

APRIL 2018

ACCELERATE

ADVANCING HVAC&R NAT

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Business Case for
Natural Refrigerants

06/12-14/2018 – Long Beach, CA



Highlights:

End-user travel fund for first-timers | Technomercials
Private end-user meetings | ATMO Connect afternoon
2 new *Accelerate America* Awards categories
Expo-only tickets | Site visits



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ATMO Connect



Michael Garry
Editor

THE BLOSSOMING OF LOW CHARGE

Unlike natural refrigerants like CO₂ and hydrocarbons – which have had a relatively recent rebirth after a hiatus of many decades – ammonia has had a continuous run as a refrigerant for more than a century.

Of course, its use has been primarily restricted to the industrial sector, where it has been applied in copious amounts to processing, freezing, storage, and other applications. Its toxicity and pungent odor have made it a non-starter for household or supermarket applications.

But recent events have changed the status of ammonia within industrial refrigeration, its traditional stronghold, and possibly set the stage for its use in other sectors.

Most notably, the explosion at a fertilizer plant in Texas in 2013 “drove a stake in the ground for [ammonia] regulations in the U.S.,” said Joseph Pillis, director, global industrial refrigeration technology, Johnson Controls, at the IIAR Natural Refrigeration Conference & Expo in Colorado Springs, Colo., last month. That incident led to an uptick in the enforcement of federal ammonia safety regulations and the development of updated standards (though those have been delayed by the Environmental Protection Agency till next February).

Last year, in Fernie, British Columbia, an ammonia leak that killed three workers at an ice rink underscored the risks associated with this refrigerant.

The upshot of stricter regulations and concerns about safety has been the advancement of a trend toward using considerably less ammonia in so-called low-charge systems.

While low-charge technology has been around since at least the 1980s, its growth has been dramatic in the past few years – which was amply demonstrated at the IIAR Conference.

This issue of *Accelerate America* offers in-depth coverage of that conference, with articles on the myriad low-charge systems featured on the exhibit floor ([page 42](#)), new guidelines on safe handling of low-charge systems ([page 46](#)) and insights into the low-charge market from a presentation by my colleague Derek Hamilton, VP of business development for shecco America and technical editor of *Accelerate America* ([page 22](#)).

Derek is working on a comprehensive study called “World Guide to Low-Charge Ammonia,” which will be published this year.

And our cover story ([page 32](#)) looks at the installation of Colmac Coil’s centralized low-charge Advanced DX (ADX) system at Liberty Cold Storage in Bolingbrook, Ill. Based on Colmac’s DX evaporator, the system dramatically cuts the charge in a large cold-storage operation while adhering to a conventional machine room layout. The serves as a contrast to last month’s cover story on KPAC General in South Gate, Calif., which has installed ultra-low-charge packaged units designed by NXCOLD.

While low-charge ammonia technology will no doubt change the industrial sector over the coming years, the greatly improved safety of this technology has the potential to lead ammonia into largely uncharted commercial territories such as supermarkets (particularly with ammonia/CO₂ refrigeration) and other commercial properties like hotels and convention centers with large-capacity chillers.

The final book on ammonia cooling has yet to be written.

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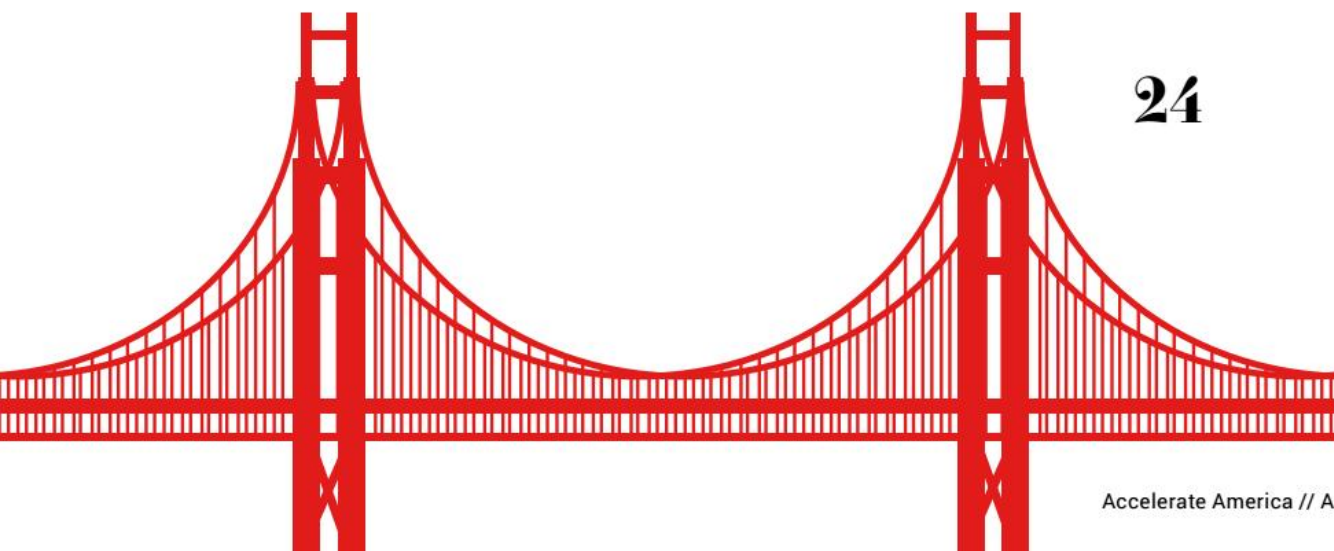
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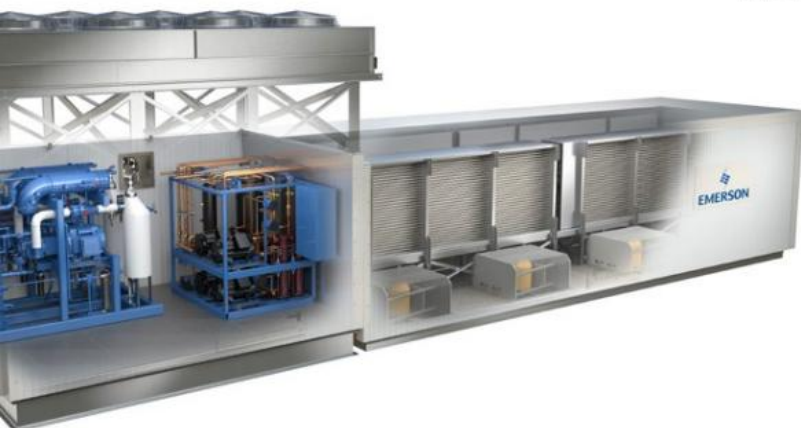
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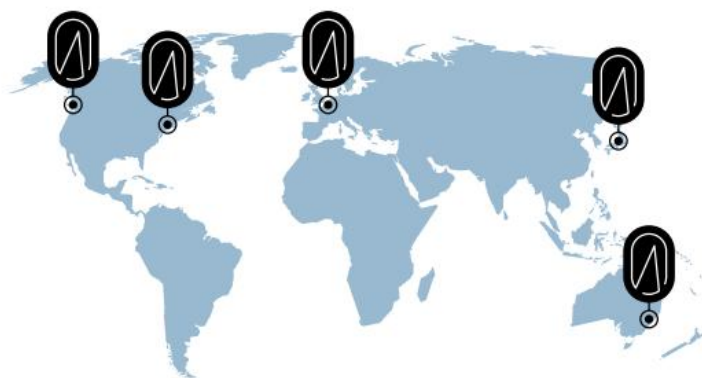
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ACCELERATE

ADVANCING HVAC&R NATURALLY AMERICA



About Accelerate America

Brought to you by shecco, the worldwide experts in natural refrigerant news, *Accelerate America* is the first news magazine written for and about the most progressive business leaders working with natural refrigerant solutions in all HVAC&R sectors.

<http://acceleratenews.com>

Accelerate America publisher shecco's network spans the globe with offices in Brussels, Tokyo, New York, Portland (Oregon) and Sydney.

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// Volume 4, Issue #34

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// ISSUE #33 *March 2017*

FOCUS:

Low-charge ammonia (packaged)

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March 13



#GoNatRefs



LETTERS TO THE EDITOR

HYDROCARBON CERTIFICATION NEEDED

The report discussed by Bill Goetzler, managing director of Navigant Consulting, ("[U.S. Lags in Flammable Refrigerant Safety](#)," *Accelerate America*, March 2018") states that, in the U.S., researchers identified as a gap the lack of training and certification requirements for technicians specific to flammable refrigerants. I wish to address this statement.

As far as training is concerned, the Refrigeration Service Engineers Society (RSES) has had hydrocarbon training since 2012. This includes all the A3 refrigerants and the A2L refrigerant R32 as well as the A2L HFOs. There is online training available through the RSES website and I have personally been involved in face-to-face training with technicians and employers using RSES training materials for the last three years.

More recently, others have begun to offer less comprehensive training online, including webinars. Manufacturers of domestic appliances either have or will have training available for their service folks. So training is available, and those who need it can seek it out.

On the other hand, in terms of certification requirements, the U.S. Environmental Protection Agency (EPA) does not require Section 608 certification for flammable refrigerants. I was part of an industry-wide group that went before the EPA to not only request that the EPA have certification for flammable refrigerants, but also offer to participate in making that happen. The EPA basically said NO. I am afraid we may never have hydrocarbon certification, though that remains to be seen.

What RSES and others are doing is requiring a passing grade on a flammable-refrigerant-training exam, which will come with a "certificate" indicating some form of training has been taken. While not requiring training, the EPA recommends that anyone servicing appliances with a flammable refrigerant receive appropriate training and follow industry best practices.

Arthur Miller
Principal
KAM Associates
Apollo, Pa.



GET THEM WHILE THEY'RE YOUNG

While reading the opinion piece by Todd Ernest ("[Training and Culture Can Solve the Technician Shortage](#)," *Accelerate America*, March 2018), I was reminded of our trials and tribulations relative to the manning of the oars here at Professional HVAC/R Services. While his company has grown with his mantra of Train, Train, Train, we see others here in the U.S. struggle to decide how best to get the right staff.

One thing we agree with, for sure, is that getting the young involved will prove to be the No. 1 issue we all face together. Our ongoing efforts to build a STEM-type school here in Ohio have been met with pushback from academia and sundry legal requirements. Our current effort to take the message to the young is to attempt to emulate the success of others. For

example, the National Fire Protection Association years ago started "Sparky the Dog" to reach the very young at schools all over the nation. Remember "Stop, Drop and Roll"?

At our company, we like "Omega the Octopus." Omega's sketches/videos are all about how this friendly animal can show how we do what we do. For example, how do we properly carry our tools from our vehicle to our work site, which may be way up in the air? Omega whisks through this task using a rope and arms to get this task done safely.

Taking the message to the very young requires a "hook." Get them while they are young and impressionable. Middle school or high school is sadly too late.

Joe Kokinda
President/CEO
Professional HVAC/R Services
Avon Lake, Ohio

LETTERS ARE WELCOMED!

Accelerate America invites readers to submit letters to the editor at michael.garry@shecco.com. They can be about a recent article; an industry issue that readers would like us to cover in greater detail; or the value of *Accelerate America* and *ATMOSphere America* in educating the industry about natural refrigerants, including what we can do better. Letters may be edited for clarity or length.

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Reduced



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avoided deaths

HEALTH

2.4 million avoided premature deaths annually from outdoor air pollution

52
million tonnes
 of AVOIDED CROP LOSSES

CROPS

52 million tonnes of avoided crop losses from 4 major staples

*Short-Lived Climate Pollutants (SLCPs), which contribute to global warming, include hydrofluorocarbons (HFCs), methane, black carbon (soot) and tropospheric ozone. SLCPs have relatively a short lifetime in the atmosphere – a few days to a few decades.

Source: Climate and Clean Air Coalition (CCAC)

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15-17**Supply Chain Conference, Trading Partner Alliance (FMI and GMA), Orlando, Fla.**

Exhibit hall and 30+ educational sessions on topics such as fresh distribution, transportation, regulatory compliance, and on-shelf availability.



www.fmi.org/supply-chain-conference

19, 1PM-4PM**ASHRAE Webcast: Making Energy Efficiency a Reality, Online, 1PM-4PM eastern**

This webcast will focus on strategies and policies for efficiency goals. Viewers will learn how a practical design approach can help achieve optimum energy performance in commercial and high-rise residential buildings.



<https://bit.ly/2q5vmbs>

**24-26****CPMA Convention & Trade Show, Vancouver, B.C.**

Canadian Produce Marketing Association (CPMA) event, dedicated to the fruit and vegetable industry, attracts more than 3,000 attendees from all segments of the produce supply chain and showcases produce from around the world.



www.convention.cpma.ca

26-27**MCEE, Montreal, Canada**

MCEE is a plumbing, HVAC&R, hydronic, electrical and lighting expo.



