-free, and heat pumps are one, if not the integral part, for the decarbonization of heating supply. The heating demands in Europe are often many times higher than the cooling demands. Heat pumps can be perfectly combined with cooling requirements by directly and very efficiently using the waste heat from refrigeration processes as a heat source or working as a combined cooling and heating device.

Thomas underlines that a holistic approach covering capacities – demands on different temperature levels using chillers and heat pumps operating together – provides massive energy saving potential and yields not only ecologic but also economic benefits, irrespective of carbon taxes.

With increased heat pump installation, it is a question whether electrical energy savings will be realized soon, particularly when using the cooling possibility as well. We have seen that air conditioning demand is growing when summers get hotter in Europe (with the exception of last summer). As a result, solar and wind energy have to

eurammon board members


Monika Witt, TH. WITT


Thomas Spaenich, GEA


Andrew Stockman, EVAPCO


Michael Freiherr, Güntner (eurammon chairman)

COLMAC COIL
Manufacturing Inc.

CO2 Industrial Refrigeration Solutions
FROM COLMAC COIL

A+Series® Industrial Evaporators, Fluid Coolers and Condensers designed for CO2 Industrial Refrigeration Systems

- High Pressure Design: 1740 PSIG (120 BAR)
- Electronic Expansion Valves
- Defrost Options
  - Hot Gas, Interlaced Glycol, Electric
- Fan Speed Control with EC Fan Motors
- Stainless Steel Construction
- Customized Footprint Optimized to your Application

UL 207

ASME U Stamp

CRN
Canadian Registration Number

View our latest C02 Evaporator Solutions training by scanning the QR code below:

SCAN ME

Available on all A+Series® Industrial Evaporators

VISIT US
at IIAR 2022 in Savannah, GA BOOTH 823

be pushed much harder, and the electrical grid must be upgraded and extended much faster, than in the past years.

Andrew Stockman, also a eurammon board member, sees that natural refrigerants are generally gaining more interest because they have proven to be reliable, sustainable, and are less affected by ever-changing, stricter regulations.

Even the latest French regulation for ammonia refrigeration systems has adopted several design and safety aspects related to safe distances between the machine room and inhabited areas – towards the requirements of European standard EN 378. Andrew underlines that this also applies to the piping and the condensers located outside the refrigerated warehouse. These updates have made it less challenging to design and install ammonia refrigeration systems in France while keeping health and safety as the highest priority.

Meanwhile, investigations have revealed the potential contamination of aquatic systems when increasing the output of HFO in mobile air conditioning systems. And HFOs for stationary systems seem to have a much higher GWP than calculated because decomposition under a certain wavelength in the atmosphere seems to have been missed when looking at the risk potential.

As in the past, synthetic alternatives seem to come with negative side effects that have not been anticipated. This may be one of the reasons why more and more end-users are looking into natural refrigeration options, like ammonia and carbon dioxide, as the sustainable solution in the long term. And those attracted by the safety aspect of former synthetic refrigerants may look into options with the A1 refrigerant CO_2 or opt for low charge systems limiting the use of the refrigerant (whether it is i.e. A3 like propane or B2 like ammonia) to the machinery room.

Andrew also sees a fast-growing development of CO_2 refrigeration systems. In some European countries carbon dioxide has developed quickly, such as the Netherlands and Scandinavia (and now we can see a trend back towards more ammonia), whereas in other countries the acceptance is improving, and as such, more CO_2 projects are underway. The improved efficiency of CO_2 systems when using ejector or expander technology may pave the way for increased success.

Although a lot of investigations went into batteries and the use of solar and wind to produce electrical energy, hydrogen technology seems to be positioned for success in the next few years.

Thomas reported that there are investigations underway to store hydrogen in ammonia or even use ammonia directly in larger shipping vessels as "green fuel." We will see whether this will result in wider acceptance of the public or how safely these large quantities can be handled.

From my point of view, every refrigeration technician will feel a little uneasy at the prospect of using tons of ammonia on a ship without escape routes. And it will be essential to make sure the people dealing with ammonia are trained adequately.

The hydrogen production is depending on refrigeration and this may offer new opportunities as well. Overall, refrigeration technology is seeing increasing demand, and not only in Europe!

INTRODUCING

THE ULTIMATE IN INDUSTRIAL REFRIGERATION

by Heatcraft Refrigeration Products

MAGNA
INDUSTRIAL REFRIGERATION®

At Heatcraft Refrigeration Products, we know that industrial refrigeration applications come in all shapes and sizes.

Introducing **MAGNA Industrial Refrigeration®**, the latest addition of **large-capacity cold storage equipment solutions** for the industrial refrigeration market.

The MAGNA Industrial Refrigeration product line represents the:

- Ultimate in engineering and manufacturing capabilities
- Ultimate in range of industrial grade, long-lasting products
- Ultimate in lead times and warranty
- Ultimate in project-specific support

Visit Heatcraft Booth #603 at
IIAR Natural Refrigeration Conference & Expo
Learn more at heatcraftrpd.com/magna

HEATCRAFT™ Worldwide Refrigeration

TECHNICAL PAPER #4

Benefit of Ammonia Heat Pump Implementation in the Industry and for District Heating

KENNETH HOFFMANN, APPLICATION MANAGER HEAT PUMPS, GEA HEATING AND REFRIGERATION TECHNOLOGIES

ABSTRACT

Over the last 15 years the market for high-temperature ammonia heat pumps has been growing in Europe and now it is also taking off in North America. That period in Europe has yielded many lessons as higher pressure and temperature present new challenges in refrigerant design. This paper explains where heat pump installation differs from refrigeration installation through three case studies of installations in Europe. The favorable thermodynamic properties of ammonia and good system design lead to high efficiency and short payback, which the three cases will describe. With many heat pumps being installed into the district heating market new challenges also arise regarding ammonia handling and safety as the installations are now closer to the public than traditional industrial settings for ammonia refrigeration systems. The paper will describe how these challenges have been overcome. With the phasedown of fluorinated greenhouse gases (F gases), incentives to go for natural refrigerants for these solutions have increased, and as this paper shows financial and environmental incentives to employ ammonia heat pumps are also large.

