

MARCH 2016

ACCELERATE

ADVANCING HVAC&R NATURALLY

A M E R I C A

DAWN OF THE LOW-CHARGE AGE

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New ammonia systems are poised to
reinvent industrial refrigeration.
Neptune Foods' Maiden Voyage

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IIAR's Eric Smith on
low-charge ammonia

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SABMiller's toast to
propane refrigeration

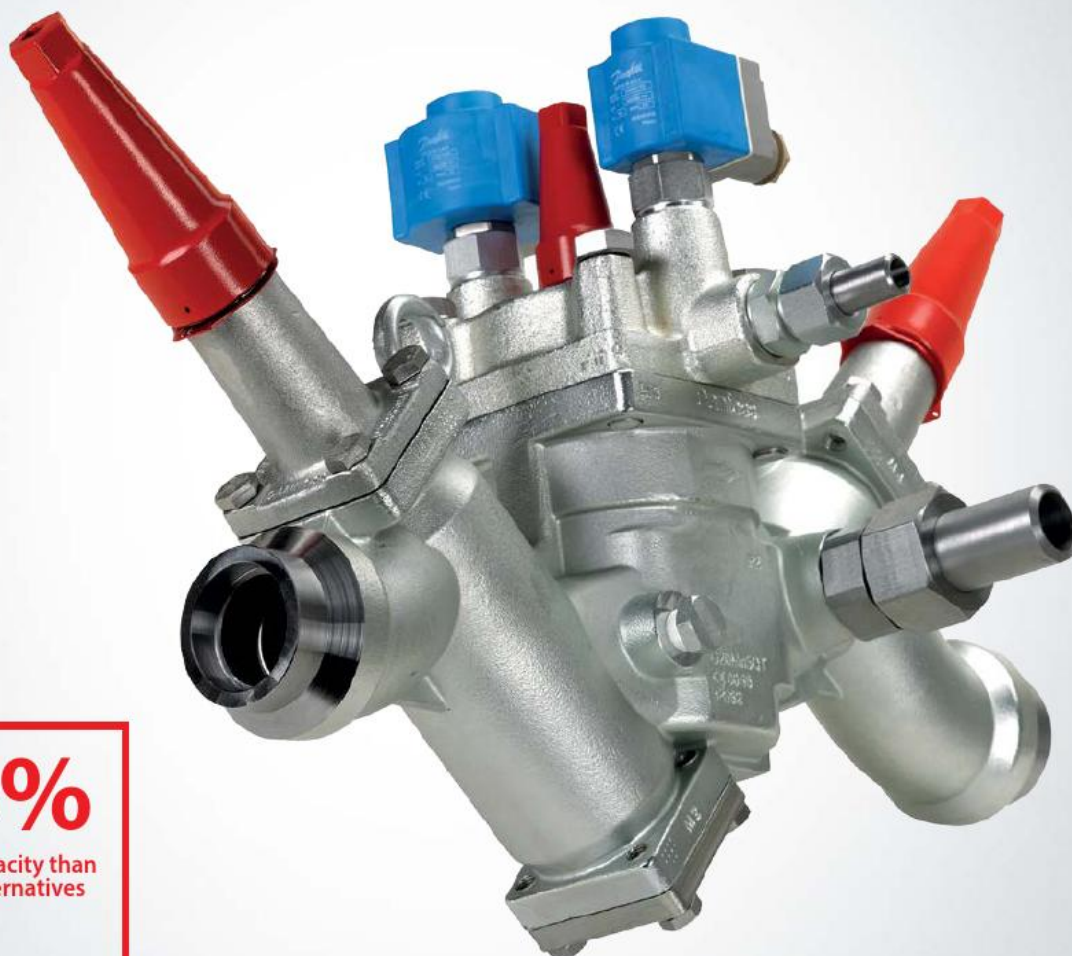
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ATMOsphere Asia:
NatRefs in Japan



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Editor's note by Michael Garry

AMMONIA'S TRANSFORMATION

Ammonia, a pungent, potentially toxic gas, is also one of the world's oldest, most efficient and least costly refrigerants. On top of that it's naturally occurring and environmentally benign.

Due its dangerous qualities, ammonia has been used mostly in industrial settings, far from public exposure. There it is heavily regulated, especially in quantities exceeding 10,000 pounds.

But, as we report in this issue, ammonia refrigeration is undergoing a transformation that will fundamentally change the way it is used in food processing and cold storage facilities, and even allow it to enter the very public world of food retailing.

How is this happening? Simply through technology that enables a much smaller amount of ammonia to be used. The smaller the charge, the safer and less regulated the system.

In our cover story, we show how two innovative companies, NXCOLD and Azane, have created low-charge packaged units that can be placed on rooftops or outside on the ground near refrigerated

loads. One of NXCOLD's customers, Neptune Foods, talks about using the technology to refrigerate a freezer room with only 0.5 lbs. of refrigerant per ton of capacity.

The story also covers a low-charge DX evaporator system developed by Colmac Coil and used by Preferred Freezer Services, among others. This system works in the traditional format of a machine room connected to evaporators in the storage/processing area.

And the cover story reports on yet another low-charge alternative – an ammonia/CO₂ cascade system, which is marketed by Carnot Refrigeration along with its industrial CO₂-only transcritical system. We get into a lot more detail about NH₃/CO₂ in a profile of M&M Refrigeration, which pioneered the system and has installed it in 55 facilities around the world.

To get a sense of how the ammonia industry views this break from tradition, we interviewed Eric Smith, vice president and technical director of IIR (International Institute of Ammonia Refrigeration). IIR recently adjusted its longtime safety standard, IIR-2, to address low-charge systems, a change that Smith expects

to support the uptake of low-charge technology.

What makes low-charge ammonia and NH₃/CO₂ systems particularly interesting is that they not only replace large-charge ammonia systems, but also industrial equipment that uses synthetic refrigerants like R22 and HFCs. This, of course, is not just a win for safety but also for the environment. Moreover, NH₃/CO₂ is regarded as having potential in supermarkets, where they would be an all-natural alternative to synthetic systems and would be an efficient solution in warm climates, competing there with transcritical CO₂ systems.

Already NH₃/CO₂ systems are being employed in such locations as an Albertsons store in Carpinteria, Calif., and a commissary at the Lackland Air Force Base in San Antonio, Texas. In these scenarios, the ammonia is kept on the rooftop in small quantities such that a leak dissipates into the atmosphere out of harm's way.

Now that ammonia can be used in smaller quantities, its potential to change the refrigeration industry knows no bounds.

●MG

VOLUME 2, ISSUE #13, MARCH 2016

ACCELERATE

ADVANCING HVAC&R NATURALLY

AMERICA



 @AccelerateNA

About Accelerate America

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

<http://acceleratenas.com>

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Ammonia's Transformation

Editor's note by Michael Garry

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Embarking on a New Voyage

Seafood processor Neptune Foods is one of a growing number of industrial refrigeration end users installing low-charge-ammonia packaged units, in a major break from traditional refrigeration technology

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for March, April & May 2016

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Low-Charge Ammonia in Industrial Refrigeration

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U-Turn on Ice

In converting from R22 to ammonia, Montreal's ice rinks are using a u-shaped liquid separator to save space and reduce charge

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Raising a Toast to Natural Refrigerants

Brewing giant SABMiller is employing propane refrigeration in new beer coolers throughout its sprawling global enterprise

Credit Bank Aims to Incent HFC Reclamation

By offering carbon credits for reclaimed HFCs, the program would cut production of virgin HFCs and facilitate a transition to non-HFC systems

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Shedding Light on NatRefs In the Land of the Rising Sun

ATMOsphere Asia brings the global HVAC&R community to Tokyo to learn about the rapid development of CO₂ condensing units in c-stores and the growth of NH₃/CO₂ units

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F-gas restrictions are leading to greater adoption of natural refrigerants as HFC alternatives

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Pioneer of Low Charge

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Downsized Transcritical Unit Lowers First Cost of Equipment



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- 1** March 3, 12:45 pm EST, Webinar
IOR Webinar: Supermarket energy use and emissions – technology options review
<http://www.ior.org.uk/supermarket-energy-use-and-emissions-ndash-technol>
- 2** March 6-8, New York, NY
The International Restaurant & Foodservice Show of New York
<http://www.internationalrestaurantny.com/Content/16.ht>
twitter: @TheFoodShows
- 3** March 6-8, Boston, MA
Seafood Expo North America/Seafood Processing North America 2016
<http://www.seafoodexpo.com/north-america/>
- 4** March 6-9, St. Petersburg, FL
36th Annual Conference & Tabletop Display, Refrigerated Foods Association
<http://www.refrigeratedfoods.org/rfa-conference-registration>
- 5** March 8-10, Boston, MA
NESEA BE16 (BuildingEnergy) - Northeast Sustainable Energy Association
<http://nesea.org/conference/buildingenergy-16>
twitter: #sustainable #building @NESEA_org
- 6** March 9-10, Boston, MA
GLOBALCON
<http://www.globalconevent.com/>
twitter: #globalcon
- 7** March 9, Flushing, NY
ABCO EXPO
<http://abcohvacr.com/abco-expo/>
- 8** March 10-13, Charlotte, NC
ACCA 2016 and the IE3 Expo
<https://www.acca.org/events/conference>
twitter: @accausa
- 9** March 15, 11:00 am EDT, Webinar
EPA Greenchill Webinar- Waitrose's Experience Using Self-Contained Hydrocarbon Systems
<https://epawebconferencing.acms.com/waitrose/>
twitter: @EPAGreenchill
- 10** March 16-18, Toronto
CMPX 2016
<http://www.cmpxshow.com/>
twitter: @CMPXShow
- 11** March 20-23, Orlando, FL
2016 IIR Industrial Refrigeration Conference & Exhibition
http://www.iir.org/IIR/WCM/Events/WCM/Events/IIR_Events_2015-2016.aspx?hkey=ee37d734-7ec0-4fb4-a8f1-9d455ab66e2d
twitter: @IIR2016
- 12** March 20-23, Phoenix, AZ
2016 ABA Convention - American Bakers Association
http://www.iir.org/IIR/WCM/Events/IIR_Events_2015-2016.aspx
twitter: #PowerofBaking
- 13** March 20- 23, San Diego, CA
2016 PDC Summit - Summit & Exhibition On Health Facility Planning, Design & Construction
<http://www.ashe.org/PDC/index.shtml#.VqdVLt-rRcB>
twitter: #PDCSUMMIT @ASHEAHA
- 14** March 20-24, Orlando, FL
MCAA Annual Convention 2016 - Mechanical Contractors Association of America
<http://mcaaconvention.org/>
- 15** March 21-23, Las Vegas, NV
National HVACR Educators and Trainers Conference
<http://www.hvacexcellence.org/nhetc/>
- 16** March 22- 24, Baltimore, MD
National Facilities Management and Technology Conference & Exposition (NFMT) 2016
<http://www.nfmt.com/>
twitter: #NFMT2016 @nfmt_conference
- 17** March 31 - April 1, St. Petersburg, FL
Ice Cream Technology Conference 2016
<http://www.idfa.org/news-views/headline-news/article/2014/10/29/registration-now-open-for-popular-ice->