<http://mcee.ca>

**29-02****IARW-WFLO Convention, Amelia Island, Fla.**

This event is for senior-level executives at temperature-controlled warehousing and logistics companies and industry suppliers.



www.gcca.org/convention

30-03**Craft Brewers Conference, Nashville, Tenn.**

This event, designed for brewpubs and packaging breweries, and hosted by the Brewers Association, offers educational sessions on improving brewery quality and performance as well as exhibits on the latest products and services.



www.craftbrewersconference.com

MAY

02-04

SIAL Canada, Montreal, Canada

SIAL Canada is an international agri-food event for retail, catering and food processing companies. It features more than 850 exhibitors from 50 countries while hosting over 15,000 buyers from Canada, the U.S., and 60 other countries.



<http://sialcanada.com/en>

03

Natural Refrigerants Workshop/ North American Sustainable Refrigeration Council (NASRC), Boise, Idaho

This free, full-day workshop for the food retail sector, hosted by the Idaho Department of Environmental Quality (DEQ), explores trends in natural refrigerant systems, including costs, energy use, new technologies and more.



<https://bit.ly/2GllMMS>



07-09

AHRI Spring Meeting, Baltimore, Md.

Event includes 31 product sections discussing policy, standards, certification, and more. AHRI staff will provide industry and association updates.



<https://bit.ly/2pU9ikd>

07-10

Food Safety Summit Conference & Expo, Rosemont, Ill.

The 20th Annual Food Safety Summit we will address the importance of food safety throughout the supply chain and how each community that makes up the ecosystem is connected. It includes case studies, educational sessions and new technologies.



<https://bit.ly/2GhrGHb>



@foodsafetysummit



19-22

National Restaurant Association (NRA) Show, Chicago, Ill.

The NRA Show showcases the latest innovations in the food-and-beverage industry, and offers networking with over 66,000 foodservice professionals from around the world.



<https://show.restaurant.org>



@NRAShowIntl

22-25

North American Rink Conference & Expo (NARCE), Columbus, Ohio

NARCE is an annual educational conference and trade show for ice rink industry professionals.



www.usicerinks.com/narce

AMERICA IN BRIEF

Danfoss Taking Entries For Award Competition

Component manufacturer Danfoss is accepting entries for its ninth annual EnVisioneer of the Year award competition.

The competition recognizes North American original equipment manufacturers (OEMs), building owners, municipalities, contractors and end users that have introduced a new product, opened a new facility, or invested in a building or system upgrade in the past 18 months using Danfoss products or solutions to realize significant energy and environmental savings.

Interested participants may enter the competition by submitting an application by June 1, 2018.

Applications will be reviewed and selected by a panel of third-party judges representing various disciplines. To submit an entry, [click here: https://bit.ly/2GSMz3f](https://bit.ly/2GSMz3f). ■ MG

R290 Split AC Offered in Grenada

Grenada's National Ozone Unit (NOU) has made six propane split air conditioners available to end users for demonstration purposes.

The energy-efficient AC units feature 12,000-BTU and 18,000-BTU cooling capacity.

This demonstration project is being done in conjunction with "Cool Contributions fighting Climate Change," a global program, implemented by Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) as part of Germany's International Climate Initiative (IKI).

The program aims to evaluate the energy performance of R290 units throughout the world. It is not only tackling natural refrigerant air conditioning uptake, but is also trying to increase the availability of refrigeration appliances that use R600a and R290. ■ CM

Cooling Seen as Critical to Sustainable Development Goals

In a new research paper, U.K.-based Birmingham University's Energy institute has shed light on the key role that climate-friendly solutions for cooling play in achieving the United Nations-supported Sustainable Development Goals (SDGs).

SDGs encompass 17 global social and economic development goals, including climate change, water, energy, environment, social justice, poverty, hunger, health and education.

Birmingham Energy Institute's report shows how cooling will play a vital role in achieving – either directly or indirectly – almost all the SDGs.

The research paper stresses that cooling is facing a booming demand from fast-growing economies and urban populations. Providing climate-friendly and energy efficient solutions – such as natural refrigerants-based equipment – will be a key to protecting the environment and the world population's vital needs, it said.

Cooling is a fundamental component of daily survival – from cold chains for fresh food, to safe storage of life-saving vaccines and medicines, to cooler, safer workplaces and schools that can elevate productivity, the report noted.

At the same time, the world's population is projected to reach 9 billion by mid-century, and food demand to increase by 60%. The world is also seeing the rapid emergence of new middle classes in countries such as China, India, Indonesia and Brazil.

Air conditioning is also set to boom. Researchers at Lawrence Berkeley National Laboratory estimate the global stock of room air conditioners will rise by an additional 700 million by 2030, and 1.6 billion by 2050.

"There is no question that we will need far more cooling," said Professor Toby Peters of the Birmingham Energy Institute.

The study points out that cooling is responsible for 7% of total CO₂e emissions, and will almost double to 13% by 2030. ■ MB

IIAR Progresses With CO₂ Safety Standard

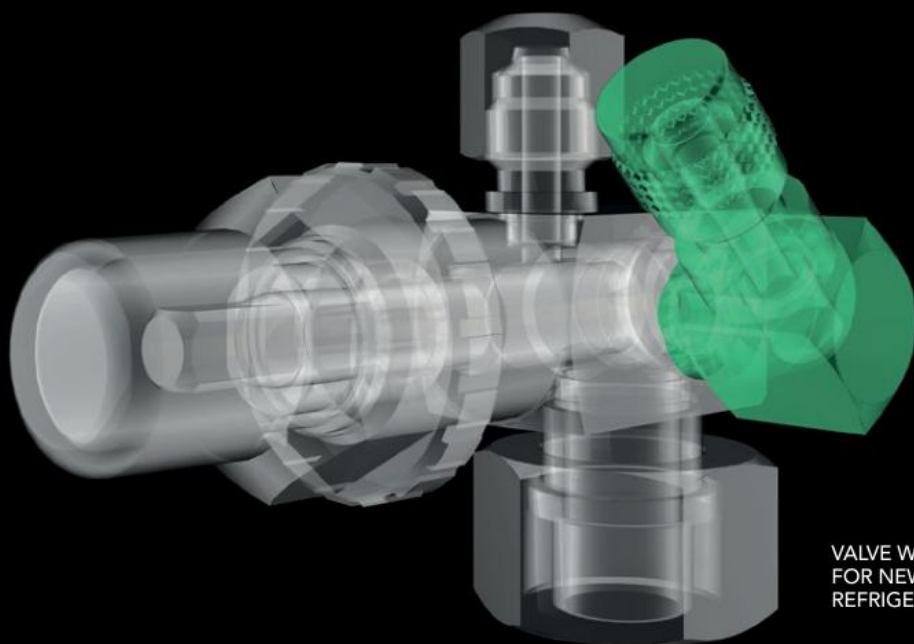
Efforts to create a safety standard for CO₂ by the International Institute of Ammonia Refrigeration (IIAR) have reached "pre-publication review," said John Collins, head of IIAR's CO₂ Committee and industrial sales manager for Zero Zone.

"We have an initial working draft, which consists of the first several chapters," he said at Zero Zone's booth at the IIAR's Natural Refrigeration Conference & Expo, held last month in Colorado Springs, Colo.

He expects the remaining sections of the standard to be finished in the next few months, with a final public review to take place next year. "We expect a lot of comments that would take multiple stages," with the final document possibly not ready for release until 2020.

A safety standard for CO₂ does not yet exist in the U.S., Collins said, adding that the standard under development will reflect the scope of IIAR's safety standards for ammonia. The new standard is on record at ANSI (American National Standards Institute).

The CO₂ standard will encompass applications in both the industrial and commercial sectors, with contributions from companies in both, Collins said. "It's a base-level standard covering the requirements to do CO₂ systems properly and in a safe manner." ■ MG



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Want to Save Energy? Clean Your Condenser Coils

Often ignored, condenser coils in a self-contained cooler need to be cleaned regularly to ensure efficient operation of the refrigeration system

— By Richard Fennelly



Richard Fennelly

is director of business development for CoilPod LLC, a start-up with offices in Cortlandt Manor, N.Y. and Ridgefield, Conn., specializing in developing refrigeration coil-cleaning techniques and products for dust containment in which compressed air is used in the coil-cleaning procedure.

Despite the very many advantages that natural refrigerants confer on self-contained commercial refrigeration systems, including better energy efficiency in many instances, it is still necessary that certain types of preventative maintenance be performed, just like what is done for systems using conventional refrigerants.

One critical maintenance task that is ignored almost universally is condenser-coil cleaning. One HVACR expert believes that 80% of the owners of refrigeration units never do condenser-coil cleaning and that the remaining 20% do it too infrequently.

Cooling appliances have condenser coils that are responsible for throwing off to the atmosphere the heat that has been extracted from the chamber holding the items intended to be refrigerated or frozen. To facilitate that heat-exchange process, these coils, when contained within the appliance's cabinet, have airflow directed through their structure by a fan in the condensing unit that pulls air into the coil enclosure through a cover containing vents. All manner of dust and debris are also drawn in with the air, causing clogging of the coils over time.

U.K.-based Foster Refrigerator has stated that an airflow reduction of about 95% can be expected over a one-year period of operation in most cases. Experts recommend frequent coil cleaning to insure good airflow — often at periods of every three to four months at a minimum, and even more frequently in extremely dusty or dirty environments.

Clogged coils cannot effectively throw off heat since the dust/debris forms an undesired insulation layer. The refrigerant flowing through the unit gets too hot (resulting in high pressures) and starts damaging other components. Further, the system draws higher amperage, run times increase, and the refrigerant

“ The amount of energy needed to operate an appliance can increase by as much as 90% to 100% if the coils are badly clogged. ”

degrades, restricting its flow. A number of undesired things can happen as a result:

- **Energy waste:** Recently reported data has shown that the amount of energy needed to operate an appliance can increase by as much as 90% to 100% if the coils are badly clogged. For example, for four differing reach-in commercial refrigeration and freezer units, this translated to yearly energy waste per unit ranging from about 2,000 kWh to 5,700 kWh. Cleaning the coils of these coolers resulted in energy savings from about 46% to 50%. A summary of the energy savings for a slightly larger data set of 10 units suggested that an average anticipated savings of about 20% might be more reasonable.

- **Malfunction of the unit:** If the unit runs with clogged coils, the owner may face an emergency service call, which can be very expensive. It may involve removal of the refrigerant gas and a teardown of the system. Such expensive servicing can lead to four to six hours of labor. In extreme cases, the unit might need to be replaced. Frequent condenser-coil cleaning can dramatically reduce these emergency service events since the unit will run more efficiently as designed.

- **Loss of product inventory:** If the unit begins to malfunction, it may not be able to maintain the target temperature within the enclosure being cooled, leading to compromise of the integrity of the items being refrigerated.

- **Shortening of the life of the unit:** Malfunction of the appliance can also lead to a shortening of the useful life of the unit.

- **Safety issues for hydrocarbon refrigerant units:** There is a powerful movement to replace HFC refrigerants, which are potent greenhouse gases, with natural refrigerants such as propane (R290). This type of refrigerant is highly flammable and can be problematic in indoor locations unless certain safety measures are followed. One refrigeration safety expert has counseled that R290 refrigerant units need to

have their condenser coils in a clean condition along with constantly running fans in the condenser-coil area to promote good ventilation. This is good advice.

CLEANING OPTIONS

Mere surface brushing and vacuuming of the condenser-coil structure will remove the surface matting of dust/debris but doesn't get at the clogging occurring within the interior of the structure. It is not recommended if the intent is to do a thorough job.

Specialized coil-cleaning brushes are available that allow vacuuming of the deeply embedded dust/debris. But use of these implements greatly increases the time needed to get the cleaning job done.

For decades, knowledgeable technicians have resorted to the use of compressed air to very quickly blow out clogged condenser coils, especially the deeply embedded material. However, doing this in indoor locations, requires effective capture of the blown-off debris to insure that no collateral contamination is caused.

Until recently, technicians using compressed-air coil cleaning have resorted to a damp fabric or large garbage bag to try to catch the debris blown out of the coils. These primitive items both have serious deficiencies.

The damp fabric, which is applied to the side of the coil unit opposite the input of the compressed air, in many cases might not stay in place during the cleaning, causing undesired collateral pollution that requires further clean up. If it does remain in place, the technician has to contend with a thoroughly polluted, damp article requiring cleanup or disposal. Cleaning a large number of units in a preventative-maintenance scenario is not well served by the use of a damp fabric.