INTRODUCTION

Industrial heat pump technology has been a known technology for more than 100 years and has been economically viable solution since the 1970s. Nonetheless the widespread uptake of heat pump solutions only started in the last decade. The reason is that burning fossil fuels like coal, oil, or gas is much easier than taking on the bigger investment in a heat pump to save cost in the long run. Most food factories have an abundance of waste heat available from the refrigeration system that can be upgraded with an add-on heat pump. Detailed analysis of the process requirements for heat and cold is necessary to apply the right size buffer tanks so the heat can be used in the process at low cost and high efficiency. Traditionally rejecting all this energy and then using boilers to provide the heating energy was preferred. However, as climate change continues to rise in importance on the global political agenda, major companies are looking to maximize carbon savings, which is where highly efficient heat pumps become an important replacement for boilers. If we can replace fossil fuel heating with heat pumps that only require a small percentage of the heating duty as renewable electricity to become carbon neutral, we will have taken a giant leap toward avoiding a climate crisis.

AMMONIA HEAT PUMP MAIN COMPONENTS

Compression Technology

Several compression technologies are currently available on the market, including reciprocating, scroll, centrifugal, and screw compressors. For ammonia applications, the industry typically uses reciprocating or screw compressors (Figure 1). Open-type compressors were preferred in years past, but more recently small screw compressors have also become available as semi-hermetic machines with integrated high-efficiency, copper-wound motors without a shaft seal for chiller applications. This development is just one reason natural refrigerants are becoming more accessible in commercial areas.

Each compression technology has strengths and weaknesses, so selecting the right compressor is important for getting optimal results from the heat pump installation. For heat pump applications, as for refrigeration applications, the specific running conditions for each project determines the preferred technology.

Reciprocating compressors have a smaller operating envelope relative to differential pressure. For example, high-temperature applications with a low source temperature require two-stage reciprocating compressors, whereas other applications require only a single screw compressor.

Figure 1. To the left is an ammonia screw compressor and to the right an ammonia piston compressor.

High-pressure reciprocating ammonia compressors are limited in capacity to around 580 ft³/min (1,000 m³/h), whereas some ammonia screw compressors in operation for heat pump applications have a capacity of more than 5,000 ft³/min (8,500 m³/h).

Also worth noting is that according to RTSelect, compressor selection software by GEA Heating & Refrigerating Technologies, reciprocating ammonia compressors increase in volumetric efficiency at heat pump conditions, while screw compressors' volumetric efficiency reduces at the higher evaporation and condensing temperature (Table 1).

The volumetric efficiency of the screw compressors reduces 6% in heat pump operation compared with chill operation, whereas the piston compressor increases 10% in volumetric efficiency at comparable conditions.

In the industry, reciprocating compressors do most heat recovery as they match the capacity and offer better performance than screw compressors. For district heating most cases use screw compressors due to the large capacities offered by this compressor type.

Heat Exchangers

For ammonia heat pump applications delivering up to 203°F, heat exchangers with a minimum design pressure of 870 psi (60 bar[a]) are required. For refrigeration purposes, plate and frame heat exchangers are traditionally used, but availability of plate and frame heat exchangers for ammonia at the heat pump application design pressure is limited. The most common heat exchangers used on the heating side of an ammonia heat pump are shell-and-plate heat exchangers (Figure 2).

These are available in a wide range of capacities and pressures, and for ammonia heat pumps using multiple heat exchangers in the heating circuit to optimize efficiency is common. A typical ammonia heat pump has a de-superheater, a condenser, a sub cooler, and an oil cooler (for screw compressor heat pumps), so up to four high-pressure heat exchangers are employed to get maximum efficiency out of the system (Figure 3).

Shell-and-plate heat exchanger technology is not commonly known outside the ammonia refrigeration market. The tender specification for large heat pump projects often calls for use of shell-and-tube heat exchangers as this is predominantly the choice for F-gas heat pump manufacturers. Using shell-and-plate heat exchangers has clear benefits such as compactness, low charge, no requirement for service space for tube bundle extraction, etc. Customers must be informed about these benefits to accept alternative heat exchanger solutions.

On the cooling side of a heat pump the selection of heat exchanger depends on the

Table 1. Comparison of a Screw Compressor and Piston Compressor Running in Two Different Conditions

		Screw compressor		Piston compressor	
		Chill	Heat	Chill	Heat
Evaporation / Condensing temperature	°F	14/+95	+91/+158	14/+95	+91/+158
Actual ft³/min	ft³/min	1,980	1,815	171	171
Volumetric efficiency	%	94.4	88.4	75.2	85.8

Source: Data from RTSelect, compressor selection software by GEA Heating & Refrigerating Technologies.

heat source. Many heat pumps installed in the industry use the condenser heat from the refrigeration system as the heat source. For these applications having fully welded heat exchangers is preferable as it minimizes the risk of ammonia leakage out of the system.