- | | |
|---|---|
| <p>1 April 4-6, Tempe, AZ
 National Frozen & Refrigerated Foods Association (NFRA) Executive Conference
 http://nfraexecutiveconference.org/
 twitter: @EasyHomeMeals</p> | <p>6 April 13-15, Chicago, IL
 2016 National Automatic Merchandising Association (NAMA) OneShow
 http://www.namaoneshow.org/
 twitter: #NAMAOneShow16 @NAMAvending</p> |
| <p>2 April 4-7, Austin, TX
 2016 ACI National Home Performance Conference & Trade Show (Formerly Affordable Comfort, Inc.)
 http://www.homeperformance.org/conference/2016-aci-national-home-performance-conference-trade-show</p> | <p>7 April 13-15, Montreal, Canada
 SIAL Canada
 http://sialcanada.com/sial/en/index.sn
 twitter: #SIAL2016 @SIALCANADA</p> |
| <p>3 April 10-13, Scottsdale, AZ
 BuildPoint 2016
 http://www.buildpointevent.com/
 twitter: #bp2016event @BuildPointEvent</p> | <p>8 April 16- 20, Las Vegas, NV
 IARW-WFLO Annual Convention and Expo
 http://www.gcca.org/iarw-wflo-convention-details/</p> |
| <p>4 April 12, 2pm EDT, Webinar
 EPA Greenchill webinar-Achieving Leak Reduction Goals through Effective Refrigerant Management: Case Study - King Kullen
 https://epawebconferencing.acms.com/kingkullen/
 twitter: @EPAGreenchill</p> | <p>9 April 12- 14, Indianapolis, IN
 2016 IFMA Facility Fusion Conference & Expo - International Facility Management Association
 http://facilityfusion.ifma.org/indianapolis/home
 twitter: #facilitiesmanagement @IFMA</p> |
| <p>5 April 13- 14, Tacoma, WA
 Northwest Facilities Expo 2016
 http://www.fenw.facilitiesexpo.com/
 twitter: @Facilities_Expo</p> | <p>10 April 26, 2pm EDT, Webinar
 EPA Greenchill webinar-Climate-Friendly and Energy-Efficient Heat Exchanger Designs for Supermarket Applications
 https://epawebconferencing.acms.com/heatexchanger/
 twitter: @EPAGreenchill</p> |



1

May 2-4, Reston, VA
AHRI 2016 Spring Meeting
<http://www.ahrinet.org/site/946/News-Events/Meetings-and-Events/AHRI-2016-Spring-Meeting>
 twitter: #AHRISpring

2

May 3-4, Austin, TX
NFMT High-Performance Buildings & Workplaces - National Facilities Management & Technology
<http://www.nfmt.com/highperformance/default.aspx>
 twitter: #NFMT16 @nfmt_conference

3

May 11-12, Washington, D.C.
Energy Efficiency Global Forum (EE Global 2016)
<http://www.eeglobalforum.org/>
 twitter: #energyefficiency @ToSaveEnergy

4

May 16-19, Columbus, OH
14th NARCE - North American Rink Conference and Expo
<http://www.narce.com/page/show/149176-14th-annual-north-american-rink-conference-and-expo>

5

May 18-19, Anaheim, CA
Southern California Facilities Expo 2016
<http://www.fesc.facilitiesexpo.com/>
 twitter: @Facilities_Expo #fenw2016

6

May 21-24, Chicago, IL
NRA Show
<https://show.restaurant.org/Home>
 twitter: #NRAShow @NRAShow

7

May 24-25, New York, NY
BuildingsNY 2016 (BuildingsNY and GreenBuildingsNY)
<http://www.buildingsny.com/>
 twitter: #buildingsny @BuildingsNY

8

May 25-26, Seattle, WA
34th West Coast Energy Management Congress (EMC)
<http://www.energyevent.com/>



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SHORT TAKES

— By Michael Garry

ARMY CONTRACTS FOR CO₂ MOBILE REFRIGERATION UNIT



CO₂ energy-recovery compressor

The U.S. Army Natick Soldier Systems Center (NSSC) has awarded Nashville, Tenn.-based S-RAM Dynamics a \$1 million contract to build and test a mobile refrigeration prototype system using CO₂.

Under the Small Business Independent Research (SBIR) Phase 2 contract, S-RAM Dynamics will employ its new S-RAM energy-recovery compressor in the project. The next-generation CO₂ refrigeration system is expected to reduce energy consumption of the Army's mobile refrigeration assets in excess of 50%. The mobile CO₂ demonstration refrigeration system will be installed on the Army's Multi-Temperature Refrigerated Container System (MTRCS).

The S-RAM CO₂ energy-recovery compressor integrates an axial piston compressor with an opposed axial piston expander to recapture normally lost energy and boost system performance.

"We are pleased the Army recognized the impact of our proprietary CO₂ compressor and expander technology to reduce energy consumption while eliminating harmful greenhouse gas emissions," said Lee Jestings, president, S-RAM Dynamics. "This demonstration contract will help accelerate our commercialization efforts for a broad range of refrigeration and heat pump products." ● MG

LARGE AND SMALL GROCERS GET GREENCHILL PLATINUM FOR TRANSCRITICAL STORES

Food Lion, a Salisbury, N.C.-based division of Delhaize America that runs more than 1,100 stores in the southeastern U.S., has earned the U.S. Environmental Protection Agency GreenChill Partnership's 2015 platinum-level store certification – the highest level granted – at its store located in Southport, N.C.

The store uses an Advansor CO₂-only transcritical booster system from Hillphoenix. This is also Food Lion's first test of a transcritical system.

In addition, DeCicco & Sons, a six-store grocery operation based in Pelham, N.Y., also received platinum-level GreenChill certification for a new store in Larchmont, N.Y. The store, which opened in December 2015, also uses a CO₂-only Advansor booster system from Hillphoenix. DeCicco & Sons is one of only a handful of small, independent grocers in North America that have invested in this technology.

The EPA's GreenChill Partnership recognizes individual grocery stores that implement environmentally friendly refrigeration systems. Stores can receive platinum, gold or silver-level certification, based on refrigerant leak and charge levels, as well as the use of low-GWP (under 150) refrigerants for platinum certification. In addition to the DeCicco's and Food Lion stores, nine other U.S. supermarkets have platinum certification.

"For many years, Food Lion has been committed to protecting our environment by decreasing our energy consumption, lessening our waste stream and reducing our carbon footprint," said Susan Sollenberger, director of energy, maintenance and equipment purchasing at Food Lion. "This recognition by GreenChill is one more indication of the great efforts the Food Lion team is making."

Unlike some other retailers that are installing transcritical systems, DeCicco decided to invest in two Trillium adiabatic gas coolers (from Baltimore Aircoil) instead of a conventional condenser. The units will help keep the system from going into less efficient supercritical mode when ambient temperatures exceed 88 °F, CO₂'s critical point.

John DeCicco, Jr., president, said he is happy with the CO₂ system. "The temperature control, strength of the cold, and product longevity are unmatched compared to any other refrigerant," he said. "The efficiency of the system – in terms of the reduced electrical load and the quality and quantity of the waste heat – is a great asset to help reduce the store's overall energy use." ● MG



Transcritical rack at DeCicco & Sons' Larchmont, N.Y., store.



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IIAR CONFRONTS LOW-CHARGE AMMONIA

Technical director Eric Smith discusses how the Institute's revised IIAR-2 safety standard will impact the adoption of low-charge systems in industrial refrigeration, and in other sectors as well

— By Michael Garry and Blanka Zoldi



Eric Smith, IIAR

In November 2015, the International Institute of Ammonia Refrigeration (IIAR) released updates to its IIAR-2 operational and safety standard for ammonia refrigeration. For the first time, the standard, established in 1974, addresses ammonia equipment outside of the machine room, including low-charge ammonia packaged systems. In the following interview, Eric Smith, vice president and technical director of IIAR, explains how this change can affect the adoption of low-charge ammonia systems as well as extend the low-charge market to commercial applications. He also comments on the role low-charge ammonia systems will play in industrial refrigeration.

Accelerate America: Do you think the updates to the IIAR-2 standard will support the uptake of low-charge packaged systems?

Eric Smith: Absolutely, particularly because of the new section (chapter 14) in the revised IIAR-2 standard on ammonia refrigeration

design. It makes clear that even if the packages don't happen to be listed in a nationally recognized listing laboratory like UL, they can still be completely acceptable, if they are built and installed to IIAR standards. Because IIAR-2 is referenced in the body of both the IMC (International Mechanical Code) and the UMC (Uniform Mechanical Code), packages built to the IIAR-2 standard would be code compliant.

Accelerate America: The standard details what needs to be done to ensure the safety of these packages. Is there anything that stands out as an example of that?

Eric Smith: The packages must be built in the same manner as a built-up central system. If it's a large package, then it essentially takes on the look and feel of an engine room with

ventilation, sensors, eye-wash and things like that. The structure of the package has to be designed to support the weight of the equipment and withstand the stresses caused by shipping and rigging. The package could also have removable panels to allow access, making them more like traditional rooftop equipment.