The use of a large garbage bag to attempt to catch the blown-off debris commonly would require two technicians, one to hold the bag, the other to do the blowing. This method also can allow some of the blown-off debris to miss the open end of the bag being held. While a single operator can use this method, the bag needs to be taped or affixed to the coil structure, which slows down the cleaning operation.

Alternatively, a dust-containment hood, placed over compatibly sized coils, traps the blown-off debris as the coils are subjected to a blast of compressed air supplied through one port in the hood. At the same time, the debris is removed via a vacuum hose placed through another port. With this approach, a technician can clean clogged condenser coils with compressed air without fear of polluting the surrounding area. ■ RF

PICKING THE RIGHT COMPONENTS

HVAC&R system developers can optimize the safety and efficiency of natural refrigerants through proper design and selection of switches and sensors

– By William Bentley

Governments around the world are increasingly mandating that equipment manufacturers migrate to chemicals that do not adversely impact the environment. In the refrigeration/cooling arena, this means replacing the old classes of chemical refrigerants such as CFCs, HCFCs and HFCs with green refrigerants that do not deplete the ozone layer or have a potent impact on global warming.

These alternative types of refrigerants are naturally occurring, non-synthetic substances that can be used as cooling agents in refrigerators and air conditioners, and include hydrocarbons (propane and isobutane), CO₂, ammonia, water and air.

For OEMs building refrigeration and air conditioning systems, new regulations bring new challenges, not only for selecting the best type of refrigerant for a given application, but also for selecting components that can handle a specific refrigerant's technical challenges and performance characteristics.

Regardless of the refrigerant you choose, every option comes with its own set of technical challenges for OEMs and component manufacturers to overcome – not least in the types of pressure switches and sensors that can be used, and how they are designed and tested.

DEALING WITH THE PRESSURE

Every component in today's systems is specified to certain operating conditions and pressure ranges. While CO₂

“ In researching the effects of natural refrigerants on their systems, OEMs need to know if the pressure switch has been tested with the specific refrigerant that they are planning to use. ”

is not combustible like hydrocarbons, it operates at a higher pressure almost twice the typical pressure level in a modern air conditioning system. This necessitates designing specialized components such as pressure switches to ensure reliable operation in applications where CO₂ is used, which in turn affects product manufacturing.

Some beverage manufacturers, for example, are now requiring their beverage cooler vendors to switch from R134a to CO₂. Because of the higher pressure running through the entire system with CO₂, these cooling units now need a pressure switch incorporated for safety, and if they cannot be retrofitted, they need to be replaced with new units. In addition to the safety challenges, CO₂ also operates less efficiently compared to hydrocarbons, requiring more electricity to achieve the same heating or cooling power.

Pressure switches in CO₂ refrigeration systems protect against a high-pressure burst or over-pressure situations that could cause coils to rupture. When the pressure builds up to a certain point, the switch opens the electrical contact and turns off the compressor – the heart of any refrigerating system. When the pressure drops back down to normal levels, the switch automatically puts the compressor back on.

Since a switch is an electromechanical device, it can spark when its contacts make or break, and this, of

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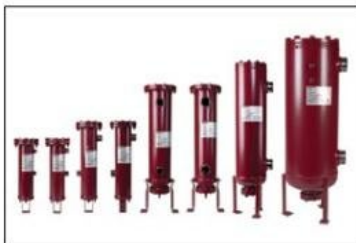
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course, can be dangerous for flammable refrigerants like hydrocarbons. To prevent a spark from accidentally causing ignition of hydrocarbon refrigerants, component designers have built extra safety into their pressure switches with a sealed design that “seals the spark” by isolating the specific pressure media (such as propane) from the electrical switch assembly.

To that end, each switch is manufactured with a hermetic seal around the gas path as well as a sealant around the electrical connections. In addition, the electrical connections tell the system whether the switch is open or closed. This safety design completely eliminates the potential for explosion by stopping the gas from entering the electrical switch compartment where sparks can be generated.

In researching the effects of natural refrigerants on their systems, OEMs need to know if the pressure switch has been tested with the specific refrigerant that they are planning to use. With propane, for example, they need to know the maximum current level of the switch that prevents an arc from igniting the refrigerant, and whether it meets the required pressure actuation point and switch point.

For CO₂ systems, operating with twice the pressure of conventional systems, the big concern is burst pressure. What kind of high pressure can it withstand? How long will it reliably operate under sustained high-pressure environments?

Whichever switches you choose for your system, make sure they have been rigorously tested by an authorized external agency to withstand the conditions to which they are being exposed, and the refrigerants with which they have to operate.

SYSTEM FEEDBACK

In environments where system-pressure information is required, a pressure sensor, as opposed to a switch, is needed. A pressure switch is strictly for

safety; in contrast, a pressure sensor provides real-time monitoring, system automation and maintenance information.

If the goal is to maintain pressure within a constant range, the pressure sensor can be used to regulate the system. For example, if the pressure goes outside the normal operating range in a supermarket, a pressure sensor could provide feedback that could activate the pressure switch and/or turn the condenser system on or off to bring the pressure within the specified range. The pressure sensor could also notify a technician or maintenance organization for a more permanent fix. This could be a simple local alert or it could send an alert via the cloud to the appropriate person or company.

Many system OEMs could also use the data generated by a pressure sensor to understand how their HVAC and cooling systems function over time, and increase their energy efficiency.

Given the changes in refrigerants being used around the world, it is clear that natural refrigerants are important to the future landscape of the industry. As OEMs research their choices, component manufacturers must meet the design challenges posed by these non-synthetic refrigerants in order to optimize safety and efficiency.

■ WB



William Bentley

is an engineering director at Sensata Technologies, where he leads teams that design and develop pressure transducers for the global industrial, HVAC and refrigeration markets. He has 20 years of experience in developing electromechanical safety products.

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Big Opportunities for Low-Charge Ammonia

But cost and industry inertia remain barriers to adoption, says shecco speaker at IIAR Conference

— By Mark Hamstra

Readers are invited to participate in a survey on low-charge ammonia technology here: <https://bit.ly/2qqLENj>

Low-charge packaged ammonia refrigeration systems are gaining momentum in the U.S., although costs remain a constraint for some potential users, according to a presentation at the International Institute of Ammonia Refrigeration (IIAR) 2018 Conference & Expo in Colorado Springs, Colo., last month.

The presentation was delivered by Derek Hamilton, VP of business development at shecco America, publisher of *Accelerate America*.

Supermarkets, craft breweries and small wineries are among the businesses that hold “huge potential” for the installation of low-charge packaged ammonia applications, he said. Another area with potential in the U.S. is the HVAC market, where ammonia has long been used in Europe. Centralized systems used by cold storage and food-processing facilities are also being redesigned to dramatically cut the amount of ammonia used.

Citing research conducted by shecco, Hamilton said the ammonia refrigeration industry has an opportunity to reach these markets if it can offer systems that are cost-competitive with the conventional refrigeration systems users currently deploy.

“One of the challenges for wineries and breweries is that these are often very cost-driven markets,” Hamilton said. A grape farmer that opens a small winery,

for example, “doesn’t want to spend a premium on his refrigeration system for the wine-making part of his business.”

Live polling of the audience during the presentation revealed that 40% of attendees believed that cost was the biggest barrier to adoption of low-charge ammonia technology, followed by inertia in the industry at 31%. The lack of credible performance analysis and a lag in the adoption of codes and standards were each seen as barriers by 13% of respondents.

In addition to concerns about costs, some users continue to worry about potential safety concerns with ammonia systems, Hamilton said, though low-charge systems reduce the risk posed by ammonia leaks.

An ammonia leak last year at an ice rink in British Columbia resulted in the deaths of three people, which prompted calls for the banning of ammonia as a refrigerant in Canadian ice rinks.

“Unfortunately, there’s been a lot of negative publicity,” Hamilton said. “When there are injuries or fatalities related to ammonia systems, it really doesn’t help the image of ammonia.”

He said the industry is working hard to educate people about the safe use of ammonia and “to show that it’s actually a very safe refrigerant when used properly.”

Responding to a question after his presentation about whether supermarkets might be concerned about using ammonia in areas where food is stored, Hamilton said the risks have been minimized by the advent of smaller charges and the sequestration of ammonia on the roof (with a secondary fluid used in the store), along with gas detectors and other controls.

REGULATORY UNCERTAINTY

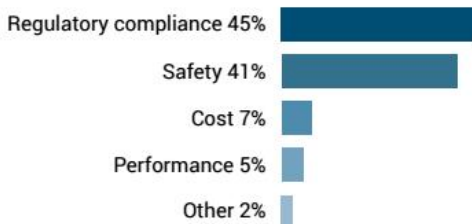
A significant challenge facing the industry in the U.S. is the uncertainty around the federal regulatory environment, Hamilton said. It remains unclear, for example, whether the U.S. will support the Kigali Amendment to the Montreal protocol, which calls for the phase-down of HFC refrigerants that have a high global warming potential (GWP).

Such a phase-down is seen as boosting the potential market for ammonia systems, which have a GWP rating of zero.

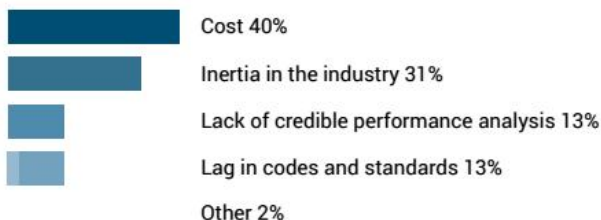
Meanwhile, states such as California have taken the lead in seeking to reduce emissions, which Hamilton said was “very encouraging.” He cited the efforts of the California Air Resources Board (CARB), which is seeking to reduce greenhouse gas emissions to 40% below 2013 levels by 2030, and new legislation introduced by State Senator Ricardo Lara, called the California Cooling Act, that incentivizes the transition to environmentally friendly refrigerants.

Low-Charge Ammonia Trends*

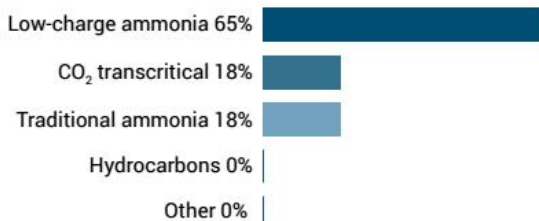
What is the primary driver for the adoption of low-charge ammonia technology?



What is the biggest barrier to wider adoption of low-charge technology?



Which technology is the future for refrigerated warehousing in North America?



* Based on polling at the 2018 IAR Natural Refrigeration Conference & Expo

sheccoBase

CARB has also proposed a ban on new stationary equipment using any refrigerant with a GWP above 150 by 2020.

"That's an ambitious target, and this is where the ammonia industry and other natural refrigerants really are going to have to step up to help California meet those goals," said Hamilton.

As high-GWP refrigerants have been phased down in Europe and elsewhere, the costs of these refrigerants have been rising, Hamilton said. Their cost quintupled in 2017, and could be 20 times more expensive in 2018. These cost increases are helping drive demand for alternative refrigerants such as ammonia.

"This is exactly the trend that we will expect to see in California when some more regulations come in," said Hamilton, noting that the trend is expected to eventually expand to other states as they adopt similar regulations.

Nearly half — 45% — of Hamilton's audience during live polling said regulatory compliance was the primary driver for low-charge ammonia systems, followed by safety at 41%.

MOMENTUM NEEDED

In order for the industry to capitalize on the burgeoning opportunity for low-charge ammonia refrigeration systems, contractors need to get on board, Hamilton said.

"There's a lot of feeling out there that the ammonia industry has been plodding along for decades and decades and doing the same old thing," he said. "There's some reluctance to change."

shecco's research shows that there may be some reluctance in the

contractor community to embrace low-charge packaged ammonia systems because they are concerned that such systems are not as profitable, Hamilton explained. However, "just as many people are saying if the contractors don't get on board and look at this new technology, then they're going to regret it in the future," he said.

In addition, it can be difficult to demonstrate the efficiency of low-charge packaged ammonia systems for end users because there have been so few deployments.

"As we get more and more low-charge packaged ammonia systems out there, we will get more reliable data," Hamilton said. "That's going to help really put this question to bed, but in the meantime, we're relying a lot of the time on claimed performance, and that's not really a great place to be."

There has been some testing of low-charge and packaged ammonia systems in laboratories, which should yield some reliable data that demonstrates the efficiency of these systems, Hamilton said.

Changes in the business models of refrigerated warehouses could also present opportunities for low-charge ammonia systems, he said. While these facilities historically have been small, family-owned businesses that held long-term contracts, increasingly they are being taken over by investment firms that execute short-term contracts that might require dividing their facilities into separate rooms with different temperatures.