For water source heat pumps the selection of evaporator is like refrigeration systems, where plate and frame are most commonly used. If there are particles in the water, shell and tube is preferable and if operating close to freezing a falling film evaporator is an option. These heat exchangers have no special requirements regarding the pressure as standard design pressure can be applied (230–360 psi).

Heat Pumps in Dairies in the United Kingdom and Ireland

In 2008, a dairy in Northeast England was looking to save costs on its fresh milk production line. Fresh milk is a low-margin, high-volume product, so a small savings per gallon can add up to high value. The dairy had installed a 398 TR (1,400kW) ammonia refrigeration plant for cooling down the milk after pasteurization, and it was using 3.14 MBtu/hr (920 kW) of steam (generated by gas boilers) to heat water to 176°F for the pasteurization process (Figure 4). This process is the same for almost all fresh milk dairies across the world.

For refrigeration 3 x GEA V1100 compressors were installed with evaporative condensers for heat rejection. At the UK average condensing temperature of 73°F the condenser heat rejection is 5.47 MBtu/hr (1,603 kW) at full load (Table 2).

When operating the dairy plant in a traditional way, the dairy uses 203 kW of electricity and 920 kW of steam. There are losses in the steam system (5%–50%), and industrial boiler efficiency is normally between 75% and 85%. For assessment of the site, we have assumed only 20% losses in the boiler and steam system. To get 920 kW of steam energy into the milk requires 1,150 kW of natural gas. Installing a heat pump that uses the waste heat from the refrigeration process enables significant reductions of energy usage. To optimize the heat pump installation, one of the refrigeration compressors is dedicated as a heat source for the heat pump compressors (Table 3). Using this configuration enables us to minimize the heat pump compressors by increasing suction temperature and still have the refrigeration plant operate with floating head pressure for optimum efficiency throughout the year.

The two heat pump compressors were added to the system via an interstage vessel, so losses between the condensing temperature of the refrigeration compressor and the suction pressure of the heat pump compressor are minimal. The heat pump compressors deliver 180°F hot water (hence the condensing temperature of 181 °F). An intermediate water circuit is between the 176 °F hot water going into the pasteurizer and the 181°F coming out of the heat pump, which ensures that any potential ammonia leak into the heating water will not contaminate the milk. Table 3 shows that the total electrical power has increased from 203 kW to 393 kW, so an extra 190 kW of electricity, but the customer has also saved 1,150 kW of gas usage. Based on a gas price of $0.052/kWh and an electricity price of $0.09/kWh and with the plant operating 7,488 hours per year the yearly savings are $307,500 per year (Unsworth, 2011). In addition the carbon savings are significant. When the plant was installed in 2008, the carbon intensity of electricity production in the United Kingdom was 1,190 lb/MWh and emissions from burning gas was 474 lb/MWh, at the time the dairy saved 1,083 tonnes of CO_2 emissions per year. Today, 13 years after the installation, all coal-fired power plants have been decommissioned in the United Kingdom and a significant part of UK electricity is supplied by renew-

Figure 2. A cut-through view of a plate-and-shell heat exchanger. It offers the high integrity of a fully welded heat exchanger (like shell and tube), but the small footprint and refrigerant charge of a plate heat exchanger.

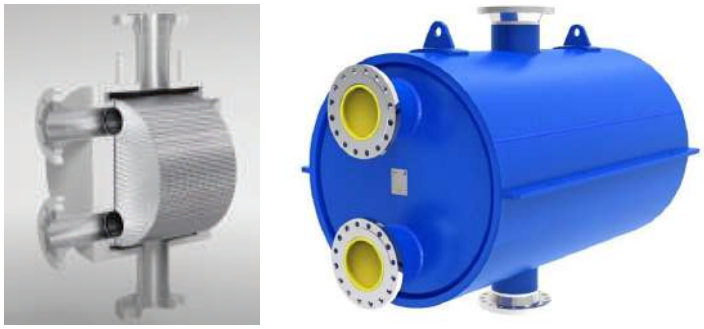


Figure 3. To the left is a typical heat exchanger setup for a reciprocating compressor heat pump, where a high discharge temperature greatly benefits a de-superheater but no oil cooling is available. To the right is a schematic of the water flow through the heat exchangers for a screw compressor heat pump, which features a lower discharge temperature and less superheat energy, but significant heat in the oil cooling circuit.