Accelerate America: Does this standard have any revisions relating to ammonia/CO₂ systems?

kinds of indirect systems are applicable. We make it clear that the use of ammonia refrigeration with secondary cooling like CO₂ or glycol is acceptable, and we encourage it for commercial and light industrial applications where synthetic refrigerants have traditionally been used, like in grocery stores. To that end, IIAR is conducting research on ammonia releases in urban settings and we are evaluating the relative risk to the public.

Accelerate America: Does IIAR have a definition of low charge?

there is no magic number as every system is unique. When I hear low charge, I think of critically charged packaged systems or critically charged built-up systems, with the correct amount of refrigerant in the system, no more and no less than you need.

Accelerate America: Do you see the demand for low-charge systems increasing?

Eric Smith: They have been allowed all along, but the standard does now explicitly state, in chapter 5, that these

Eric Smith: There are unofficial numbers about what can be considered low charge, but

Eric Smith: I think the demand is slowly ramping up, and will perhaps exponentially ramp up when the costs of synthetic refrigerants begin to ramp up too.

“ We make it clear that the use ammonia refrigeration with secondary cooling like CO₂ or glycol is acceptable, and we encourage it for commercial and light industrial applications.”

Accelerate America: Has IIAR taken an official position on the use of low-charge ammonia systems?

encouraged their use and are doing all we can to support it.

Accelerate America: So IIAR supports low-charge systems even though they are a departure from the traditional kind of systems that your members have been using for many years?

HFCs. At the same time, our membership and our industry have traditionally been focused on industrial applications with large, built-up ammonia systems. We don't want our industrial members to feel that we are abandoning them; their industry is absolutely crucial, and we stand ready to serve them at any time.

Eric Smith: We have not created anything like a position document, but we certainly have publicly encouraged their use and are doing all we can to support it.

Eric Smith: It's certainly beneficial to reduce charge because it makes for a safer system. We also promote the use of ammonia and other natural refrigerants as viable alternatives to HFCs and

continued on p.14 →

→ **Accelerate America:** So you are also supporting the notion that even in large industrial plants, there is a benefit to reducing the charge and going to these lower charge scenarios?

have large, relatively concentrated refrigeration loads, it makes sense to have a custom-built central system; however, a company might have a remotely located freezer, where it makes sense to have a limited-charge package for that area.

Energy considerations are also part of the equation. In most situations nothing is more efficient than a direct ammonia system. In case studies of new ammonia-CO₂ systems that replace older systems, a lot of efficiencies are realized just because of the fact that it is new. But the lower the operating temperature, the more beneficial CO₂ becomes. When you have a blast-freezing load, for example, then CO₂ really should be studied.

While less ammonia theoretically creates a safer system, a leak is a leak. The lower charge limits the ultimate amount of refrigerant that could escape. But it doesn't mean that negligence couldn't create an equally dangerous situation with low-charge systems.

Accelerate America: What is the role of transcritical CO₂ in industrial refrigeration?

CO₂ operates at much higher pressure and is more sensitive to moisture than ammonia.

Eric Smith: Yes, but that wouldn't be the case every single time. Every system is unique and you have to evaluate the pros and cons of having, say, multiple packages vs. a central system. If you

Eric Smith: That's probably pretty applicable for smaller systems in the right climate area. Generally speaking,

“When I hear low charge, I think of critically charged packaged systems or critically charged built-up systems, with exactly the correct amount of refrigerant in the system.”

Accelerate America: On the regulatory side, OSHA's Process Safety Management (PSM) and the EPA's Risk Management Plan (RMP) regulations set a threshold of 10,000 pounds of ammonia for stricter requirements. Is the stricter enforcement of PSM and RMP leading to more adoption low-charge systems?

and the ability to cope with a wide range of loads.

And there are some operations that are just so big that you can't get lower than 10,000 pounds of ammonia. There are plenty of facilities out there well over 10,000 by multiple factors. That application will always be there as long as people continue to eat and drink.

Accelerate America: But should those regulations better reflect the lower risk of low-charge systems?

through our ARM (ammonia refrigeration management) program, which is a generally acceptable means to comply with the general duty clauses of the EPA and OSHA. It is very much like a reduced version of the PSM and RMP programs. We hope to develop over the next year an even more reduced version for low-charge systems with 500 pounds of ammonia or less. We informally floated this idea by government officials and they seemed to be OK with it. ● BZ & MG

Eric Smith: End users would have to really consider whether or not the minor reduction of their regulatory burden is worth the convenience of versatility. By versatility I mean the ability expand a system without major engine room changes, the ability to lose some charge through minor leaking without having to recharge the system

Eric Smith: There will be still some regulatory burdens, no matter what. Right now, we address those requirements

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IIAR EXPLAINS NEW AMMONIA SAFETY STANDARD

The 2016 IIAR Conference & Exhibition will have a special session on the recently updated IIAR-2 standard, which for the first time covers ammonia equipment located outside the machine room, including low-charge systems

— By Blanka Zoldi & Michael Garry

In addition to featuring almost 200 exhibitors and numerous technical papers, technomericals and workshops, the 2016 International Institute of Ammonia Refrigeration (IIAR) Industrial Refrigeration Conference & Exhibition will offer an update on the recently revised IIAR-2 safety standard for ammonia refrigeration.

The conference, which will take place March 20-23 at the Caribe Royale All-Suite Hotel and Convention Center in Orlando, Fla., will address the IIAR-2 operational and safety standard in a four-hour educational program on Sunday, March 20.

Formally called the IIAR-2 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems, IIAR-2 is “the benchmark safety code standard for the safe, reliable and efficient design of ammonia refrigeration systems,” according to IIAR. In its latest iteration, announced in November 2015, the IIAR-2 standard for the first time covers ammonia equipment located outside the machine room, including low-charge ammonia packaged systems.

Speakers at the IIAR-2 session will include Eric Smith, IIAR’s vice president and technical director; Bob Czarnecki, a retired executive from Campbell Soup Company; Eric Johnston of American Foods Group;

Joseph Pillis of Johnson Controls; Trevor Hegg of Evapco; and Dave Schaefer of Bassett Mechanical, which is the sponsor of the program.

NATURAL REFRIGERANTS IN EUROPE

The IIAR Conference, which brings together over 1,200 engineers, end users, wholesalers, manufacturers, and contractors in industrial refrigeration from around the world, will feature a series of peer-reviewed technical papers on a wide range of topics. This year’s topics include: the use of natural refrigerants in Europe; expanding the use of ammonia refrigeration; and an introduction to the ammonia system process safety management program.

In addition, the conference will offer workshops on: revamping and upgrading a 35-year-old ammonia refrigeration systems in a brewery in India; managing an OSHA inspection; and what every manufacturer and contractor needs to know about asset protection, tax reduction and estate planning; among other topics.

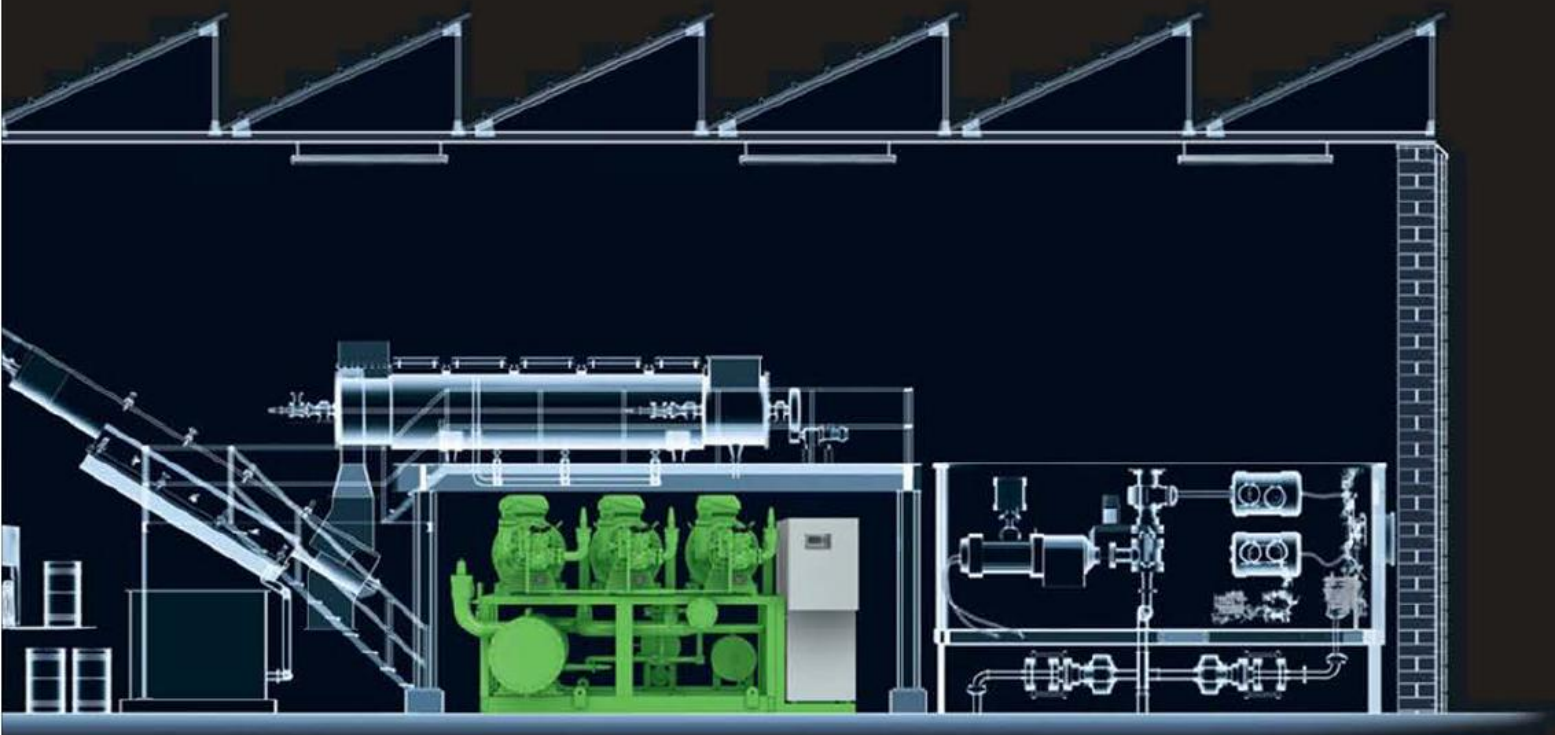
Technomercial presentations will be given by Colmac Coil, Evapco, GEA, Regal, Frick, Parker Hannifin, Baltimore Aircoil, Vilter, Mayekawa, Danfoss, California Controlled Atmosphere and Hansen.