That kind of operation is a strong candidate for the use of packaged ammonia systems, Hamilton explained. ■ MH

CALIFORNIA ADOPTS U.S. SNAP REGS ON HFCs

Air Resources Board preserves EPA rules prohibiting use of high-GWP HFCs, which were vacated in court decision last year.

— By Michael Garry



The California Air Resources Board (CARB) last month adopted a regulation prohibiting the use of high-GWP HFCs refrigerants, thereby maintaining in California the HFC prohibitions previously established by the U.S. Environmental Protection Agency (EPA).

Those EPA's HFC prohibitions, developed under its SNAP (Significant New Alternatives Policy) program, were curtailed last August in a decision by the D.C. Circuit Court of Appeals. That decision, a 2-1 ruling issued by a three-judge panel, said the EPA could not require incumbent users of HFCs to replace those refrigerants with more climate-friendly alternatives because HFCs, though powerful greenhouse gases, don't harm the ozone layer.

Honeywell, a maker of HFOs, an HFC alternative, has appealed the ruling to the Supreme Court, following the Appeals Court's refusal to rehear the case in January.

"[CARB's] action ... preserves the federal limits on the use of these powerful chemicals and refrigerants, and provides more certainty to industry," said CARB Chair Mary D. Nichols, in a statement. "We applaud the actions of many industries, which already have made significant investments in developing and using more climate-friendly alternatives to the high-global warming HFCs."

California is experiencing the effects of climate change and has committed to take action in order to meet state and federally mandated emissions reduction goals.

Under Senate Bill 1383 (SB 1383), a law authored by Senator Ricardo Lara in 2016, California must reduce HFC emissions by 40% below 2013

levels by 2030. This year, Lara introduced the California Cooling Act (SB 1013) to target HFCs and offer incentives for businesses and residents to switch to low-polluting air conditioning and refrigeration.

California already has established an approach to reduce short-lived climate pollutants (SLCPs), which include methane, black carbon and a range of powerful climate-changing chemicals, such as HFCs.

CARB was relying substantially on the EPA's SNAP rules to help meet California's emission reduction goals for HFCs, which in turn are important to ensure California meets its overall greenhouse-gas emission goals. "As a result of the recent court decision, California had to pass its own regulation to ensure it could meet those goals," CARB said in a statement.

CERTAIN END USES

The new regulation affects certain stationary refrigeration and foam end-uses. It preserves emission reductions from specific sectors with past or shortly upcoming compliance deadlines and will "prevent manufacturers from backsliding to start using high-global warming HFCs again," said the CARB statement. CARB noted that most manufacturers already have transitioned, or begun the transition, to alternatives that have less of an impact on climate change.

The regulation that CARB adopted applies mainly to equipment manufacturers, which cannot use prohibited HFCs in new refrigeration equipment or foams. Prohibited HFCs cannot be used in new equipment and materials in California for the following end-uses:

- ▶ Supermarkets and remote condensing units used by convenience stores;



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- ▶ Refrigerated vending machines; and
- ▶ Foams used in buildings and other places.

The regulation will lead to an estimated 3.4 million metric tons of CO₂e emission reductions annually by 2030. "While more reductions are necessary for California to meet its legal mandate imposed by SB 1383, this regulation is a good start," said CARB.

Christina Starr, climate policy analyst for the Washington, D.C.-based Environmental Investigation Agency (EIA) sees CARB's decision to incorporate SNAP rules having national impact. "California is a significant portion of the U.S. market, not to mention that other states could follow their lead in the not-so-distant future. It sends a strong signal to other states that are actively considering ways to contribute to U.S. climate action."

Starr also expects CARB's move to impact the economics of producing HFC systems for some manufacturers. "Smart companies recognize this trend continuing, and will focus even more on supplying and purchasing equipment that is designed for refrigerants they can continue to use well into the future," she said. ■ MG

U.S. BUDGET PROTECTS ENERGY PROGRAMS

Contrary to the aims of the Trump administration, the 2018 omnibus spending bill enacted by the U.S. Congress and signed by President Trump last month contained increases in funding for energy-efficiency programs at the U.S. Department of Energy (DOE) while maintaining funding for programs at the U.S. Environmental Protection Agency (EPA).

The bill, called the Consolidated Appropriations Act 2018, "disregards the draconian cuts proposed by the administration and instead upholds or increases investments in many federal programs that help consumers and businesses save energy," said Lowell Ungar, senior policy advisor for the American Council for an Energy-Efficient Economy (ACEEE), based in Washington, D.C.

In maintaining the previous budget for the EPA – rather than cutting it by one-third as proposed by the administration – the omnibus bill "contains no specific reference to funding restrictions" for the GreenChill Partnership, noted Christina Starr, climate policy analyst, Environmental Investigation Agency (EIA), Washington, D.C.

GreenChill, started in 2008, is a voluntary program aimed at helping supermarkets reduce refrigerant leaks and transition to climate-friendly systems that use natural refrigerants.

The bill specifically maintains current funding levels for Energy Star as well as SmartWay and other voluntary EPA programs that "give consumers and businesses the information they need to select energy-efficient products," said Ungar.

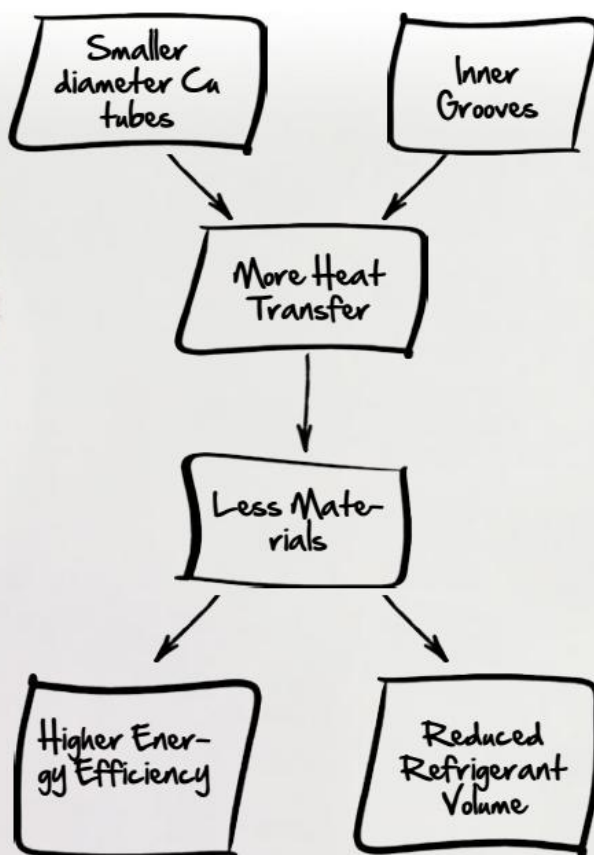
DOE programs saw increases in their budgets. The Office of Energy Efficiency and Renewable Energy (EERE) will experience an overall increase of 11%, including a 10% boost for the Building Technologies and Vehicle Technologies Offices.

DOE's Advanced Research Projects Agency–Energy (ARPA-E) program, which drives cutting-edge innovation in energy technologies got a 15% funding increase.

The legislation also includes 10% increases for the DOE's Weatherization Assistance Program, which helps low-income families and seniors make energy-efficiency home improvements, and the State Energy Program, which enables state governments to make investments in energy efficiency, renewable energy, and energy security.

The bill does cut DOE's Equipment and Building Standards Program (which includes the Building Energy Codes Program) by 7%, noted Ungar.

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Ammonia Regs in the Trump Era

IIAR is optimistic about influencing EPA; meanwhile, codes bodies are incorporating IIAR safety standards

— By Mark Hamstra

Taking advantage of the Trump administration's anti-regulation posture, the International Institute of Ammonia Refrigeration (IIAR) plans to engage with federal agencies to update regulations in ways that will both benefit the industry and augment safety, according to a presenter at the IIAR 2018 Conference & Expo in Colorado Springs, Colo., last month.

"The Trump administration's continuing regulatory reform efforts represent an opportunity to promote reform initiatives," said Lowell Randel, director of government affairs, IIAR, and principal, The Randel Group, one of three speakers at the IIAR conference's government affairs update.

Among the initiatives the IIAR is pursuing is the creation of a new category for aerosol ammonia among the chemicals regulated by the Environmental Protection Agency, Randel said.

Currently the EPA has set a 100-lb release of ammonia as the reportable threshold, or the minimum amount requiring notification of authorities. However, that figure was established based on a liquid ammonia release into a water supply and the potential damage to the environment.

"How many of you have been in a situation where there's a release that goes directly into a water source and impacted aquatic life? That's a pretty rare occurrence within our industry," said Randel.



The vast majority of releases from ammonia refrigeration systems are airborne, he noted, and dissipate into hydrogen and nitrogen in the atmosphere.

"We believe that we can make a case to the agency that we should create a new category for aerosol ammonia releases," said Randel, noting that there is precedent for segregating distinct forms of chemicals on the EPA's chemical list.

The IIAR is seeking to increase the reportable threshold to 500 lbs for aerosol releases, he said. That would limit the over-reporting of releases, which he said ties up resources both at the facility where a release occurs and among government agencies and responders.

The IIAR is also seeking to address the "immediate reporting" requirement for chemical spills, which is currently interpreted as within 15 minutes. While the IIAR supports this time frame for the notification of local authorities, it is an unnecessarily short window in which to contact the EPA's National Response Centers, which may be located far from the site of the release, according to Randel.

"It's our position that whether that call is made at minute 14 or minute 400, there's really not a lot that the NRC is going to do relative to that release," he said, adding that the IIAR is suggesting an eight-hour deadline for NRC notification.



IIAR is also seeking to raise the Immediate Danger to Life and Health (IDLH) limit for ammonia concentration, up to which responders can enter an area where a leak occurs with an air-purifying respirator (APR) mask. This threshold, currently set at 300 ppm, can safely be moved up to 500 ppm, and for up to 10 minutes in areas between 500 and 1,000 ppm, for the purposes of rescue or other emergency activities, according to Randel.

"We think that we can make the case that there have been situations where, had someone been able to enter at 500 parts per million, we could have avoided some negative health and life outcomes," he said.

Other initiatives the IIAR is pursuing include making changes in the pending EPA update to the RMP (risk management plan) rule, particularly a provision that would require facilities to hire an independent, third-party auditor in the event of a reportable incident. The rule also includes provisions about sharing certain information with government agencies, which has raised concerns about potential security risks, Randel said.

The RMP-update rule, which was created in the wake of a deadly ammonia fertilizer explosion at a plant in West, Texas, in 2013, was finalized shortly before President Trump took office and has been delayed until February of next year. Randel expects EPA to accept additional comments on the rule.

"We feel like there's going to be an opportunity for IIAR to play a lead role in communicating where we think this rule can be improved," said Randel.

One option under consideration to address the independent auditor issue would be for facilities to pay the EPA to conduct RMP audits itself. The challenge for some facility operators, especially those in rural areas, is finding qualified auditors that they have not done business with in the past two years, as required by the rule.

CODES AND STANDARDS

Several national industry code bodies have incorporated the IIAR's safety standards into their latest updates, according to Jeffrey Shapiro, president of International Code Consultants, and the code consultant for IIAR.

Speaking after Randel at the IIAR conference's government affairs update session, Shapiro said the IIAR has been successful in convincing these code organizations that ammonia should in many cases be treated differently from other refrigerants. By the end of this year, he said he hopes to have ammonia removed (by addendum) from the standard known as ASHRAE-15, prescribed by the American Society of Heating, Refrigeration and Air Conditioning Engineers.

"We've been laying the groundwork over the past several years to get out from under the umbrella of ASHRAE 15," said Shapiro.

Among other developments, ammonia is now excluded entirely from the 2018 Uniform Mechanical Code (UMC), he said, because the IIAR-2 standard includes all necessary information.

In addition, the International Fire Code (IFC) no longer references ASHRAE-15 for ammonia. One benefit of this is that users of ammonia systems will not be required to follow IFC requirements for emergency alarms and gas detection systems, which Shapiro said did not really apply to ammonia because of its unique properties. Instead, the alarm and detection issues as they relate to ammonia refrigeration are addressed in IIAR-2.

In the International Mechanical Code (IMC), Shapiro said the IIAR was successful in changing the requirements for ammonia leak detection.

The IMC has historically mandated that refrigerated process and storage areas have ammonia detection systems. The newest version of the IMC code continues to mandate that machine rooms have detection systems, but creates some exceptions for other areas. For example, it does not require detectors in any unoccupied pipe area without valves, or in industrial areas (other than machine rooms) that are always occupied and have an alternative to fixed detection equipment, such as an emergency action plan.