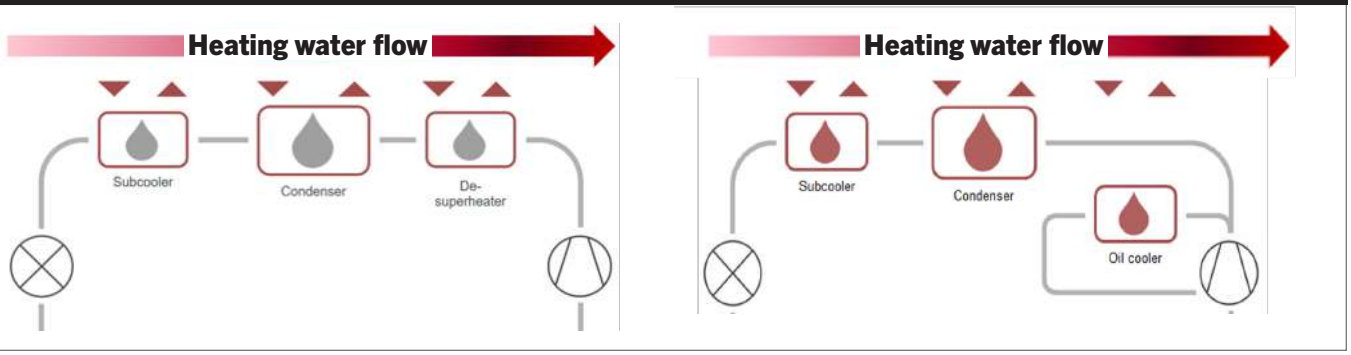


Figure 4. A typical setup for pasteurization with a three-zoned heat exchanger. First the incoming milk is heated in a regeneration area, while the pasteurized milk cools, then the incoming milk is pasteurized with hot water to above 162˚F (for fresh milk). After the regeneration area the milk is chilled to a holding temperature of around 35˚F using chilled water.

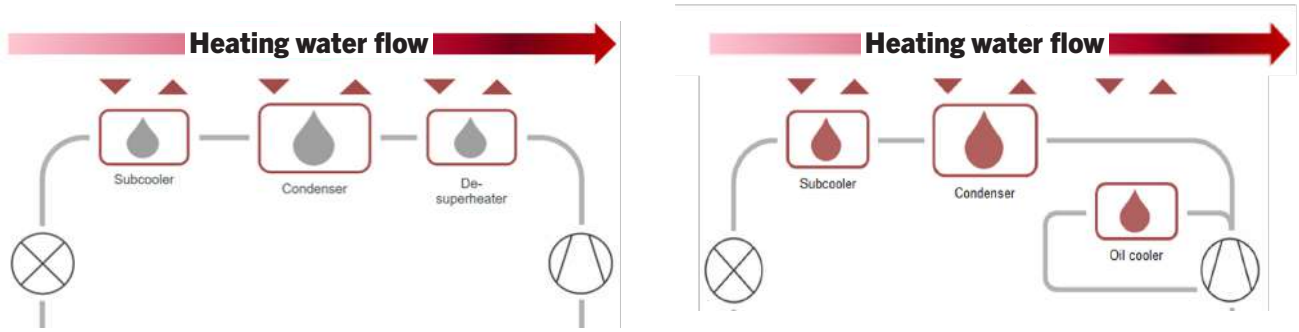


Table 2. Cooling Coefficient of Performance (COP) of the Refrigeration Plant without the Heat Pump Installed

Compressor	Rpm	To (°F)	Tc (°F)	Qo (TR)	P (kW)	Qc (kW)	COP cooling
3 x GEA V1100	734	23	73	(1,400 kW) 398	203	1,603	6.9

Note that Table 2 indicates a cooling coefficient of performance (COP) of 6.9 for the compressors. The COP is defined as the cooling duty (Qo) in kW divided by the absorbed power (P) in kW. The same expression (COP) is used for heat pump installations. In this case the heating duty (Qc) in kW is divided by the absorbed power (P) in kW.

Table 3. Cooling COP and Power Consumption of Refrigeration and Heat Pump System

Compressor	Rpm	To (°F)	Tc (°F)	Qo (TR)	P (kW)	Qc (kW)	COP cooling
2 x GEA V1100	590	23	61	786 kW 224	87	1,603	6.9

Figure 5. Installation of 1,200 kW ammonia heat pump at Aurivo fresh milk dairy in Ireland.

able sources, so the yearly average carbon intensity of electricity is now 400 lb/MWh (2020). As of this writing, the plant has reduced carbon emissions by 1,600 tonnes per year.

In 2019 Aurivo dairies in Ireland made a similar installation for their fresh milk pasteurization process in County Donegal (Figure 5), where they pack 120 million liters of fresh milk per year and are saving $402,500 per year and 400,000 lb of CO_2 emissions per year (*Dairy Reporter*, 2020).

LONDON UNDERGROUND HEAT PUMP

In 2016, Islington Council in Central London built the world's first heat pump to feed cheap low-carbon heat into a district heating network using the exhaust ventilation air from the London Underground as the heat source. The plan is to continue the development of district heating networks in London and eventually connect all the tower blocks and public buildings like schools, hospitals, and leisure centers. When the heat network has been established, the plan is to try to attract private and commercial owners to sign up to the network also. The heat network will be able to supply environmentally friendly heating at lower cost than burning gas and with zero NO_x emissions, which cause around 4,000 deaths per year in central London (Imperial College London, 2020).

For this phase of the project (Bunhill 2), a 1,034 kW two-stage ammonia heat pump was installed. The ammonia charge is approximately 770 lb (Hoffmann, 2017). The heat pump consists of a combined evaporator/separator in a fully welded shell. Four heat exchangers are in series in the heating circuit to optimize the performance of the heat pump (Figure 6). First the district heating water cools the de-superheated gas from the low-stage compressor, and then the water is heated in series through the sub cooler, condenser, and de-superheater from the high-stage compressors.

The design criteria for the heat pump are based on heating water returning at 122°F and supplied at 167°F. The air cools from 75°F to 57°F in the cooling coil with water at 55°F/46°F. At these conditions,

Figure 6. Simplified schematic of the ammonia and water circuit of a high-efficiency heat pump.