Vilter’s presentation will be on a new range of NH₃/CO₂ refrigeration systems using single screw and reciprocating compressor technology, while Mayekawa will discuss packaged NH₃/CO₂ chiller system technology.

There will also be an International Program with presentations in Portuguese, Spanish, and Mandarin. All technical papers presented in English will be offered with simultaneous translation into Spanish, and all international language presentations will be offered with simultaneous translation into English.

Among the exhibitors with products related to low-charge ammonia, NH₃/CO₂ systems or CO₂ transcritical systems are the following: Alfa Laval (booth 708/710), Bitzer U.S. (401/403), Danfoss (821/823), Evapco (208/201), Hillphoenix (405), Mayekawa (808/810), Vilter (309/311), Azane (321), Colmac Coil (907/909/911), GEA (515, 517), Parker Hannifin (614, 616), Baltimore Aircoil (600/602), Danfoss (821/823), Carnot Refrigeration (923), Cimco Refrigeration (514/516), Frick (701), Fujian Snowman (222), M&M Refrigeration (322), GCAP (522), Innovative Refrigeration Systems (817), Zero Zone (300), Westermeyer Industries (609), Vahterus (518), Republic Refrigeration (301) and Stellar (409.411). **BZ & MG**

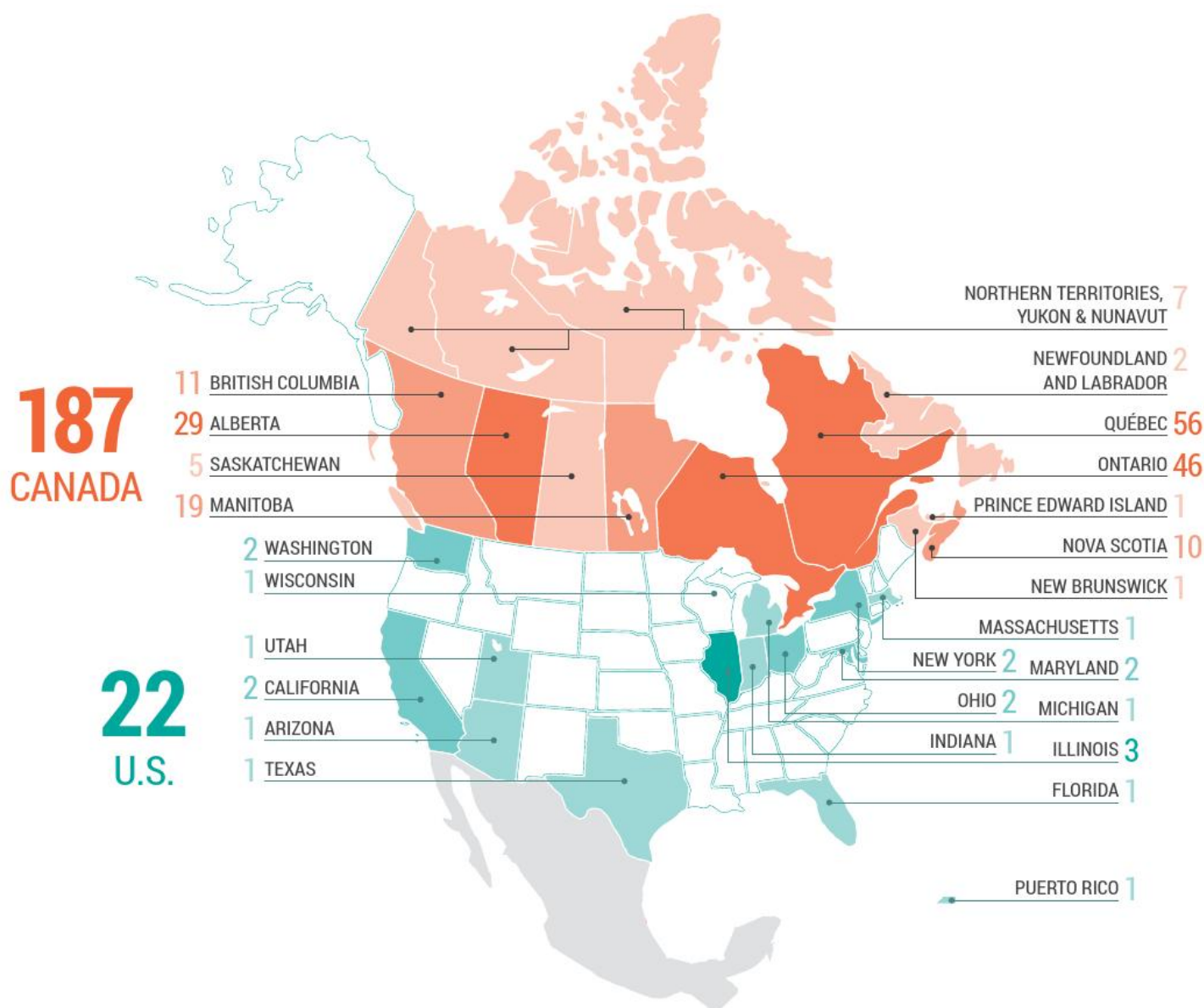


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USE OF LOW-CHARGE AMMONIA IN INDUSTRIAL REFRIGERATION

*As of September 2015



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EMBARKING ON A NEW VOYAGE

Seafood processor Neptune Foods is one of a growing number of industrial refrigeration end users installing low-charge-ammonia packaged units, in a major break from traditional refrigeration technology

— By Michael Garry

A large fishing boat is docked at a pier. A prominent black crane with multiple pulleys and ropes extends from the deck towards the top of the frame. In the foreground, a large, rectangular, silver metal container sits on the deck. The background shows a harbor with other boats and a city skyline under a clear blue sky. Two people are visible on the deck near the bottom right.

Fishing boat at Neptune Foods, San Pedro, Calif.



continued on p.22

On Terminal Island along the southern coast of Los Angeles County, Calif., Neptune Foods operates a seafood storage facility in an old Chicken of the Sea cannery right on the waterfront at San Pedro Bay.

Every day four fishing vessels head out to the Pacific waters near Santa Catalina Island and Santa Cruz Island and haul back about one million pounds of fish – mostly squid, mackerel, anchovies and sardines. The fish is unloaded at the Neptune Foods facility and trucked out for processing and blast freezing. Some of it returns and is stored in a 30,000-square-foot freezer at -4 °F before being shipped to markets overseas.

It all sounds fairly routine until you look at the refrigeration system used with the freezer. Instead of employing a standard liquid-overfeed ammonia system, Neptune Foods operates two low-charge-ammonia freezer units from Los Angeles-based NXCOLD that reside outside the building next to the freezer room. Rather than using thousands of pounds of ammonia refrigerant, each unit requires only 20 pounds of ammonia to generate 40 tons of refrigeration capacity. In total, the system's 0.5 lbs. per TR makes it one of the lowest-charge industrial refrigeration systems in the world.

"I'm real happy with [the NXCOLD units]," said Joseph Burch, general manager at Neptune Foods, a San Pedro, Calif.-based subsidiary of Red Chamber Co. "Personally, I don't know why anyone would go another route at this point. It's much, much simpler [than a traditional ammonia system] and it works."

NXCOLD is one of a handful of companies marketing systems that requires far less ammonia than the conventional pumped or gravity-fed overfeed systems that industrial food processors and cold storage facilities have been using for decades. While the definition of low charge varies, "people are using 10 pounds



NXCOLD low-charge-ammonia unit outside Neptune Foods

per ton of refrigeration capacity as a threshold for low-charge systems," said Pega Hrnjak, professor of mechanical science and engineering at the University of Illinois, Urbana, Ill. All low-charge systems drastically reduce the traditional "overfeed" of ammonia (four times as much as would ideally be needed to change phase from liquid to gas).

Low-charge systems currently represent a small percentage of the installed base, but they have captured the imagination of the industry and stand to revolutionize the way industrial refrigeration operates – and perhaps light-industrial and commercial refrigeration as well.

According to research conducted by shecco (publisher of *Accelerate America*), as of last September 209 industrial sites (22 in the U.S. and 18 in Canada) used a low-charge ammonia system (see page 18). Including hybrid low-charge systems (i.e., ammonia-CO₂ cascade), John Scherer, chief technology officer for NXCOLD, estimated that less than 2% of all industrial refrigeration systems in North America incorporate low-charge ammonia. But he foresees robust growth ahead, putting the percentage at 15% in five years, 25% in 10 years and 70% in 20 years. "It is my opinion that low-charge ammonia systems will dominate about 80% of ammonia refrigeration installations," he said.

Derek Hamilton, business development manager for Azane, another low-charge-ammonia packaged system supplier, estimated that 25% of new industrial buildings, and 30%-40% of renovations, are installing low-charge units.

Hamilton sees low-charge-ammonia systems covering the smaller end of the traditional ammonia market and the larger end of the R22/HFC condensing unit market. "It's carving out a new sector," he said.





“It’s much, much simpler [than a traditional ammonia system] and it works.”

Facilities that use condensing units with R22 or HFCs are particularly suited for replacement by low-charge-ammonia packages, said Hamilton. “You can switch to something that looks and feels the same but uses ammonia.” The challenge for Azane is that its units are more expensive than HFC models, though the R22 phase down and impending restrictions on HFCs are leading many companies in the direction of natural refrigerants. In addition, Azane’s units are 15%-20% more efficient than comparable HFC equipment, he said.



So far, Azane has had the most success with its low-charge chiller line, which use about 2 lbs. per TR and employ a glycol or water loop in process cooling and AC applications. (Azane’s low-charge-ammonia freezer, which places the evaporator in the cooling area unit, uses 5 lbs. per TR.; [see “Azane Has Big Plans for Low Charge,” *Accelerate America*, April 2015.](#)) This year, the company is supplying 300 TR air-cooled ammonia chiller packages to a food manufacturer for comfort cooling, and 450 TR packages to another food company for process chilling.