IIAR was also successful in changing the IMC to permit the use of certain low-risk pumps outside of machinery rooms, and in allowing machinery rooms on process floors to not have direct egress to outside the building. It also changed the definition of a machinery room so that such rooms only have to meet machinery room regulations under certain conditions, not merely because of the presence of refrigeration equipment.

Another change in the IMC involves the requirements for industrial spaces that are chilled with brine as a secondary refrigerant. While previously the IMC required that such spaces be treated as industrial, even though brine does not behave like a refrigerant in terms of undergoing a phase change, the updated IMC exempts brine from these requirements.

The National Fire Protection Association's National Electrical Code (NEC) no longer requires adequate ventilation in process and storage areas of facilities that use ammonia in order

for those areas not to be considered hazardous (classified). The NEC refers users to IIAR-2, which states that ventilation is not required in process and storage areas.

Among the proposals that the IIAR is looking at for the 2021 codes is the elimination of the requirement for emergency pressure and control systems for outdoor NH₃ equipment. The IIAR is also proposing that operators not be required to conduct fire and environmental impact analyses for emergency releases of ammonia into the environment, as currently required. Instead they would only need to conduct a health analysis. The IIAR is also suggesting that the code not require the services of an engineer for such an analysis.

IIAR is also seeking to have the 2021 IMC put IIAR-2 on par with ASHRAE-15 for ammonia refrigeration, or to defer to IIAR-2 completely, following the example of the UMC. ■ MH

HAVE YOU REGISTERED WITH DHS?

Any facility that stores, manufactures or distributes ammonia above a certain threshold is required to register and report their holdings with the U.S. Department of Homeland Security.

In a government affairs update last month at the International Institute of Ammonia Refrigeration (IIAR) 2018 Conference & Expo in Colorado Springs, Colo., a DHS representative outlined the steps that such facilities must take.

James Williams, chief of regulatory compliance for Region VIII of the DHS Office of Infrastructure Protection, said it is important for the industry to make operators aware of the requirement so that the DHS can ensure that the facilities are taking adequate steps to prevent a terrorist attack.

"One of the main things we want to avoid is for that facility to have to come to the top because of an incident," he said. "We don't want them on the 10 o'clock news."

DHS requires that facilities with 20,000 lbs or more of ammonia at a concentration of 20% or higher, or with 10,000 pounds or more of anhydrous ammonia at concentrations of 1% or higher, register with the DHS Chemical Facility Anti-Terrorism Standards (CFATS) program and fill out what's called a Top-Screen online at <https://csat-registration.dhs.gov/>.

The information in the Top-Screen is used to determine the risk posed by the facility. Those considered to be at risk are placed into one of four tiers, based on the degree of risk. If a facility is placed in one of the tiers, it must then conduct a security vulnerability assessment (SVA) and a site security plan. An SVA takes into consideration factors such as the location of the facility, the location of the ammonia storage within the facility and other factors.

Then, DHS visits the facility and goes over the security plan, which, once approved, must be followed by the facility.

CFATS also has a personnel surety program, which is designed to vet people who have access to ammonia and other chemicals of interest against a terrorism screening database.

Operators who have questions or need help can contact the CFATS help desk at 1-866-323-2957 or csat@dhs.gov.



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A man in a blue and white checkered button-down shirt and blue jeans stands in the center of the frame. He is positioned in front of two large, blue industrial storage vessels. The vessel on the left is labeled 'V-10' and 'LT TRANSFER'. The vessel on the right is labeled 'V-9' and 'HT TRANSFER'. Both vessels feature a yellow diamond-shaped hazard label with the number '3' in a red triangle and '0' in a blue triangle. The background shows a complex network of pipes, valves, and other industrial components, all in a clean, industrial setting.

HOW LIBERTY COLD STORAGE GOT ITS AMMONIA CHARGE DOWN

The Chicago-area operator invested in a low-charge DX system configured to use less than 10,000 lbs of NH_3 , for both low and medium temperatures

— By Michael Garry

When Western Liberty Foods, an Iowa-based meat processor, opened a cold-storage facility in Illinois in 2015, it decided to use a lot less ammonia for refrigeration than it employed at its four processing plants.

Those plants have vast quantities of NH₃ in a liquid-overfeed process, including one facility in Illinois that holds 80,000 lbs of the hazardous refrigerant. By contrast, the cold-storage plant it opened, Liberty Cold Storage, located in Bolingbrook, Ill., near Chicago, uses 7,500 lbs to refrigerate West Liberty's meats and an array of produce, desserts and other third-party foods.

The Liberty Cold Storage plant, which underwent a 123,000-sq-ft expansion completed in early 2018, now encompasses 253,360 sq ft, and its ammonia charge supports a capacity of 928 TR, with a ratio of 8.1 lbs/TR. (See [System Specs](#), page 39.)

This is a much-reduced amount of ammonia and keeps the charge under the 10,000-lb threshold, above which cold storage plants need to abide by strict regulations mandated by the Environmental Protection Agency (risk management plan), the Occupational Health and Safety Administration. (process safety management), and the Department of Homeland Security (chemical facility anti-terrorism standards).

How did Liberty Cold Storage get its charge down?

One of the ways that cold storage operators are reducing their ammonia charge is to install one or more low-charge packaged systems, either on a rooftop or on the ground outside. At the IAR Natural Refrigeration Conference & Expo (see

[page 42](#)), a slew of manufacturers displayed these systems, including Hillphoenix/NXTCOLD, Evapco, Stellar, Zero Zone, Vilter, GEA and Azane.

KPAC General, a South Gate, Calif., cold-storage operator, last year installed eight ultra-low-charge packaged ammonia units from NXTCOLD on the roof of its new plant. (See ["KPAC General Embraces Ultra-Low-Charge Ammonia," Accelerate America](#), March 2018.)

But another approach – the one implemented by Liberty Cold Storage – is to keep the stick-built, central-engine-room format traditionally used by industrial operators, but employ a DX (direct expansion) evaporator from Colmac Coil Manufacturing for both medium-temperature and low-temperature applications.

DX evaporators, which require much less ammonia than an overfeed system, have been used for medium-temperature applications but not for low-temperatures. However, Colmac Coil, based in Colville, Wash., came up with a design (called ADX or Advanced DX) to make them work with low temperatures.

Colmac Coil has installed, since 2014, 47 ADX systems around the world, mostly in the U.S., with several in Australia; this includes 16 new facilities and 31 retrofits and expansions, and in some cases multiple installations at the same facility. Thirty-five more installations are expected this year, said Patty Smith, Colmac Coil's marketing department manager.

In addition to Liberty Cold Storage, other users of the Colmac system include Joliet Cold Storage, Preferred Freezer Services, Shepherd's Processed Eggs, U.S. Cold Storage, Bidvest Australia and Conestoga Cold Storage.

TIM COX
Liberty Cold Storage

Photography by: Alyssa Schukar

Liberty Cold Storage, Bolingbrook, Ill.



GUIDANCE FROM CONTRACTOR

Tim Cox, vice president at Liberty Cold Storage, who previously spent nine years at parent West Liberty Foods, made the decision to invest in the Colmac Coil ADX evaporators, with direction from his refrigeration contractor, AMS Mechanical Systems, Woodridge, Ill. In particular, Cox was helped by industry veteran Rick Watters, AMS' VP refrigeration/food process piping who has been with the company almost 35 years. In his spare time, Watters teaches an "Introduction to Ammonia Refrigeration Class" to pipefitters.

Watters designed and installed one of the first ADX installations at another Chicago-area warehouse, Joliet Cold Storage, Joliet, Ill., in 2014, and since then has followed suit at other plants, including Liberty Cold Storage. "We try to partner with the right people and let them teach us," Cox said. "Rick took us through [Joliet Cold Storage] with the building contractor [United Insulated Structures]. It just seemed like the right fit. We went with his recommendation and it's worked out well."

The number one priority was "less ammonia in the facility," acknowledged Cox. "Being under the 10,000 pound mark was important to us," though he still has a PSM program.

The ADX system could have used 800 lbs less ammonia if it didn't incorporate thermosyphon oil cooling, but the alternative would have been costly, said Watters.

The ADX system primarily reduces the ammonia charge by dint of the patented design of the evaporator. According to Bruce Nelson, president, Colmac Coil, the internal surface of the evaporator tubes has a "wicking structure," which produces "sufficient capillary pressure to cause liquid ammonia to completely coat the inside of the tubes," he said. "Otherwise, the liquid falls to the bottom of the pipe, with incomplete wetting."

Watters likened the grooves inside the tubes to that of a rifle barrel, enabling the ammonia to rotate 360 degrees through the length of a tube like a spinning bullet, and thereby enhancing the heat transfer.

The other part of the evaporator system that lowers the charge is a distributor that optimizes the flow of ammonia throughout the tubes. "What the distributor does is it allows each tube to get the same amount of liquid as the others," said Watters.

Cox thinks the ADX system "makes more sense in how it delivers ammonia to the evaporator and gets on coils versus a traditional system."

The technology behind this evaporator is actually not new, but Colmac Coil found a way to harness it differently in the ADX unit to reduce the amount of ammonia needed, noted Watters. According to Nelson, the ADX evaporator decreases the ammonia charge by 30-50 times compared to an overfeed system.

By reducing the ammonia charge, the ADX system becomes simpler to manage than a traditional system, said Cox. "The engine room seems simpler when you compare the two for me. It sends out the liquid ammonia that the system needs instead of over-pushing it and bringing it back wet. With ADX it all comes back as a gas."

The ADX system also uses smaller vessels that reduce the amount of ammonia held and eliminate the liquid ammonia pumps used in recirculated systems along with "valving, regulators, reliefs and electrical," said Watters.

"To me, [the ADX system] is simpler to operate," said Watters, pointing to the ease of restarting the system after a power failure. "It's as easy as flipping on a light switch."

Preventive maintenance is handled by AMS, which monitors the system remotely and visits the plant every other week. "For this system I don't need someone on site – AMS supports it," said Cox.

For Watters, the maintenance of the ADX system "is no different than what it is for a conventional ammonia system," though for technicians not familiar with it, the ADX technology would require some training.

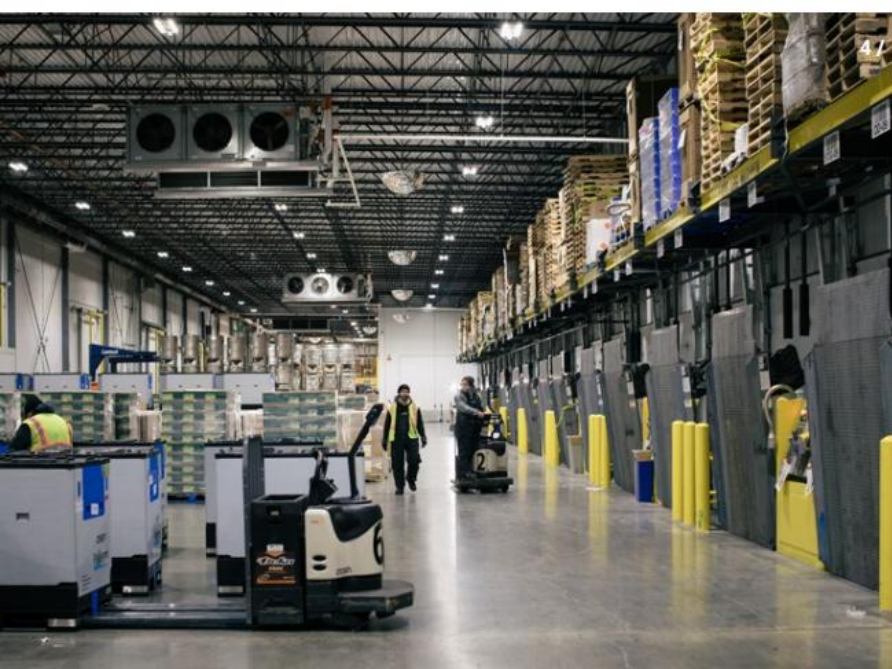
One caveat for the ADX system, noted Watters, is the need to use water-free (anhydrous) ammonia and evacuate the system after servicing "so the system is as dry as possible."

SAFETY FIRST

Ammonia, particularly in large quantities, remains a hazardous chemical; last year a leak at an ice rink in British Columbia caused the death of three technicians. Thus, reducing the charge is an important safety consideration for cold storage operators like Liberty Cold Storage.

BAC evaporative condensers above the engine room





- 1 / Penthouse DX evaporators
- 2 / DX evaporator tubes
- 3 / High-side pilot valve
- 4 / Dock area
- 5 / Hanging DX evaporators in dock area

To enhance the safety of the system, most of the 32 evaporators used at Liberty Cold Storage are housed in penthouse enclosures on the roof of the building, blowing cold air through ducts into the cooling areas. (The exception is the dock and a small cooler, which use hanging evaporators) In this way they resemble low-charge packaged units, except that the latter contain all of the refrigeration equipment, not just the evaporators.