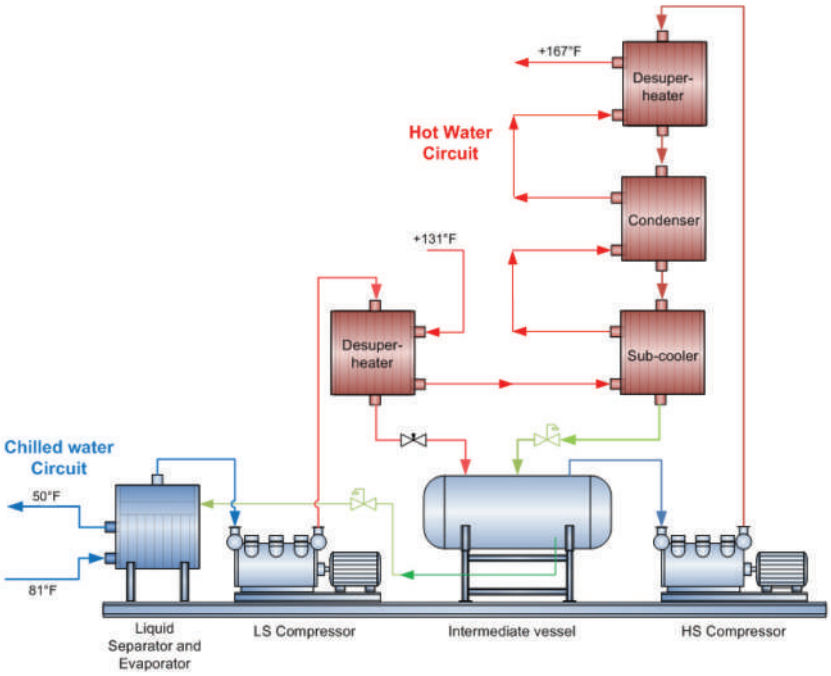
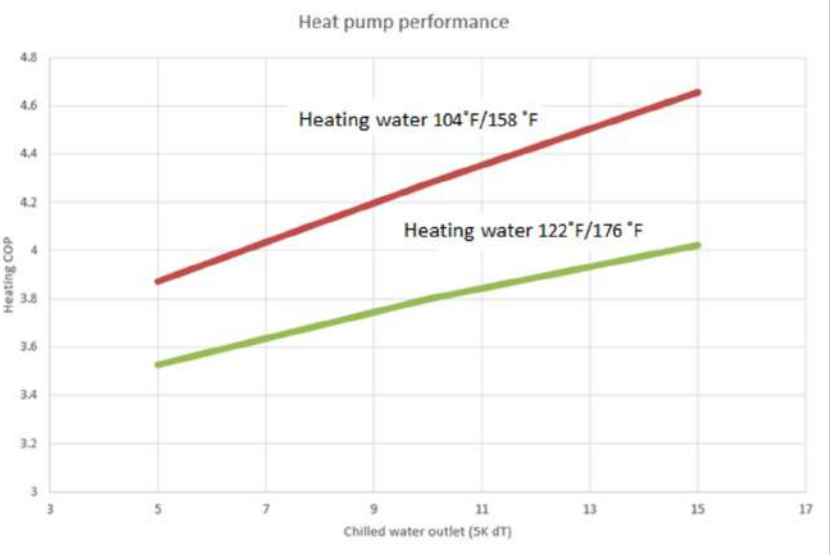


Figure 7. Illustration of the performance of the London Underground heat pump. The green line (122˚F/176˚F) is the performance at the time of installation. The council aim to optimize the heating network over time and lower the flow and return temperature and eventually achieve the performance illustrated by the red line (104˚F/158˚F).



the total cooling duty is 222 TR (780 kW), the absorbed power of the three compressors is 369 BHP (275 kW), and the heating duty is 1,034 kW giving a heating COP of 3.7. The heat network needs a higher temperature in the peak of winter, so the heat pump is designed to supply heating water up to 176˚F (Figure 7). On the cooling side the ventilation air coming out of the underground can also vary. In the peak of summer, it can be 86˚F and in the winter, it can drop to 68˚F. It rarely drops below 68˚F. When the tube started operating in the 19th century it was cool underground, but due to inadequate cooling and ventilation, the generated heat from the people and friction from the train operation have heated up the whole network 18–25˚F since it began operation.

The heat pump has one low-stage piston compressor and two high-stage compressors. The low-stage compressor provides enough cooling capacity to generate 1,000 kW heating capacity. The minimum part load of the system is 25% of the design capacity—both low-stage and high-stage compressors have VFD motors for optimised performance at part load.

Heat Source

From other air source heat pumps, we are accustomed to the air-cooled evaporator blocking up with ice, which can be overcome by defrosting the coil. In this case defrost is unnecessary as the temperatures are much above 32˚F, but an issue remains with the cooling coil blocking up. The air is extracted from the underground to ambient at ground level. A (780 kW) 222 tons of refrigeration water–cooled cooling coil is mounted in the airstream with a reversible fan extracting 70 m^3/s. Most of the year the air from the London Underground will be cooled before being vented to atmosphere. On warm days, the airstream is reversed and chilled across the cooling coil before being vented into the underground tunnel. The London Underground has experience with this type of installation from other parts of London where the air is chilled before venting to the underground tunnels. The air quality from street level differs significantly from air extracted from the underground. The underground air has a high metal content (Transport for London, 2014), whereas the air quality on busy London streets is mainly (around 80%) NOx and PM10 and PM2.5 from exhaust and brakes from cars, busses, and trucks (Chetan Lad, 2016). To avoid the coil being blocked by the pollutants, a wide fin spacing was chosen (four fins per in.). Based on the London Underground's experience from other sites and tests made with the cooling coil the coil will need to be cleaned every 6–12 months.