Azane’s packaged system employs a low-pressure receiver that prevents liquid from entering the compressor and includes a heat exchanger that subcools liquid coming from the condenser. The system also uses a “reverse cycle” process to defrost the evaporator.

In addition to NXTCOLD and Azane, Evapco markets a low-charge-ammonia packaged unit ([See “Research + Sustainability = Low-Charge Ammonia,” *Accelerate America*, December 2015-January 2016.](#)) Colmac Coil makes a DX low-charge ammonia evaporator for industrial applications ([see story, page 28](#)) while M&M Refrigeration has been a pioneer in the development of ammonia-CO₂ central systems that use relatively small amounts of ammonia ([see story, page 48](#)).

In addition, Japanese manufacturer Mayekawa is partnering with Cimco to bring its NewTon NH₃-CO₂ packaged unit to North America ([see “Coming to America,” *Accelerate America*, February 2016](#)); Stellar has been marketing a low-charge-ammonia packaged chiller that uses a secondary fluid like glycol; and Carnot Refrigeration supplies ammonia-CO₂ systems as well as all-CO₂ transcritical systems to its industrial customers. ([See story, page 27.](#))

continued on p.26 →

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INSIDE THE NXTCOLD LOW-CHARGE UNIT



Controls for NXTCOLD unit



Danfoss valves



Variable-speed
exhaust fan



Ammonia compressor package



Main power/variable
frequency drive panel



Evaporator

RPM display and control modules for variable frequency drive





Azane low-charge-ammonia freezer

→ 61 MORE UNITS

NXTCOLD's own installation numbers bolster the argument for growth in low-charge technology. The company currently has five packaged units in operation (including one at LA Cold Storage), with 61 more released for production. "I expect a similar number to be approved in the next six months," said Scherer. About 60% of these installations are for new facilities, the rest for existing plants.

Most of the units are going into cold storage facilities, 20% of which include food processing; each unit delivers from five to 150 tons of refrigeration capacity, with operating temperatures from -60 °F to 60 °F. They are replacing or upgrading traditional ammonia systems in larger plants and R22/HFC systems in smaller ones. So far 98% of the jobs have been in the larger facilities though "in the next three years it might be 50/50," said Scherer.

NXTCOLD is owned by Scherer and Los Angeles Cold Storage, where he is also manager of engineering. (See ["Breaking with Tradition," Accelerate America, April 2016.](#)) NXTCOLD's sales have benefited from Scherer's longtime connections with other cold storage operators. "The cold storage industry is tight," he said. "Competitors are usually friends and we support each other."

In addition to traditional industrial plants, NXTCOLD is targeting craft beer facilities, which range from 3,000 to 6,000 square feet. "They almost all use R22 and now need to switch," said Scherer. He is also looking at marketing NXTCOLD units as well as ammonia-CO₂ systems to light industrial and commercial applications, including supermarkets. Low-charge ammonia systems would be used in walk-in freezers, and in retail distribution hubs, while ammonia-CO₂ would be used with display cases. "We get a lot of calls about this from Mexico and Latin America," said Scherer.

NXTCOLD is now developing a system that could be used in concert with an existing central engine room. "If the engine room is in good shape, why replace it?" said Scherer. "Install NXTCOLD coils and take the tanks out."

The biggest initial driver of low-charge-ammonia adoption has been the opportunity to potentially lower the federal regulatory burden imposed on plants that have more than 10,000 pounds of ammonia, as well as reduce the hazards and potential legal liability that large charges present.

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CO₂ FOR INDUSTRIAL

When Marc-André Lesmerises cofounded Carnot Refrigeration in 2008, his first project was to build an ammonia refrigeration system for a Sobeys dairy distribution center in Trois-Rivières, Quebec. The system uses ammonia in the central chiller and glycol as a secondary fluid.

But Carnot's future would be more focused on CO₂. The Quebec-based OEM went on to become one of the main suppliers of CO₂-only transcritical refrigeration systems for supermarkets operated or franchised by Sobeys, Canada's second largest food retailer, and the leading user of transcritical refrigeration, with more than 70 store installations.

Carnot now supplies CO₂ transcritical systems to food processing and cold storage operators, which make up half of its business. "More and more we're seeing CO₂ transcritical warehouses," said Lesmerises.

Lesmerises believes CO₂ transcritical makes more sense for industrial warehouses, at least in northern climates, than low-charge ammonia systems in terms of energy efficiency, water usage and maintenance. They are similar in cost and installation to traditional ammonia systems and better in energy efficiency.

He noted that transcritical CO₂ systems in industrial plants are able to "hold pressure" better than transcritical systems in supermarkets. "You can stop the system without releasing CO₂."

Three years ago, Carnot installed a 690 kW CO₂ transcritical system in a new plant operated by Les Atokas Bieler, a Quebec cranberry processor, and added a second CO₂ system a year later. Carnot has since supplied the system to other cranberry processors.

Cranberries enter the Les Atokas Bieler facility only once a year – from late September to late October – and need to be cooled to about -20 °C. The original CO₂ system includes a medium-temperature section with nine semi-hermetic reciprocal compressors and a low-temperature section with 10 of the same compressors. Waste heat from the system is used for hot-gas defrost and sub-slab heating.

Carnot is also providing ammonia-CO₂ systems to some industrial facilities. For example, it is building a 350 TR NH₃-CO₂ system for an existing 500,000-square-foot warehouse that will use 1,764 pounds of ammonia and 3,300 pounds of CO₂ per rack in place of an all-ammonia system. Lesmerises recommends these systems for southern locations.

COLMAC'S LOW-CHARGE COILS

At the 2014 ATMOsphere America conference in San Francisco (organized by shecco, publisher of *Accelerate America*), Bruce Nelson, president of Colmac Coil, gave a presentation called "Reducing Ammonia Charge in a Large Refrigerated Warehouse."

In it, he described how Colmac's Advanced DX low-charge-ammonia evaporator, used for low temperatures in concert with a central machine room, resulted in a 4-5 times charge reduction compared to a conventional pumped ammonia system. (DX ammonia is typically limited to medium-temperature loads.) In one new Midwest facility, with a refrigeration load of 1,007 TR, Colmac's evaporator cut what would have been a 30,000-lb. charge to 7,300 lbs., Nelson said. The power consumption was expected to be equal to or less than a pumped system while the cost of the DX system was \$200,000 less.

Since then, Colmac has released case studies on several installations of its Advanced DX system at U.S. cold storage warehouses, including facilities operated by: Preferred Freezer Services in Richland, Wash.; Shepherd's Processed Eggs, Spanish Fork, Utah; Joliet Cold Storage, Joliet, Ill.; and US Cold Storage, Laredo, Texas.

"It's definitely starting to catch on in the industry," said Todd Shelden, sales manager, Colmac Coil, at the Seafood Expo North America March 6 in Boston. "There are enough projects so people can see it works."

The Colmac evaporator is able to bridge the gap from medium-temperature to low-temperature loads via three additions, explained Shelden: an electronic expansion valve, a tank distributor and enhanced evaporator tubes "that allow the ammonia liquid to coat the entire surface of the tube."

Over the past five years, Preferred Freezer Services has built seven facilities with low-charge DX ammonia evaporators and liquid injection oil cooling connected to central engine rooms, and will be installing this technology in five buildings under construction, said John Galiher, CEO of Preferred Freezer Services, at the company's booth at the Seafood Expo. The least amount of ammonia Preferred uses is 2,000 pounds.

"They know how to make DX coils within 95% of the efficiency of recirculated coils," said Galiher, who added that Preferred purchases DX evaporator coils from Colmac and Evapco.

Preferred follows OSHA's PSM requirements even in facilities with less than 10,000 pounds, Galiher said.



But Scherer points to a slew of other benefits associated with low charge: highly competitive installation costs, reduced operating (energy and maintenance) costs, lower insurance costs, simplified and lower-cost back-up power options, and smaller land and building requirements. In addition, the low-charge technology "enables the end user to focus more on 'core' business activities," he said.

Factors inhibiting the adoption of low charge include the conservative nature of the industrial refrigeration industry and the newness of the technology. With central ammonia systems, the industrial refrigeration industry "has a formula that has worked for decades," said Hamilton. "Now the traditional way is being challenged and it's taking time for them to come around to a new way."

BLAST FREEZING PLANS

Neptune Foods has occupied the old facility on Terminal Island (which had been vacant for 14 years) for about 1.5 years, and has been using the NXCOLD units for its freezer for about five months. The building is still being renovated, with plans to add blast-freezing capability this year.

Burch first saw the NXCOLD unit in operation at LA Cold Storage, where it is located on the rooftop. (Neptune's roof couldn't support the unit so it is located on the ground.) "Once we took a look at it, we liked it a lot," he said. "We liked the idea of not having so much ammonia, and the simplicity of it."

A conventional ammonia system would use 7,000-10,000 lbs., "and I'm running 40 pounds, if that," he said. Each of the units has a capacity of 40 TR, and it may be possible to turn one unit off and use it as a backup, he said, though he has not tried that yet.

What makes the unit simple is that virtually all of the refrigeration components are inside, including the evaporator, which normally would be inside the storage room. "There are no coils in the room, no fans; ducts blow cold air into the freezer," Burch said. "I'm no engineer and I can run the thing." Each unit has a water tower next to it for condenser cooling.



John Scherer, NXTCOLD

The NXTCOLD system is designed to control the refrigerant quantity within the evaporator "by keeping the quality level where it needs to be," said Scherer. It achieves this by means of an electronic refrigerant injection control (ERIC) mechanism. "We inject it when we need it, not when we don't need it."

A technician does a monthly check of Neptune's units. Low-charge ammonia does not appear to face the same technician training issue that burdens other natural refrigerant applications. "Many of the same [technician] channels used for [ammonia refrigeration] in the past are involved," said Scherer. "Generally, the low-charge systems are similar in concept to the large systems." In addition to monthly checks, he recommends continuous monitoring.

Better safety is another aspect of the low-charge system that appealed to Burch. "If we have a spill, there's no danger. With such a low charge, it evaporates into the air." By contrast, he alluded to the 2013 accident at a cold storage plant in Shanghai, China, that killed 15.