With penthouse evaporators on the roof, “no ammonia is in the room itself,” noted Cox. That means they are out of reach of forklifts that may bump into a hanging evaporator. The penthouse evaporators “are a little more expensive but you see more people going to them, just from a safety standpoint,” he added.

A major leak in the penthouse units could still spill into the refrigerated space through the ducts, but a small leak “would just go up in the air,” said Cox.

In addition to safeguarding employees, the lower ammonia charge helps keep stored products out of harm’s way, which aligns with the overall design of the building. “When we built Liberty Cold Storage, we tried to build with the idea of food safety and food security inside and outside the building,” said Cox. “And give people peace of mind that we have control of the product.”

While Cox wants to reduce the amount of ammonia he uses, and recognizes its potential toxicity, he still appreciates its value as an environmentally friendly natural refrigerant with a GWP of zero. “We did not want a Freon system,” he said. Liberty Cold Storage also prides itself on sending less than 1% or its waste to landfill.

COST ADVANTAGE

In terms of cost, Cox saw “an advantage on price,” with the ADX system being a little less expensive (in equipment plus installation) than a liquid-overfeed system. According to Nelson, what is helping to drive adoption of the ADX system is its lower cost – 2% to 5% less than that of a traditional overfeed system.

Watters calculated that the Joliet facility’s ADX system cost 2.4% less than a liquid-overfeed system, a savings of \$100,000. “We priced it both ways,” he said.

Comparable low-charge packaged ammonia systems are regarded as more expensive than the ADX system – two-to-three times more, said Nelson. Watters agreed that packaged units would be expensive in a new building, but could fit well in an expansion “where you don’t have enough room in your engine room.”



1 / Frick screw compressors in engine room
2 / Accumulators (large blue vessels) flanking transfer system (small blue tanks); and yellow controlled pressure receiver



▶ Saving energy was another consideration for Cox. In a presentation with Nelson at the Global Cold Chain Expo in Chicago last year, Watters provided an energy-usage analysis that compared the Liberty Cold Storage and Joliet plants with a Chicago-area facility that uses a liquid-overfeed system. In 2015, the Joliet plant used 38% less power (annual average power/sq ft) than the liquid-overfeed facility while Liberty Cold Storage (which does blast freezing in its main freezer) consumed 18% less. (The ADX plants employed VFDs for evaporator fan motors while the overfeed facility did not.)

"We saw the benefits with the cost of energy," said Cox, adding, "We're trying to raise the bar by being more efficient with energy and having less ammonia."

Liberty Cold Storage's landlord, from whom it is leasing the building, received an energy rebate from ComEd for the

overall efficiency of the building.

TAKING A RISK?

A few concerns Cox initially had about the ADX system was its relative newness (its first installation was in 2014) and the fact that Liberty Cold Storage was one of the larger facilities where ADX had been installed to that point. He perceived the long-term effectiveness of the evaporation units as a "risk over traditional systems."

But Watters believes the long-term viability of the ADX system is the same as any recirculated ammonia system. "Ninety-eight percent of it is already known technology that was married together for ammonia," including the enhanced evaporator tubes and optimized distribution in the tubes, he said. The only part that has not been tested over time is the electronics, but that has developed "in leaps and bounds over the last 10 years."

In effect, what Colmac Coil did was like taking the elements of a Ford Model T and "building a Ferrari," said Watters, who builds and races drag racing cars on the side.

So far, after some initial tweaking of the controls for the pulse-width thermostatic expansion valves (TXVs) and other typical start-up adjustments, the system has run "great," said Cox. "I'd do it again if we were to build another cold storage facility."

Watters sees the low-charge movement as a good direction for the industrial refrigeration industry. "The less ammonia, the better, period," he said. "There's always risk, so why not minimize the risk?" ■ MG



**LEFT**

H.A. Phillips transfer vessels, which channel liquid ammonia to controlled pressure receiver

BELOW

Ammonia gas detectors

COLD PASTEURIZATION

In addition to cold storage, Liberty Cold Storage in Bolingbrook, Ill., employs a high-pressure cold pasteurization process to eliminate bacteria and "extend shelf life," said Tim Cox, the plant's vice president.

To achieve those ends, the process subjects foods packaged in semi-rigid sealed plastic to 86,000 psi of water pressure. "We do vegetables, diced vegetables, juices, and deli meat," he said.

The temperature of the water is controlled so that it remains cool. Pasteurizing with heat, Cox noted, could destroy the nutritional content of some foods, which is why this process is used.

"It's not that common in cold storage," he said, adding, "We pride ourselves on food safety."

**SYSTEM SPECS**

The Colmac Coil ADX system at Liberty Cold Storage, Bolingbrook, Ill., has these characteristics:

- ▶ Total warehouse space: 253,360 sq ft
- ▶ 30,000 pallets
- ▶ Two freezer rooms (-5°F)
- ▶ Convertible room (-5°F to 35°F)
- ▶ Two cooler rooms (35°F)
- ▶ Two processing rooms (40°F)
- ▶ Dock (40°F)
- ▶ Total capacity: 928 TR
- ▶ Total ammonia charge: 7,500 lbs
- ▶ Charge/capacity ratio: 8.1 lbs/TR
- ▶ 32 ADX Colmac Coil evaporators (penthouse and hanging)
- ▶ Two BAC low-charge evaporative condensers on the roof above engine room.
- ▶ Five Frick screw compressors; single-stage economized; -15°F suction; 20°F economizer port; and 95°F discharge.
- ▶ Stainless steel piping to evaporators
- ▶ Thermosyphon oil cooling
- ▶ H.A. Phillips transfer vessels
- ▶ Controlled pressure receiver
- ▶ 15°F and 20°F low-charge accumulators
- ▶ Two nickel-brazed liquid subcoolers from Alfa Laval
- ▶ Hansen pulse-width TXVs
- ▶ Hot-gas defrost, including under-floor heating with glycol
- ▶ Allen Bradley PLCs programmed by AMS Mechanical Systems
- ▶ Calibration Technologies Inc. ammonia detectors

AHR Expo Roundup, Part 3

More coverage of CO₂ and hydrocarbon developments at the giant event

— By Michael Garry and Charlotte McLaughlin

At the AHR Expo in Chicago in January, there were 2,155 exhibiting companies occupying over 534,000 sq ft of floor space, including many featuring products or services related to natural refrigerants. Typically, these exhibitors increased the scope of their natural refrigerant equipment from previous expos.

In this third account of natural refrigerant exhibitions at the AHR Expo, *Accelerate America* covers three natural refrigerant component manufacturers, Baltimore Aircoil, Carel and Eliwell Controls

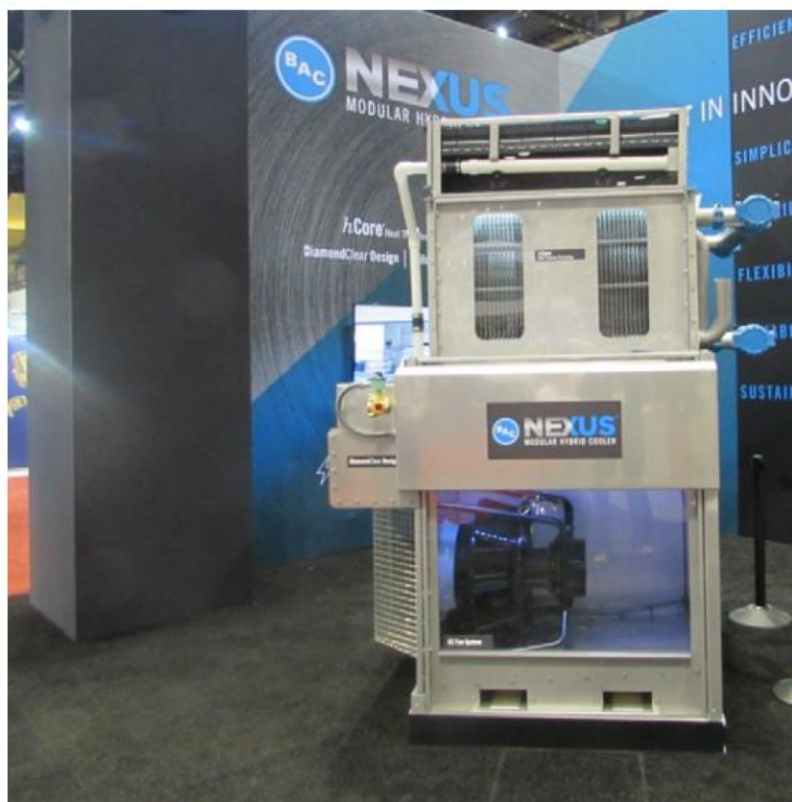
(For the first two installments, see [“AHR Expo Roundup,” Accelerate America, February 2018](#), and [“AHR Roundup, Part 2,” Accelerate America, March 2018](#).)

BAC'S MODULAR HYBRID FLUID COOLER

Baltimore Aircoil Company (BAC), Jessup, Md., has introduced a modular hybrid fluid cooler, called Nexus, that can be employed with a transcritical CO₂ refrigeration system, as well as in HVAC and light industrial applications.

The stainless-steel Nexus, which was unveiled at the AHR Expo, took five years to develop. It has a modular design that can range between one and six modules, depending on capacity, noted Paul Noreen, BAC's director of sales for North America.

When the Nexus fluid cooler is used with a transcritical CO₂ system, the CO₂ rack is fitted with a brazed plate heat exchanger, explained Noreen. CO₂ gas from compressors condenses (or cools, depending on the ambient temperature) in the heat exchanger, with heat removed by water pumped from the fluid cooler on the roof. The fluid cooler in this scenario replaces a condenser/gas cooler on the roof.



1 / BAC's modular hybrid fluid cooler

2 / Eliwell banner at AHR Expo



The hot water brought back to the roof is cooled in the hybrid fluid cooler, either by water sprayed on a BAC-developed "hCore" heat exchanger or by air when the ambient temperature is less than 60°F.

This scenario is especially suited for a grocery store on the ground floor of a multi-story building, Noreen said. "CO₂ pipes can hold 1,200 pounds of pressure, and you probably don't want those running through somebody's apartment. It's a lot safer to run water with 30 pounds of pressure."

The Nexus system in concert with a compressor rack heat exchanger uses less CO₂ refrigerant, he said, adding that the Nexus requires 40% less water than a typical fluid cooler.

In addition, the Nexus, which can also be used inside a building, offers "more capacity in a smaller footprint," said Noreen. The units are up to eight feet shorter in height, 40% smaller in footprint and 35% lighter in weight than traditional fluid coolers, said BAC.

The modular makeup of the Nexus allows it to be brought to a rooftop in a freight elevator instead of with a crane, he noted.

The Nexus system could also be used in a water-loop application for propane self-contained display cases.

CAREL'S HECU CO₂ CONTROLLER

Italian component maker Carel is working on bringing its CO₂ condensing unit controller, Hecu Sistema, to the U.S.

Carel is "open to partnering" with OEMs in the U.S. to bring the Hecu to market, and is "in talks with a few," said Brandon Marshall, application manager – refrigeration, for Carel USA, Manheim, Pa., at the AHR Expo. It is designed for condensing units used in convenience stores, small grocery stores and quick-service restaurants. CO₂ condensing units, prevalent in Japan, are rare in the U.S. convenience store market.

The Hecu system, which debuted in 2016, works with a BLDC inverter to manage a DC compressor in a CO₂ condensing unit, and oversees the CO₂ high-pressure and flash-bypass valves. It also oversees with the Carel's MPXPRO case controller that controls electronic expansion valves.

By modulating the speed of the compressor and reducing the number of on/off cycles, the Hecu is

able to reduce energy costs, and increase the reliability and lifespan of the compressor because it "never operates outside of the happy place of the compressor," said Marshall.

The modulation of the compressor through the BLDC inverter takes place at partial loads, "where the system is most of its life," he said. Under this scenario, "you will have a significantly higher efficiency than with an on/off compressor."

The system also helps stabilize product temperatures, increasing shelf life for fresh foods, he added.

Carel made the Hecu CO₂-compatible because "we want to be as green as possible," Marshall said. "If we can move away from HFCs to CO₂, that's our preference."

To date, Carel has linked the Hecu to CO₂ compressors made by Toshiba, Mitsubishi and others.

ELIWELL'S CO₂ AND R290 CONTROLLERS

Italian component manufacturer Eliwell Controls introduced its CO₂ and hydrocarbon controllers to the U.S. market this year at the AHR Expo.

Eliwell, which operates as Eliwell by Schneider Electric in Europe and as Schneider Electric in the U.S., previously made these products for the European market in its Italian factory.