To avoid ammonia potentially leaking from the air-cooling coil and being vented into the underground, there is an intermediate water loop. The heat pump cools water that is circulated in the cooling coil in the ventilation shaft.

Ammonia Absorber

The ammonia heat pump is installed at street level on the corner of a busy London

Figure 8. Drawing of the absorber vessel holding 17,600 lb of carbon pellets, through which the ventilation air passes.

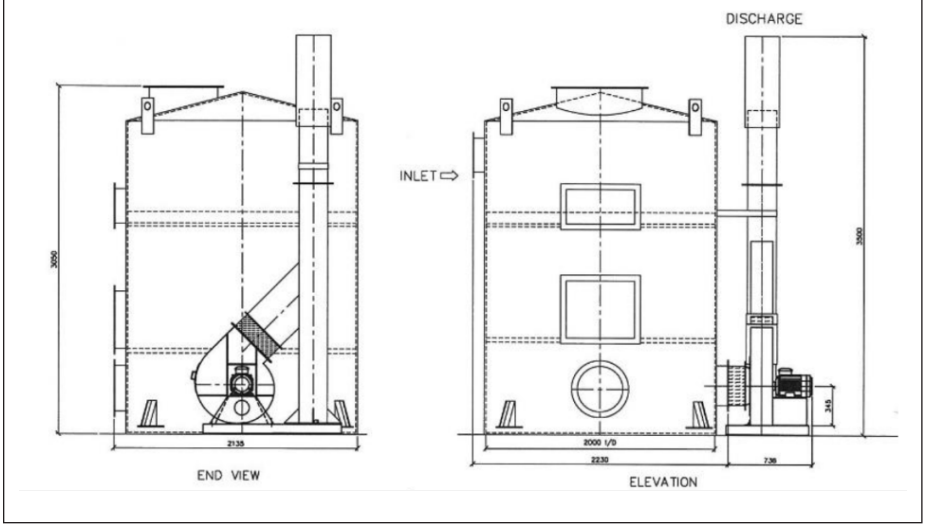


Figure 9. Four 10 MW heat pumps installed in Malmö, Sweden.

street. To avoid any harm to people the extract air from the plant room will be rejected above the roof of the nearby 18-story block of flats during normal operation. When the plant is serviced (some ammonia smell can be expected) or an ammonia alarm is set off, all the ventilation air will be passed through a carbon filter, which absorbs all the ammonia leaving 0 ppm of ammonia in the air after filtration. We have investigated other options, but no other solution can offer 100% removal of the ammonia in the air. Water scrubbers and acid-based scrubbers reduce the ammonia content in the air below dangerous levels, but they do not completely remove the ammonia from the air, and with a large population in the area with no knowledge of ammonia safety levels, any prevailing ammonia smell could cause panic. Although the ventilation air is rejected at the highest level, taller buildings are under construction nearby, so having zero ammonia content in the ventilation air is important.

The absorption material used is a carbon-based pellet, with an additive to improve the ammonia absorption properties. In our test we found that that material can absorb up to 5.6% ammonia. For the project in London, the absorber quantity is selected based on 4.6% ammonia absorption capacity. Therefore, installation of 17,600 lb of absorbent material would be required to absorb the 770 lb of ammonia in the heat pump (Figure 8). This could have been mitigated by selecting a design with independent ammonia circuits for the low stage and high stage, which would have more than quartered the ammonia content per circuit to less than 150 lb, thereby reducing the size of the absorber equally.

Malmö District Heating Heat Pumps

In a world of phrases such as "environmentally friendly," "sustainable," and "natural," Swedish district heating is using innovative technology to meet regulations and set quite high efficiency standards. In 1980, the Swedish town of Malmö installed its first district heating heat pump plant. However, in 2012 when the Montreal Protocol banned the synthetic refrigerant used in the plant (R22), the plant was decommissioned. In November 2017, the second generation was up and running after one year of preparation.

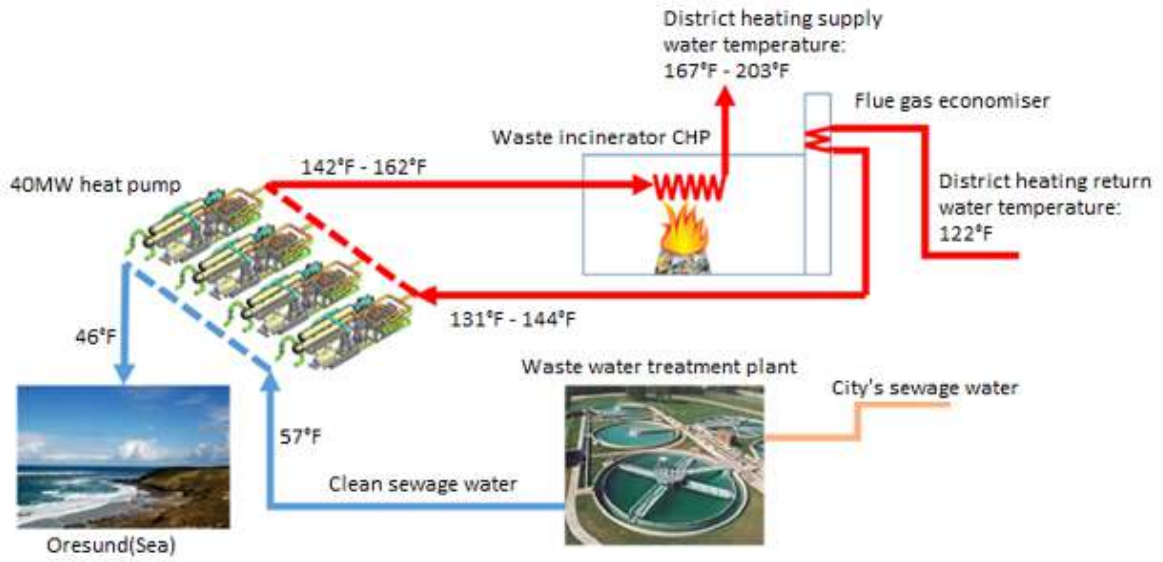
E.ON, one of the world's largest investor-owned electric utility service providers, installed four ammonia heat pumps, each with just more than 34 MBtu/h (10 MW) heating capacity next to the sewage treatment and waste incinerator plant in the Malmö harbor area (Figure 9). The heat pump system extracts nearly 8,500 TR (30 MW) of heat from the sewage water and adds 10 MW of electrical power to generate 136 MBtu/h (40 MW) of heating.