Scherer noted that the NXTCOLD unit is designed to automatically pump ammonia leaks into a diffusion system if the gas exceeds five parts per million. Even with the small quantities of ammonia in the unit, "you've got to be very, very careful to comply with applicable codes and regulations," he said.

The unit's simple design reduces the initial cost of the equipment and the cost of installation, which took only two days, noted Burch. "First costs are highly competitive," said Scherer, adding that compared to ammonia systems with central engine rooms, his systems are usually less, but they are more than for packaged HFC systems.

Hamilton agreed that packaged ammonia units tend to be competitive with central ammonia systems, at least in the small-to-mid range. "But if you have a large warehouse that would require 20 packages, it would undoubtedly be cheaper to install a central system."

Utility rebates for the systems may be available. "Some utilities

SYSTEM SPECS

Neptune Foods' low-charge-ammonia refrigeration system at its plant in San Pedro, Calif., has the following characteristics:

- » Provider: NXTCOLD
- » Freezer size: 30,000 square feet
- » Temperature of freezer: approx. -4 °F
- » Number of packaged units: 2
- » Location of packaged units: outside building, next to freezer room
- » Ammonia charge per unit: 20 pounds
- » Refrigeration capacity per unit: 40 tons
- » Key technology: Electronic Refrigerant Injection Control (ERIC)
- » Unit contains compressor, condenser and evaporator
- » Unit contains no receivers or accumulators
- » Cold air transfer: Ducts into freezer room
- » System controller: Logic Micro-Systems

are setting up special rebate systems specifically for low ammonia charge refrigeration systems," Scherer said. (Neptune did not receive a rebate, but Lineage Logistics received one from Southern California Edison for a NXTCOLD unit installed in a facility in Oxnard, Calif.)

Burch didn't have energy consumption numbers but, according to Scherer, NXTCOLD units are typically 8%-10% more efficient than central ammonia systems. The units are 15%-25% more efficient than small HFC packaged units, making up for the cost difference in 1-2 years, he said.

Neptune next plans to install 900 TR of blast freezing at its San Pedro plant to process incoming fish hauls, making it one of the largest blast freezers in the U.S. Burch's goal is to freeze the fish in 10-12 hours. The company is still evaluating refrigeration options, including NXTCOLD units. If selected, NXTCOLD would install nine 100-TR units outside the building, three at a time, encompassing 2,400 HP of equipment. In this case, evaporator coils would go inside the blast freezer.

Hamilton, who spoke about low-charge systems at the IAR Conference in 2015, does not believe there is a single low-charge solution for every industrial facility. "Each facility is unique, he said. "There's the age and condition of the plant, and whether you expect to be there for the next 20 years, or does it have just 8-10 more years of life. If you invest in low charge, it will have a lifespan of 20-25 years, so your buying decision will be driven by that and by the condition of the existing equipment." **MG**

U-TURN ON ICE

In converting from R22 to ammonia, Montreal's ice rinks are using a u-shaped liquid separator to save space and reduce charge

— By Robert Davidson



While the transition from ozone-depleting R22 refrigerant to more environmentally friendly alternatives under the Montreal Protocol is most notable in the supermarket industry, it also applies to ice rinks.

The city of Montreal, for example, over the past year has begun the conversion of its 40 municipal ice rinks – used primarily for ice hockey – from R22 to ammonia, at the pace of about four per year.

As part of this conversion, the municipality is using technology designed to reduce ammonia charge, save space and maximize efficiency, including components from Swedish heat exchanger manufacturer Alfa Laval.

For example, the renovated ice rinks are employing Alfa Laval's "U-Turn" liquid separator designed to work with plate heat exchangers in ammonia applications. The U-Turn, literally u-shaped, is placed on top of the Alfa Laval M10 semi-welded gasketed heat exchanger in an evaporator, and the Alfa Laval AlfaNova 400 in a condenser. It can cover ammonia capacities from 200 to 1400 kW at 0°C evaporation temperature and from 50 to 500 kW at -40°C evaporation temperature.

The U-Turn benefits the operation of the ice rink as well as delivering a significantly reduced environmental impact. For example, it requires less floor space and is quicker to install than the relatively cumbersome surge drum, which was used previously. It also reduces the amount of insulation and structural steel required.

Compared with an installation using shells and tubes, the U-Turn "is much smaller and the system is much more responsive," said

John Goswell, general manager, equipment division, in Alfa Laval's Toronto office. Many ice rink facilities have height restrictions "and our system – including the U-Turn separator – fits these requirements easily."

The U-Turn also minimizes the amount of refrigerant required, which lowers operating costs while improving safety. "Using our separator and heat exchanger design in our products allows us to have the smallest charge possible," said Goswell. At the Ahuntsic Arena in Montreal, the amount of ammonia used in the system was reduced by about 25%, according to Alfa Laval.

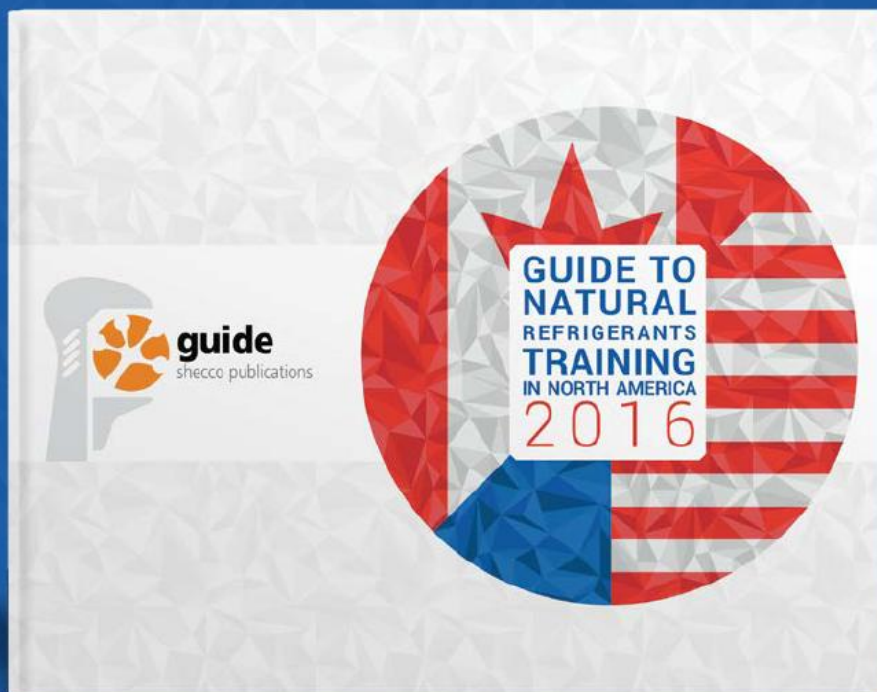
SOME CO₂ INSTALLATIONS

The use of ammonia in Montreal's ice rinks is part of an overall trend towards natural refrigerant solutions, including some CO₂ transcritical systems, across the 2,600 indoor ice rinks in Canada and 1,900 in the United States.

In the U.S., a CO₂ transcritical system was installed in two ice rinks in Alaska in 2014 and 2015. However, the use of CO₂ as a refrigerant for in ice rinks has yet to receive approval under the Environmental Protection Agency's SNAP (Significant New Alternatives Policy) program, which will prevent the technology from gaining wider usage. Both Alaskan ice rinks were granted special exemptions.

In Canada, the vast majority of ice rinks in the last 15 years have been ammonia installations, along with a few CO₂ transcritical sites, said Goswell, adding that the CO₂ systems are more expensive. Alfa Laval continues to target "older R22 systems that will need replacing." **RD**

Report on Natural Refrigerants Training in **North America**



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RAISING A TOAST TO NATURAL REFRIGERANTS

Brewing giant SABMiller is employing propane refrigeration in new beer coolers throughout its sprawling global enterprise

— By Andrew Williams



André Fourie, SABMiller



As the world's second-largest brewer by revenue, London-based SABMiller uses a lot of resources. But the company is aware of its responsibility to marshal those resources in a sustainable way.

"We measure the carbon impact of the company across the value chain," said André Fourie, the company's head of water security and environmental value. "We look at agriculture – the barley, the malt and the hops that we buy. We look at the malting process, we look at the manufacturing process, we look at the refrigeration and packaging of our products, we look at the distribution process, and we look at end-of-life," Fourie told *Accelerate Europe* (sister magazine to *Accelerate America*) at his base in Woking, Surrey, near London.

Founded as South African Breweries in 1885, SABMiller is now an FTSE (Financial Times Stock Exchange) 100 company with operations across six continents, employing some 70,000 people in more than 80 countries.

Among SABMiller's portfolio are premium international brands such as Milwaukee, Wis.-based Miller Genuine Draft, Peroni, Nastro Azzurro, Foster's and Grolsch alongside local names such as Pilsner, Urquell, Castle, Tyskie and Lech. The company is also a major bottler of Coca-Cola.

With refrigeration representing between 18% and 20% of the company's carbon footprint, natural refrigerants are playing a central role in helping to deliver on the firm's commitment to reduce carbon emissions by 25% across its whole value chain by 2020 (compared to 2010 levels).

SABMiller is committed to purchasing 100% HFC-free store fridges (largely using propane) by 2020 for its bottled beer. The purchase rate of new fridges across the markets in which SABMiller is active is around 10,000 per year. It started the process in Europe, purchasing about 8,000 new propane fridges for its Polish retail network, and then scaling up that strategy. Last year, about 90% of new fridges purchased in Europe were HFC-free.

All told, the brewing giant owns some 900,000 fridges, making the strategic decision by such a large multinational company to adopt natural refrigerants a potential landmark moment.

With that plan underway, Fourie stressed the importance of keeping up the momentum. "Despite some challenges, we are pleased that we're currently on track to meet our commitments."

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→ He expects the market to move quickly. "Once the suppliers have one or two models, all of a sudden their competitors are under pressure to have similar models, they have more confidence, and their maintenance suppliers quickly make the shift to support the industry."

In Poland, for example, where SABMiller has deployed the highest number of natural refrigerant-based equipment, the market is already reaching a point where the best performing and best value fridges on the market use natural refrigerants.