Its EWCM 9000 targets CO₂ transcritical rack systems and can be programmed for all capacities, according to Mauro De Barba, product marketing manager refrigeration components & systems for Eliwell.

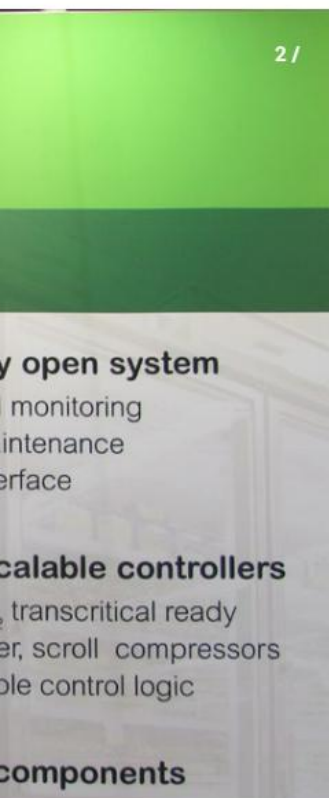
"The controllers work with a full range of [CO₂] compressor racks, from the smallest to biggest, including parallel compression," De Barba said.

The EWCM 9000 is designed to accommodate end users still using HFC or HFO refrigerants but planning to use CO₂. "We've created a bridge solution," he said.

With its propane controller, the company is targeting the self-contained display case market, but it is not selling this commercially in the U.S. yet. Instead it is working with companies like Secop and Embraco, which are using it with their compressors.

The propane controller works with a compressor inverter to increase the efficiency of the system. "[You can then] increase the power and size of application," without increasing the charge of refrigerant, which has a cap of 150 g, he said.

De Barba stressed that Eliwell's philosophy is to use "standard protocols" in its components, unlike some competing systems that are proprietary. ■ MG & CM



IIAR Highlights Low Charge

Low-charge ammonia technology was on display throughout the IIAR Natural Refrigeration Conference & Expo

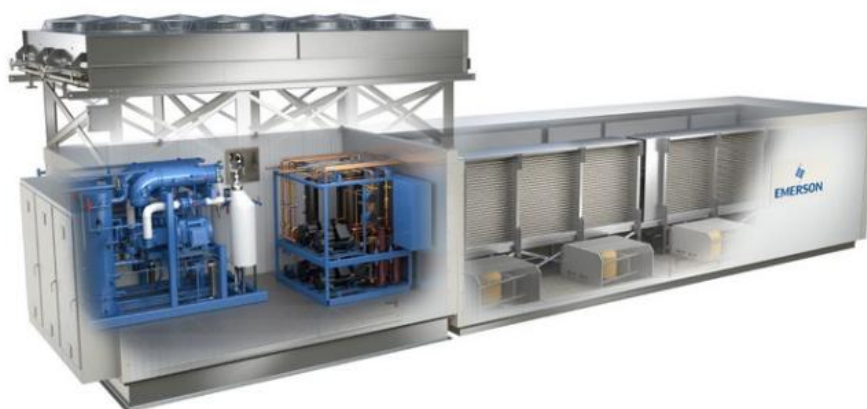
— By Michael Garry, Charlotte McLaughlin and Mark Hamstra

While low-charge ammonia packaged and central systems have been visible at industrial refrigeration conferences over the past few years, they were more prevalent than ever on the exhibit floor at the International Institute of Ammonia Refrigeration (IIAR 2018 Natural Refrigeration Conference & Expo, held in Colorado Springs, Colo., March 18-21.

The proliferation of low-charge technology at the IIAR Conference “affirms the concept,” said Caleb Nelson, VP of business development at Azane, which makes low-charge packaged systems. “It confirms this is the future.”

“I believe [low-charge] is coming, whether our system or somebody else’s,” said Joseph Pillis, director, global industrial refrigeration technology for, Johnson Controls, Waynesboro, Pa., whose Frick subsidiary has developed a low-charge ammonia central system. “This is a big market; there’s room for all of us.”

The following report describes many of the low-charge systems featured at the conference.



Vilter's Modular Rooftop Unit (MRU)

VILTER'S LOW-CHARGE PACKAGED SYSTEM

Vilter Manufacturing unveiled its Modular Rooftop Unit (MRU), the company's first ammonia/CO₂ packaged system for industrial applications, at the IIAR 2018 Natural Refrigeration Conference & Expo. The plug-and-play MRU is in the last stage of its development.

Vilter, a Cudahy, Wis.-based subsidiary of Emerson, will start taking orders for the MRU later this year and begin shipping it by the end of the year, said Antonio De Lourdes, Emerson's product marketing manager of industrial refrigeration.

The MRU, which ranges in capacity from 25 to 80 TR, contains two 50% refrigeration lines for efficient operation at reduced loads and for redundancy, said De Lourdes. Each line uses less than 100 lbs of ammonia.

With the ammonia/CO₂ MRU, Vilter is using CO₂ reciprocating semi-hermetic compressors as well as other Emerson CO₂ components – valving, controls, filters and driers – in a platform for the industrial space, said De Lourdes.

In addition, the MRU includes a small (100 cfm) open-drive single-screw ammonia compressor, which can be used in low-charge ammonia packaged systems. The MRU also includes a helix cascade heat exchanger.

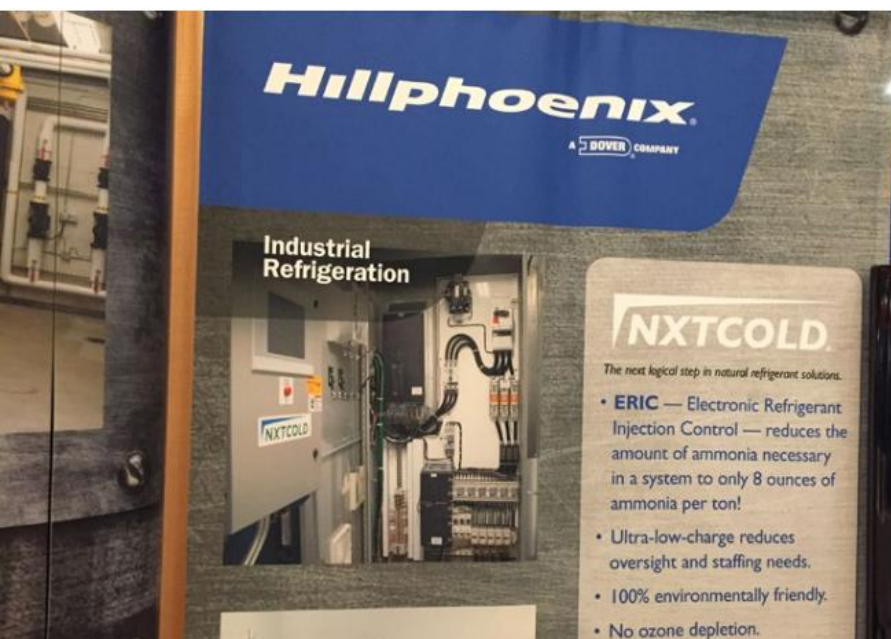
The MRU fits the industrial space, De Lourdes added. “Ammonia is a common, low-cost, environmentally friendly and very efficient refrigerant. Maintenance staffs are familiar with ammonia, and we didn't want to take that away.” He also sees these low-charge systems finding use in commercial applications.

The cascaded version of the MRU enables ammonia to be kept out of the cold space, which is cooled by CO₂.

Emerson and Vilter believe the combination of ammonia and CO₂ in one cascade system will be commonly utilized in the future, said De Lourdes.

Vilter will provide the MRU to contractors, who can deploy it as a “plug-and-play” packaged solution or “use components however they choose,” said De Lourdes. “You could use the CO₂ compressors to get extra capacity and use the engine room as the high side. You could use hanging evaporators and run CO₂ lines because ammonia is still in the unit.”

Used as a package, the MRU could be set up on a rooftop or on the ground outside a building, eliminating the need for an engine room. It could be employed in an expansion of an existing cold storage warehouse “if you can't, or don't want to, make the engine room bigger,” De Lourdes said.



Hillphoenix has exclusive licensing rights to NXTCOLD technology in the U.S., Canada, Mexico and Latin America

HILLPHOENIX SELLS FIRST NXTCOLD UNITS

Conyers, Ga.-based OEM Hillphoenix has sold its first two NXTCOLD ultra-low-charge packaged ammonia refrigeration units to Drayton Foods to support an expansion at its manufacturing plant in Fargo, N.D.

This represents the first NXTCOLD units designed, manufactured and sold by Hillphoenix since it acquired exclusive licensing rights to the technology in the U.S. last September from Los Angeles-based NXTCOLD, said Tim Henderson, industrial program manager, Hillphoenix, who handled the transaction and discussed it at the IIAR Conference.

The Hillphoenix licensing agreement for the NXTCOLD technology extends to Canada, Mexico and Latin America. The units will go by the brand, NXTCOLD by Hillphoenix.

Over the past few years, NXTCOLD has installed its units in cold-storage facilities in California, including a KPAC General facility in South Gate; a Lineage Logistics plant in Oxnard; a Baker Cold Storage Facility in Long Beach; a Los Angeles Cold Storage facility, and a Neptune Foods seafood storage warehouse in San Pedro.

The two 60-TR rooftop units will be installed at Drayton Foods – which makes pizza crust, dough balls, bread sticks and dinner rolls – in late May or early June, said Henderson.

NXTCOLD units each contain under 1 lb of ammonia per TR – 6 oz to 8 oz/TR – so the total charge for the two units is less than 60 lbs, he noted.

Drayton Foods, which has an existing ammonia-based spiral freezer and storage area, “wanted to add a freezer but not go over 10,000 pounds of ammonia,” the point at which more restrictive federal safety regulations come into play, said Henderson. The NXTCOLD units keep the charge under that threshold.

Reflecting the cold ambients of North Dakota, the NXTCOLD units are supported by dry fluid coolers that don’t use water, employ a space heater in the units and include additional heating for oil lines, noted Henderson. “We want to show they can work anywhere.”

Hillphoenix also makes transcritical CO₂ refrigeration systems for industrial and commercial operators.

AZANE’S NEW ROLE

Last month, Scottish OEM Star Refrigeration and Tustin, Calif.-based contractor Controlled Environments Construction (CEC) announced a joint venture to market the low-charge ammonia refrigeration systems previously sold by Star’s U.S. division Azane.

The new company, Controlled Azane Refrigeration (CAZ), also based in Tustin, will serve as a “sales vehicle for freezers into the cold storage market,” explained Caleb Nelson, VP of business development at Azane, at the IIAR Conference. CAZ is being led by president and CEO Rick Loesel, a veteran of the refrigerated and frozen food industry.

Meanwhile, Azane, which remains independent of the joint venture, will focus on serving cold storage and other industries with its low-charge ammonia chillers.

Nelson said Azane has come out with a new, more efficient version of its low-charge ammonia chiller that the company is planning to deploy in an industrial processing plant in Cedar Rapids, Iowa.

“This is the most efficient chiller we’ve ever built,” said Nelson.

The Azane 2.0 chiller, which features a reciprocating compressor rather than the screw compressor used in Azane 1.0, focuses on part-load efficiency, he explained. This allows for higher efficiency during off-peak times and when ambient temperatures are lower.

The newest chiller also features a stainless-steel control panel and plate-and-shell technology, which eliminates the surge drum. It also has a smaller footprint.

“It is a simplified system, and it drives some of the costs out,” said Nelson. “It’s helping the business case a lot for ammonia. It can show much better lifecycle cost savings.”

From left, Mike Kallas and Caleb Nelson, Azane



GEA'S LOW-CHARGE CHILLERS

German OEM GEA, whose North American office is in York, Pa., discussed its GEA Blu low-charge ammonia chillers, which have been sold in Europe and are now available in the U.S., at the IIAR Conference.

The Blu line has a temperature range of between 5°F and 60°F.

GEA has sold nearly 300 units of the modular Blu-Astrum chiller in Europe (primarily with glycol) since its launch in 2012, said Lawrence Bradley, director of solution sales – refrigeration for GEA North America. This chiller uses a screw compressor and offers capacities of between 156 and 492 TR, and an ammonia charge range of between 110 and 242 lbs.

The Blu-Genium chiller uses a reciprocating compressor and delivers capacities of between 85 and 341 TR.

GEA touts high ESEER efficiency for both chillers as well as compact dimensions and low noise levels. Its modular design accommodates “substitution of HFC chillers,” said Bradley.



GEA presentation at the IIAR Conference

John Collins, Zero Zone



ZERO ZONE'S LOW-CHARGE CHILLER

At the IIAR conference OEM Zero Zone, Ramsey, Minn., showcased an ammonia chiller that uses less than one lb/TR and has been installed in industrial facilities since its introduction a year ago.