The sewage water temperature varies between 54°F and 64°F depending on the season. The cleaned sewage water was previously returned to the sea, but now it passes through the heat pump evaporator and is chilled 6K before being returned to the sea. By harvesting the heat from the wastewater, which has a higher average temperature, the plant is running with better efficiency than if it had been using sea water (-15% efficiency) or ground source water (-10% efficiency).

As the sewage water is not constant throughout the year (more after rainfall) or during the day (more in the morning), a large reservoir for the sewage water was built, which was ready a year after the heat pump was installed. By evening out the sewage water flow the yearly energy output from the heat pumps has increased from 110 GWh to 170 GWh.

Although the sewage water is taken at the end of the cleaning process, particles of organic material remain in the water. To avoid these blocking up the evaporator, a fine filter (2 mm) is installed, and the tubes in the shell-and-tube evaporator are

Figure 10. Schematic of the water flow through the heat pump. The sewage water is first cleaned before the heat pump and afterward pumped into the sea. The heating water comes back from the city and is heated in the flue gas economizer and then heated by the heat pump before it returns to the waste incinerator plant where it is heated further from the waste heat to the desired outgoing temperature.



cleaned daily, using a ball cleaning system, without stopping the heat pump. Efficiency improves 2%–3% after each ball cleaning of the tubes.

Heat Network

The heat pump has been integrated into the district heating network to work with the nearby waste incinerator plant. The return water from the city comes to the waste incinerator plant at around 122°F, where the flue gas economizer heats it to around 131°F before it enters the heat pump where it is further heated to 151°F. The water then returns to the waste incinerator plant where it is further heated to the required temperature for the heating network, which can vary depending on the heating demand from 167°F to 203°F (Figure 10). The heat pump is designed to deliver heat up to 176°F, but will rarely deliver temperatures greater than 162°F.

By replacing heating traditionally done by gas boilers the district heating network saves more than 50,000 tons of CO_2 per year. Many other cities aim to decarbonize their heating systems over the coming years and remove NO_x from the local environment. Many other Nordic cities have already installed high-efficiency heat pumps to combat local and global pollution, and more will surely follow globally in the coming years. By using ammonia heat pumps, the City of Malmö is not only swapping from fossil fuel to electrically driven heating, it is also doing it in the most efficient way. Today delivering heat up to 203°F is possible (Ammonia21, 2021) with a heating COP greater than 3.0 using an ammonia heat pump, which is more than 20% better than F-gas competition.

In the future when all heating has moved from fossil fuel to electrically driven heat generation green electricity production will be unable to fulfil this growing demand. To achieve a match between the available electricity and renewable heating installing the most efficient system today is important.

CONCLUSION

Ammonia heat pumps are suitable for many applications. Industries with combined cooling and heating needs are the most obvious application because payback of the investment is the shortest. However, many other applications also exist such as in industries where there is no cooling demand but plenty of waste heat. Many cities are also looking into decarbonizing the heating of homes, as replacing fossil fuels not only reduces the carbon footprint, it also reduces NO_x emissions, which are a major health problem in large cities.

Heat pump installations have also advanced from being purely based on payback, as demand for decarbonization is increasing, leading to ever increasing temperature demand. Many customers now ask for heat pump solutions up to 203˚F hot water, which is possible with today's ammonia heat pumps.

As with refrigeration, ammonia is not competitive for small domestic systems, but the upper size of ammonia heat pumps has few limits. So far, the largest installed is 136 MBtu/hr (40 MW), but with modular design even larger ammonia heat pump installation are achievable.

REFERENCES

Ammonia21. (2021). GEA launches ammonia heat pump capable of producing 95˚C heat. October 19.

Chetan Lad. (2016). Source appointment for the City of London corporation. July 15.

Dairy Reporter. (2020). Aurivo cut fossil fuel by 80%. March 12, available at https://www.dairyreporter.com/Article/2020/03/17/Aurivo-reduces-fossil-fuel-consumption-by-80#.