All of SABMiller's pilots have confirmed the viability of natural refrigerants if the required technical expertise and maintenance capacity are available. "We work closely with suppliers in this regard," the company said in a document, "Refrigeration," released by the Consumer Goods Forum (CGF), a Paris-based trade group to which SABMiller belongs.

SABMiller has also developed user-friendly guides and training tools for its sales representatives and retailers to guide them on the safe and sustainable operation of the fridges. "Useful tips on the placement, condition and operation of the fridges ensure optimal cooling of the beer, and energy and cost savings for the retailer," said SABMiller in the CGF document.

The company is keen to make the financial case for adopting natural refrigerants for fridges. Fourie is confident that fridges using natural refrigerants are cheaper to run. The company is currently collecting data from its suppliers and retailers to help demonstrate this. "We've had very encouraging data. There are definitely financial savings for the retailer, and at the same time, CO₂-equivalent savings."

THE WAY THE WORLD IS GOING

Having chosen to phase out HFCs, did SABMiller consider other synthetic refrigerants before opting for 100% natural refrigerants? No, says Fourie. "Our decision was that when you're moving, you may as well move out of [synthetics]. Why repeat what we had with CFCs? It's quite clear which way the world is going."

Officially, the firm's policy remains "HFC-free" – meaning free of low-GWP synthetic refrigerants (unsaturated HFCs) too. "But as the language developed over time, we saw the value of talking about natural refrigerants," he said. "It's a marketable term. We also think it's the right direction, that we want the world to take. So we came to talk about natural refrigerants."

Currently, SABMiller's policy is to adopt propane as the refrigerant of choice for trade fridges that it purchases specifically for beer, because retailers understand its use very well. However, some



retailers prefer to use CO₂ cases – particularly when a case also includes soft drinks – either their own or from a soft drink supplier. So SABMiller decided against imposing one particular refrigerant on their retailers. "We're entirely comfortable with CO₂," said Fourie. "But when we buy [a case] ourselves, we prefer to use propane."

All SABMiller's breweries use ammonia – another natural refrigerant – for industrial refrigeration purposes. "We used to operate quite distinct ammonia systems in different parts of the breweries. We're getting better at managing it more centrally and making sure that they are efficient," Fourie said.

On the retail side, in larger markets, SABMiller draws up contracts with direct service providers, whose telephone number will be clearly visible on the fridge. They take care of maintenance and tackle any faults with the refrigeration equipment on SABMiller's behalf.

For many food retailers, distribution also plays a large role in their refrigeration footprint. But SABMiller took the strategic decision not to go down that road. "By and large, we don't transport our beer cold. And in many cases, we don't own the transport," he explained. In fact, the company actively discourages the transportation of cold beers, which it sees as a waste of energy. "Because you unpack them, and they get warm again."

It used to be quite common in the U.S. to transport beer cold, "but that's changed over time," he added.

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THE POWER OF BRAINS

A machine is only as good as the engineer who built it



THE FLAGSHIP SOLUTIONS FOR CO2 TRANSCRITICAL APPLICATIONS

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→ JOINING REFRIGERANTS, NATURALLY!

Recently, SABMiller became the fifth member of Refrigerants, Naturally! – an initiative of international companies taking action against global warming and ozone layer depletion by replacing harmful greenhouse gases in point-of-sale cooling and freezing units with climate-friendly natural refrigerants.

The goal of the group – in which SABMiller, Red Bull, PepsiCo, the Coca-Cola Company and Unilever join forces with supporting partners Greenpeace and UNEP – is to make natural refrigerants the preferred cooling technology in a safe, reliable and cost-effective manner.

Fourie stressed the importance of working together with global partners to tackle the challenges facing our planet. “It’s part of our understanding that in just about all the areas in which we invest in terms of sustainable development, the challenges and the solutions are bigger than us as a company,” he explained.

Fourie said it was particularly helpful to see other major multinational brands commit to sustainable business practices under the Refrigerants, Naturally! umbrella – both in terms of seeing how other companies have overcome some of the obstacles, and in raising awareness of SAB Miller’s sustainability initiatives among its own workforce.

CGF is also helpful in these regards. In 2010, CGF – which brings together over 400 manufacturers and retailers of consumer goods – adopted a resolution recognizing that the HFCs used in the majority of refrigeration systems are powerful greenhouse gases and pledging to start the process to replace them with natural refrigerants.

Fourie recently assumed the chairmanship of CGF’s Refrigeration Working Group. “There is a clear policy logic for this group to explore how it can improve the environment for more sustainable refrigeration of their products,” he said.

The 2010 resolution saw some of the world’s biggest companies pledge “to begin phasing out HFC refrigerants as of 2015 and replace them with non-HFC refrigerants (natural refrigerant alternatives) where these are legally allowed and available for new purchases of point-of-sale units and large refrigeration installations.”

Fast-forward to this year, and CGF members have installed low-carbon refrigeration systems in over 4,000 supermarkets and four million ice cream and drink chiller units worldwide. The majority of these systems use natural refrigerants. And in January, they agreed to consider increasing their use of natural refrigerants as an alternative to climate-damaging HFCs.

SABMiller is working with partners in both bodies to ascertain which policies would be most helpful to promote.

Not everyone may agree on exact formulations, dates, or targets. “But to say, ‘this is the type of regulation that we want in the rest of the world,’ whatever the appropriate timeline – I think that would be possible. It could be powerful,” Fourie said. Having business voices commit to supporting a phase down of HFCs in the Montreal Protocol would also be a massive step forward.

Business voices need to be careful about how their actions are perceived, he noted, admitting that this may lead some companies to exercise caution in calling for strong regulation. And yet he is also in no doubt about the vital role that regulatory action can play in forcing businesses to move decisively.

In Europe, for example, the EU F-Gas Regulation has helped to focus business minds on the need to phase out HFCs. “There is only one reason why our European business is ahead of the rest – and that’s because regulation has moved faster in Europe.”

In addition, regulation plays a key role by triggering overarching cost structure changes, investment in new suppliers,



technological innovation, and new maintenance processes. “So it’s a package. You cannot deny that regulation is a very important part of that,” he said.

At the COP21 climate change talks in Paris last December, some manufacturers and end users of natural refrigerants – including Carrier Commercial Refrigeration, Dorin, EVAPCO, Unilever and the Coca-Cola Company – broadly welcomed the historic climate agreement reached among nearly 200 countries.

These companies see business opportunities in reducing HFC use to help keep the global temperature rise below two degrees Celsius. Fourie shared their enthusiasm; however, he is more cautious on the implications for sustainable refrigeration. He felt that in Paris, the policy discussion around refrigerants was not strong enough. But with national governments now charged with coming up with national plans to deliver on the global objective agreed at COP21, a new window of opportunity might be about to open.

“The fact that national governments now need to work out their own targets for how they’re going to get there is really important, and hopefully over time they’ll see some opportunity in refrigeration,” he said.

Fourie suggested the G20 group of the world’s major economies holds more promise for phasing down HFCs – with the majority of its governments supportive of taking decisive action. What if the CEOs of the world’s 20 biggest companies were to echo a political agreement with a similar declaration themselves? “I think that would be quite powerful,” said Fourie.

Fourie hopes that by sharing SABMiller’s experiences with his counterparts from other companies, he can inspire others to commit to natural refrigerants. “That’s very much part of the journey – to inspire and challenge, but also to learn and to find consensus,” he said. **AW**

A MERGER’S IMPACT

In November 2015, Anheuser-Busch (AB) InBev – the world’s largest brewer – agreed to a merger with SABMiller in a deal that will combine the planet’s two largest beer makers.

Headquartered in Leuven, Belgium, AB InBev boasts a portfolio of over 200 brands including Budweiser, Stella Artois, Leffe, Beck’s, Hoegaarden and Corona. With a total market share of over 20%, it employs over 155,000 people in 25 countries.

If approved by regulators, the merger is expected to take place in the second half of 2016. The newly created firm would produce about 30% of the world’s beer.

Asked what effect the merger would have on SABMiller’s environmental practices, André Fourie, the company’s head of water security and environmental value, stressed that it is too early to speculate. Nevertheless, he stated that SABMiller would be eager to promote the lessons learned from all of its environmental initiatives.

“There are lessons we have learned on how to save energy from making beer, how to manage water risks to our operations and how to make refrigeration sustainability have environmental and financial value for us and our partners. All this is an important part of our story. These are things that we will be sharing with them.”

CREDIT BANK AIMS TO INCENT HFC RECLAMATION

By offering carbon credits for reclaimed HFCs, the program would cut production of virgin HFCs and facilitate a transition to non-HFC systems

— By Andrew Williams

In an effort to reduce the production of HFC refrigerants by incentivizing the reclamation of existing HFCs – and potentially boost the usage of HFC alternatives like natural refrigerants – several HVAC&R industry organizations are developing a U.S.-based “Reclaimed HFC Credit Bank.”

The Reclaimed HFC Credit Bank was announced at a White House-hosted meeting on HFC reduction last October. It will harness an HFC reclaim protocol under the American Carbon Registry to provide certified carbon credits for reclaimed HFCs, thereby allowing end users, technicians, refrigerant distributors and reclaimers, manufacturers and other industry participants to increase the use of reclaimed HFCs. Credits will also be offered for destroyed HFCs.

Companies that earn carbon credits can sell them to organizations, such as utilities, operating under a cap-and-trade regimen like that used in California.

The organizations involved in developing and implementing the Reclaimed HFC Credit Bank, include: The Alliance for Responsible Atmospheric Policy (ARAP), the Air Conditioning, Heating and Refrigeration Institute (AHRI); the Air Conditioning Contractors of America (ACCA, also called the Indoor Environment and Energy Efficiency Association); the Heating, Air-Conditioning and Refrigeration Distributors International (HARDI); and EOS Climate, a San Francisco-based company that develops refrigerant management strategies.

“The goal is to minimize the aggregate amount of HFCs produced between the present and the phase down,” said Jeff Cohen, senior vice-president of EOS Climate, which played a central role in designing and implementing the HFC Credit Bank and designed the Greenhouse Gas Protocol recently approved by the American Carbon Registry. “Greater reliance on reclaimed HFCs displaces production of virgin HFCs, reducing the inventory of HFCs and facilitating a transition to non-HFC systems.”