“We’ve got several operating systems out there now,” said John Collins, industrial sales manager, Zero Zone. “I think it’s a relatively unique product from the standpoint that it’s a truly fully contained unit.”

The chiller can deliver up to 50 TR of capacity with no more than 35 lbs of ammonia. This makes it a good fit in California, where codes require a machine room for ammonia systems with more than 35 lbs of ammonia,

Collins said; though this code is not consistently applied, it is considered a best practice in the industry.

The chiller, which can be installed outside or in a machine room, produces glycol to deliver cooling for process cooling or air conditioning, as well as ice rinks.

“All the ammonia piping is done in the shop and really all the end user needs to do is bring in the glycol supply, return connections, and power,” Collins said. “So it’s a minimal amount of field work required.”

The chiller can deliver temperatures of 5°F (-15°C) to 45°F (7.2°C) even with ambient temperatures of 10°F (-12.2°C) to 120°F (48.8°C). “This is developed to be operable over a wide range of ambient conditions,” he noted.



Heatcraft's low-charge ammonia rack used in NH₃/CO₂ cascade system

FRICK'S LOW-CHARGE CENTRAL SYSTEM

Last year at the IIAR Conference, Frick Industrial Refrigeration introduced a low-charge ammonia central system (LCCS) that uses remote distributed condensing (RDC) units to reduce the amount of ammonia charge of a liquid overfeed system by 80% or more, to between 1.5 and 3 lbs/TR from 20 to 23 lbs/TR. (*See "IIAR's Natural Refrigerant Show," Accelerate America, March 2017.*)

The system was installed last year at a food processing plant, originally providing 660 TR of capacity with only 2 lbs/TR of ammonia charge; the plant was expanded at the end of 2017. Frick "tweaked the system" to better accommodate low ambient temperatures, said Joseph Pillis, director, global industrial refrigeration technology for Frick's parent, Johnson Controls, Waynesboro, Pa.

This year, the LCCS was installed at a cold-storage facility in Canada, said Pillis.

For the LCCS, Frick makes its own compressors but employs condensers and evaporators from G ntner, said Pillis.

The LCCS places the RDC units – which could be adiabatic, plate-and-frame, dry or evaporative – directly above the evaporators. Condensed liquid is subcooled in liquid supply vessels, which feed the evaporators.

HEATCRAFT'S INDUSTRIAL NH₃/CO₂ SYSTEM

Heatcraft Worldwide Refrigeration launched a low-charge NH₃/CO₂ cascade system for industrial applications at the IIAR Conference, based on a similar commercial system.

The commercial system, using a very low charge of ammonia (53 lbs, or .76 lb/TR) was installed at a Piggly Wiggly supermarket in Columbus, Ga., in 2015. It employs 1,400 lbs of CO₂.

"It's pretty much the same thing," said Grady McAdams, Heatcraft's director of cold storage sales. "We're now trying to grow that into the cold-storage market."

The industrial NH₃/CO₂ system covers capacities between 100 and 300 TR while the commercial version serves capacities up to 125 TR, said McAdams. The Piggly Wiggly store had an ammonia-cycle capacity of 70TR.

Like the commercial system, the industrial system uses a rooftop low-charge ammonia package on the high side and CO₂ on the low side, inside the building.

The store was shown to cut its energy consumption by 33% on average – for a total of \$74,640 in savings – over a 13-month period, compared to a similar store using HFC refrigeration.

Heatcraft, a traditional commercial refrigeration player, is also looking at targeting the industrial market with a large capacity CO₂ transcritical rack.

"I think the interest has been almost equal on both NH₃/CO₂ and transcritical CO₂," he noted. But, he added, "most people think it's still a further leap to go to the larger transcritical systems [and say] I'll see where I can get to with an ammonia cascade."

Model of Frick's low-charge central system



The LCCS eliminates centralized condensers, high-pressure receivers, ammonia storage vessels, low-liquid supply lines and wet return lines, according to Frick. There is no liquid ammonia in the engine room or in piping leading to the condensers or from the evaporators. ■ MG, MH & CM

PAVING THE WAY FOR LOW-CHARGE AMMONIA

IIAR creates guidelines to help introduce the technology to more end users and enable them to install and operate it correctly

— By Mark Hamstra



As more businesses consider replacing their conventional refrigeration systems with low-charge ammonia technologies, they are increasingly seeking information about what such a switch entails.

The International Institute of Ammonia Refrigeration (IIAR) is seeking to meet that demand with new guidelines designed to help users safely install, operate and maintain ammonia refrigeration systems that use a charge of 500 lbs or less (and under 100 lbs in the next step). These guidelines, called Ammonia Refrigeration Management - Low Charge (ARM-LC), are a scaled-down version of the ARM guidelines the IIAR had previously issued for ammonia systems using charges under 10,000 lbs.

The overarching goal of the ARM-LC guidelines is to help end users comply with the General Duty Clause of the Occupational Safety and Health Act, which requires that a place of employment be “free from recognized hazards.”

Peter Thomas, president and senior engineer, Resource Compliance Inc., and the author of the ARM-LC guidelines, outlined the document at the IIAR 2018 Conference & Expo in Colorado Springs, Colo., last month. The guidelines are currently being reviewed before final publication, which is expected to occur by the end of the year.

The good news for operators seeking to convert to low-charge ammonia refrigeration is that, under ARM-LC, equipment manufacturers and contractors will likely shoulder most of the work involved in the

Kurt Liebendorfer, Evapco

“For the owners, probably the most important thing they can do, outside of selecting the system that they’re going to install, is selecting a good, qualified contractor.”

safe operation and maintenance of these systems, which have ammonia charge to capacity ratios of 0.5 lb/TR to 7 lbs/TR (compared to 20-30 lbs/TR or more in conventional systems).

“For the owners, probably the most important thing they can do, outside of selecting the system that they’re going to install, is selecting a good, qualified contractor,” he said.

Under the guidelines, contractors that install low-charge ammonia systems will still be responsible for training on-site employees, although the training would be significantly less intensive than for large, industrial facilities that use bigger ammonia charges.

“Bringing an ammonia system to a site, even a low-charge system, still represents a new hazard,” Thomas explained. “Ammonia does have certain hazards, and employees need to be aware of that.”

Training of employees should be relatively simple, he said, and should revolve around a few key areas:

► **The safety hazards of ammonia.** This should be similar to safety-hazard training offered for other refrigerants, Thomas pointed out. “This is not really a new category of training, but it’s adding a new chemical to a category of training that should already be taking place,” he said.

► **Monitoring the system.** Employees should be aware of what situations fall outside of normal operational parameters and require a phone call to the contractor.

► **Steps to take in an emergency.** If there is an accidental release, training should detail what steps should be taken.

Thomas said the ARM-LC guidelines recommend an audit of the system every five years, which he described as a fairly straightforward process. The document also includes templates that operators can use to create their own maintenance and operational procedures.

MANUFACTURERS’ ROLES

Manufacturers will play a significant role under the guidelines proposed in the ARM-LC document.

For packaged systems — which are expected to be a significant percentage of low-charge installations — the ARM-LC guidelines suggest that manufacturers should conduct a hazard review before the equipment is installed, in lieu of the full-scale process hazard analysis (PHA) that would normally be conducted at facilities with large ammonia systems.

Although some site-specific factors come into play, such as equipment accessibility, “what’s being proposed in ARM-LC is drastically, drastically reduced,” compared to full on-site PHA, said Thomas.

For stick-built low-charge ammonia systems, contractors would help in the consideration of site-specific concerns, he said.

Similarly, manufacturers can provide operating procedures for all phases of the system, from the initial start-up to how to conduct an emergency shut-down. Manufacturers would also supply

recommended maintenance schedules.

As far as emergency response programs, the ARM-LC guidelines recommend that users amend their existing emergency response action plans with recommendations about how to respond to the smell of ammonia. It should trigger a call to the contractor, first of all, and could include an evacuation plan.

The ARM-LC guidelines also detail how changes to low-charge systems should be handled. This is more likely to be relevant with site-built as opposed to packaged systems, Thomas noted.

“If there’s going to be a change to a small-charge system, those shouldn’t be done in a cavalier way — they shouldn’t just be done on a whim,” he said. “There should be a process that’s followed to make sure components are compatible with ammonia and so forth.”

OPPORTUNITIES FOR AMMONIA

Kurt Liebendorfer, VP of Evapco, a maker of low-charge packaged ammonia systems, who is also chairman of the IAR committee overseeing ARM-LC, described the document as an important step in the journey to present low-charge ammonia options to new end users “in a fashion that doesn’t scare them.”

Also speaking at the IAR conference, Liebendorfer outlined the opportunities for increasing the adoption of low-charge ammonia systems in a variety of industries, whether as a direct coolant or as the primary refrigerant in an ammonia-CO₂ system, for example.

Businesses such as data center operators and pharmaceutical manufacturers are eyeing low-charge ammonia systems, he said, as natural refrigeration technology tends to align with these businesses' missions around sustainability.

Supermarkets and ice rinks have also begun to install ammonia refrigeration systems, he noted, and there are many opportunities in large cold-storage facilities that historically have used larger ammonia charges, as well as opportunities in the HVAC industry.

"It's all because there's significantly less ammonia in these small-charge systems," Liebendorfer said. "They're safer to operate, maintain and work around."

Low-charge systems are "inherently safer technology," Liebendorfer stressed, citing in particular the fact that extensive testing has already been done on packaged systems before they leave the manufacturer's plant.

Liebendorfer outlined several other benefits of low-charge ammonia systems, including reduced energy usage, faster installation, and the elimination of a central machine room. They can also accelerate and facilitate tax depreciation, compared with conventional systems, and can have lower lifecycle costs.

End users of packaged ammonia systems should face a reduced risk of Occupational Safety and Health Administration (OSHA) violations and fines, he said. Most of the citations issued by OSHA in recent years have been related to inadequate process safety information and other violations that should be prevented through the testing and documentation provided by manufacturers of packaged systems, he said.

"If we're expecting to bring our [low-charge] ammonia systems to new industries, we need to bring these available programs and documentation to the owner and allow him to manage it without having to be responsible for writing it himself, as is prevalent in the rest of the ammonia industry," Liebendorfer said. "And they will definitely satisfy the requirements, and then some, of the General Duty Clause."

In turn, he added, regulators "need to recognize the lower risks of low-charge systems." ■ MH

SELLING AMMONIA TO SUPERMARKETS

Suppliers of ammonia systems for industrial users need to tailor their approach to meet the unique needs of the supermarket sector, according to a presentation at the International Institute of Ammonia Refrigeration (IIAR) 2018 Conference & Expo in Colorado Springs, Colo., last month.

"Speaking to commercial refrigeration end users the way you speak to industrial refrigeration end users is not going to get you anywhere," said Keilly Witman, owner of KW Refrigerant Management Strategy and former manager of the Environmental Protection Agency's GreenChill program.

One of the first things suppliers of these systems need to understand about supermarket operators is that they are not in the business of cooling — they are in the business of selling groceries, and they would ideally like refrigeration to be a low-maintenance afterthought, she explained.

"Refrigeration is nothing but a cost center," Witman said. "The top management tries to avoid thinking about refrigeration, and the store owner and the employees don't want anything to do with it."

In addition, supermarket operators tend to be skittish about ammonia use in the store, and might even be repelled by the term "low-charge ammonia," she said, noting that they associate it closely with large-scale, industrial ammonia applications.

However, rooftop ammonia-CO₂ cascade refrigeration systems offer several advantages for supermarket operators, and should be an easy sell, Witman said.

"Ammonia-CO₂ cascade should be the most successful natural refrigeration system in the commercial refrigeration world," she said.

But the cost of a refrigeration system is a significant consideration for supermarket operators and the biggest barrier to adoption of ammonia systems, she said. These users tend not to think in terms of total lifecycle costs, but instead are focused on upfront costs.

Supermarkets are, however, interested in systems that lower their operational costs through reduced energy use.

"There's no better, more energy-efficient refrigerant than ammonia," said Witman. "Commercial refrigeration pays those energy bills on a monthly basis, and they are happy with someone who comes and claims to be able to save 2% energy. So imagine how happy they're going to be when you talk about the amount of energy you can save them with ammonia."

In addition, ammonia offers cost savings in reduced regulatory requirements, she said. For example, Section 608 of the Clean Air Act, which regulates the release and recycling of chemical refrigerants, can be extraordinarily expensive. The potential EPA fines for noncompliance "are horrific," Witman said.

"You need to be telling commercial refrigeration end-users, 'Imagine never having to think about the EPA enforcement people coming to your store to talk to you about section 608. Imagine never having to go through another phase-out in your entire lifetime,'" she said. "This is your story."

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