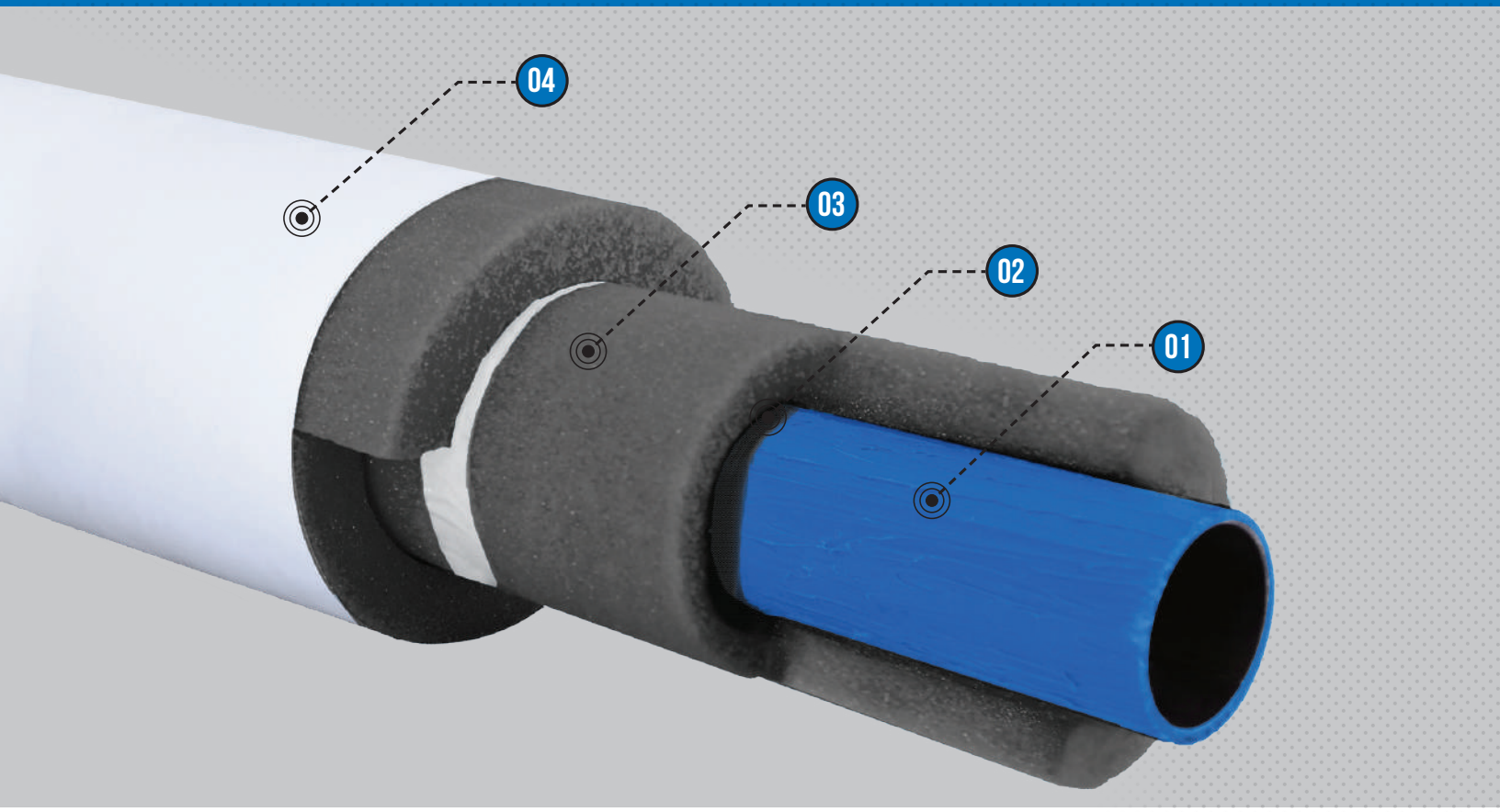
Hoffmann, K. (2017). High efficient, high efficiency industrial ammonia heat pump installed in central London. IEA Heat Pump Conference 2017,

Imperial College London. (2020). London health burden of current air pollution and future health benefits of mayoral air quality policies.

Transport for London. (2014). Air quality on the underground 2004–2013. Available at http://content.tfl.gov.uk/air-quality-on-underground.pdf.

Unsworth, R. (2011). Add on heat pump for dairy application. 23rd IIR International Congress of Refrigeration (August 21–26, 2011).

THE OPTIMAL COLD SERVICE SYSTEM



01 The optimal Cold Service System starts with RG-2400® gel on the pipe to prevent corrosion.

02 VaporGuard™ for use as a vapor stop on sub-freezing insulation systems.

03 DuPont™ Styrofoam™ insulation provides long-term stable R values.

04 The insulation is covered with Polyguard ZeroPerm® or Insulrap™ vapor retarders to keep the insulation dry. Or complete the system with our Alumaguard® family of flexible weatherproof cladding products.

Polyguard®
Innovation based. Employee owned. Expect more.

214-515-5000
www.Polyguard.com/mechanical

73 years … and counting

What began in 1949 as Freezing Equipment Sales (FES), in York, Pennsylvania, is today the North American headquarters of GEA Heating & Refrigeration Technologies. From its humble beginnings more than 70 years ago, the company has steadily grown and increased its product and service offerings to become an industry leader.

Today, our 90,000-square-foot factory on our 13-acre campus produces process-critical, custom-engineered systems; screw compressor packages; chillers; heat pumps and controls — all backed by a comprehensive service platform in conjunction with experienced and qualified refrigeration contractors throughout North America.

It is our mission to continue to provide innovative, efficient and reliable solutions to those we serve and whose trust in us has propelled our growth. We look forward to the opportunity to continue to be of service to this great and essential industry.

GEA Heating & Refrigeration Technologies – North America
York, Pennsylvania

GEA North America
717 767 6411 | sales.unitedstates@gea.com

engineering for a better world

gea.com