Reclamation or destruction of used HFCs would also reduce the amount vented into the atmosphere.



“The GHG protocol that we developed also enables credits for deployment of low-GWP commercial refrigeration systems, including those using natural refrigerants.”

The Environmental Protection Agency has been delisting high-GWP HFCs such as R404A and R507A in commercial refrigeration applications. In addition, the Montreal Protocol is embarking this year on negotiations to phase down production of HFCs on a global basis, which would be similar to the group's phase down of CFCs and HCFCs.

The Reclaimed HFC Credit Bank is envisioned as being both consistent with, and further supportive of, U.S. regulations concerning refrigerant management, including the extension of regulations issued under Section 608 of the Clean Air Act to HFCs.

PILOTS IN 2016

The new scheme will launch as a pilot project among selected U.S. businesses in 2016. Initial pilot projects will work with OEMs, building owners, and retailers, as well as the service industry and distributors, to demonstrate how additional usage of reclaimed material, either through direct reclaim activity or purchase of reclaim credits, “can be used to reduce the overall HFC carbon footprint,” said Kevin Fay, executive director for ARAP.

Full implementation across the U.S. is foreseen for 2017. “Participation will be on a voluntary basis, and could also include government entities. Government entities are typically the largest building owners within their jurisdiction,” said Fay.

EOS will be working with companies in the refrigeration sector to design and implement the credit bank “so that credit reporting, verifications, transactions and environmental metrics are integrated into normal business operations, and that they are able to realize the economic and environmental benefits associated with increased HFC reclamation.”

Asked how the new HFC Credit Bank scheme would affect the use of natural refrigerants in the U.S., Cohen said, “It’s important to remember that in addition to credits for reclaimed HFCs, the GHG protocol that we developed also enables credits for

deployment of low-GWP commercial refrigeration systems, including those using natural refrigerants. The initial phase of the Credit Bank is focused on reclaimed HFCs but as the banking scheme evolves, we will be looking at how the low-GWP credits could be incorporated.”

However, Charlie McCrudden, senior vice-president for government relations at ACCA, noted that the Credit Bank is “focused on the reclamation and destruction of HFC refrigerants, so any impacts on natural refrigerants will be secondary.”

Cohen believes the HFC Bank could eventually inspire similar schemes elsewhere. “The pilot will be done with a select subset of U.S. businesses, but we are designing the system to scale at the national level and, where possible, extend to other countries around the world,” he said.

The Credit Bank is designed to be a component of the Global Refrigerant Management Initiative (GRMI), which was announced at the United Nations Secretary General’s 2014 Climate Summit by the ARAP, AHRI and the Brazilian Association for HVAC-R (ABRAVA). GRMI is developing initiatives aimed at reducing global HFC emissions by 30% to 50% within 10 years.

In particular, GRMI will work to identify opportunities to educate the industry’s global supply chain on ways to improve the management of refrigerants and to reduce leaks and service emissions, particularly where current leak rates are the greatest.

In addition, the initiative promotes the recycling, recovery, reclamation and end-of-life destruction of refrigerants, as in the Credit Bank plan. ● AW

SHEDDING LIGHT ON NATREFS IN THE LAND OF THE RISING SUN

ATMOsphere Asia brings the global HVAC&R community to Tokyo to learn about the rapid development of CO₂ condensing units in c-stores and the growth of NH₃/CO₂ units

— By James Ranson and Klara Skacanova



There was a distinct international flavor at the third edition of the ATMOsphere Asia conference, with end users from around the globe descending on Tokyo to tap into Japan's technological expertise.

Japan's progress in adopting CO₂ technology at convenience stores was of particular interest to end users from Belgium (Delhaize), Germany (METRO AG) and Canada (Sobeys) who attended the event, held in Tokyo February 9 and 10, and organized by shecco, publisher of *Accelerate America*.

During her opening address, Nina Masson, shecco's deputy managing director, highlighted the considerable impact that Japan's work with natural refrigerants is having on the rest of the world. "What we are seeing is companies bringing CO₂ stores to Indonesia and EcoCute CO₂ heat pumps to Europe – not to mention joining

forces on next-generation technology in Canada and entering into joint ventures with North American companies," Masson said.

More than 200 individuals attended the event (the most ever), including 30 end users, government officials, environmental bodies and professors. The attendees viewed 40 presentations covering the integration of more compact, lower-charge ammonia systems for industrial applications; the growing role CO₂ is playing in the commercial sphere; barriers related to equipment cost; and the unstable, yet crucial legislative programs currently propelling natural refrigerant technology forward in Japan.

Masson also highlighted the opportunities that exist for foreign manufacturers offering solutions that are well established in other world regions but not yet widely used in Japan.

To this end, there was a heated debate about the prospects for hydrocarbon technology in Japan, where companies are hesitant to overcome the barriers (such as lack of safety standards) to adoption of technology that is widely used in Europe and other parts of Asia. The exception to that is the beverage vending machine sector, which has 1.35 million HFC-free units (using CO₂ and hydrocarbons) in Japan.

LAWSON LEADS THE WAY

Japanese convenience store giant Lawson, the world's largest retail user of natural refrigerants, is expected to have 1,300 stores with CO₂ transcritical condensing units this year in Japan. The retailer said it is also establishing the technology in neighboring regions.

In Indonesia, Lawson helped install 13 natural refrigerant solutions for Alfamidi (PT Miti Utama Indonesia), of which Lawson is a subsidiary, with funding from the Japanese Ministry of Economy, Trade and Industry's Joint Crediting Mechanism (JCM). Lawson intends to install natural refrigerant systems in another 12 stores there in 2016.

The Delhaize Group, which announced a merger with Dutch retailer Ahold in June 2015 to bolster both companies' U.S. operations, has 130 stores in Indonesia and said it is investigating the idea of testing natural refrigerant solutions in Southeast Asia.

These developments represent positive news for manufacturers like Japanese compressor maker Sanden, which announced at the event that prices of its CO₂ compressors have halved in the last five years. It hopes to reach cost parity with HFC models in the next three years.

Sanden sold 1.5 million CO₂ compressors globally between 2011 and 2015. That includes 500 installations in the growing convenience store market as of the end of 2015 – a figure the company expects to reach over 50,000 by 2020.

Aside from Indonesian retailer Alfamidi, the event also welcomed a number of other new Asian end users: COOP Mirai, Marukyu, Patine Leisure (all Japan) and PT Adib Global Food Supplies (Indonesia).

In addition to the focus on CO₂ solutions for the commercial sector, a number of manufacturers and end users discussed the latest technology developments for low-charge ammonia and ammonia/CO₂ technology in the industrial sector, including Mayekawa, Mitsubishi Heavy Industries, Danfoss, Yokorei, Yokohama Reito and Chemical Grouting.

Mayekawa has so far installed 880 units of its NH₃/CO₂ NewTon cooling system in Japan and abroad. In 2016, the company plans to develop an ammonia packaged solution to target smaller applications, using scroll compressors rather than screw compressors.

In late 2015 Mayekawa's president, Tadashi Maekawa, spoke of the company's plans to branch out from industrial to the commercial sector. "We are planning to develop NH₃/CO₂ showcases for supermarkets and convenience stores [in 2016]," he said.

Adib Global Food Supplies and Patine Leisure were among the end users to disclose results of their NewTon installations, reporting energy savings of 30% and 50% respectively. Patine Leisure has utilized solar power in combination with two NewTons at its Saitama Ice Arena and in view of the impressive results would like to market the concept outside Japan.

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ATMOsphere Asia 2016

→ POLICY CONCERNS

Three major concerns were raised at the event with the potential to slow the advancement of natural refrigerant technology in Japan.

First, the country's High Pressure Gas Safety Act (HPGSA) continues to run contrary to the huge growth of CO₂ solutions, and threatens their potential for larger systems.

For example, the restrictions imposed by the HPGSA are limiting the uptake of higher-capacity CO₂ transcritical booster systems, which are used in more than 5,500 stores in Europe.

Nonetheless, Japanese OEM Panasonic announced plans to launch a 30HP CO₂ condensing unit in 2016 with the hope of targeting larger convenience stores and supermarkets in Japan. Panasonic's acquisition of major U.S. OEM Hussmann will help fast-track production in 2016, including variations of the company's convenience store solutions to "provide new natural refrigerant solutions for every customer," said Panasonic's chief Tetsuro Homma.

"We are always communicating this question with government, having successfully launched bigger CO₂ products in other parts of the world," Homma said of the HPGSA limitations.

Another concern is the Ministry of the Environment's subsidy scheme, which has provided over 11 billion yen (\$97 million) in the past two fiscal years, and an expected 8.5 billion yen (\$73 million) in 2016. The subsidies continue to be essential to eliminating the cost disparity between natural refrigerant and synthetic refrigerant-based systems.

In the event the subsidy scheme is discontinued in Japan, it remains to be seen whether multinational companies like Lawson, AEON, 7-Eleven and FamilyMart, will continue to introduce natural refrigerant technology at the same rate, and what the implications would be for natural refrigerant markets in neighboring regions.

Finally, Japan's more lenient F-Gas laws are failing to accelerate the phase out of HFCs at the same rate as in Europe and as proposed by the Air Resources Board in California. Concrete bans and phase downs would have a direct effect on end users and suppliers in Japan, who may not be sufficiently incentivized by a comparatively unambitious GWP cap of 1,500 in some applications.

Conference speakers pointed out there the need to define on a global basis what low-GWP actually means. In Japan, the labeling scheme is unclear in that it mixes HFOs and natural refrigerants under the same "non-Freon" banner.

Sidi Menad Si Ahmed, shecco's international chief advisor, and Armin Hafner, professor of refrigeration technology at the Norwegian University of Science and Technology, questioned the calculation of some HFO GWPs, and stressed the need to make a distinction between all synthetic refrigerants and natural refrigerants.

"Who is doing these calculations of the GWP value of these [HFO] fluids?" Hafner asked. "Who is on these committees and who is doing independent research on these values? The value of some of the figures is below one – how can that be? This is very suspicious in itself." ● JR & KS

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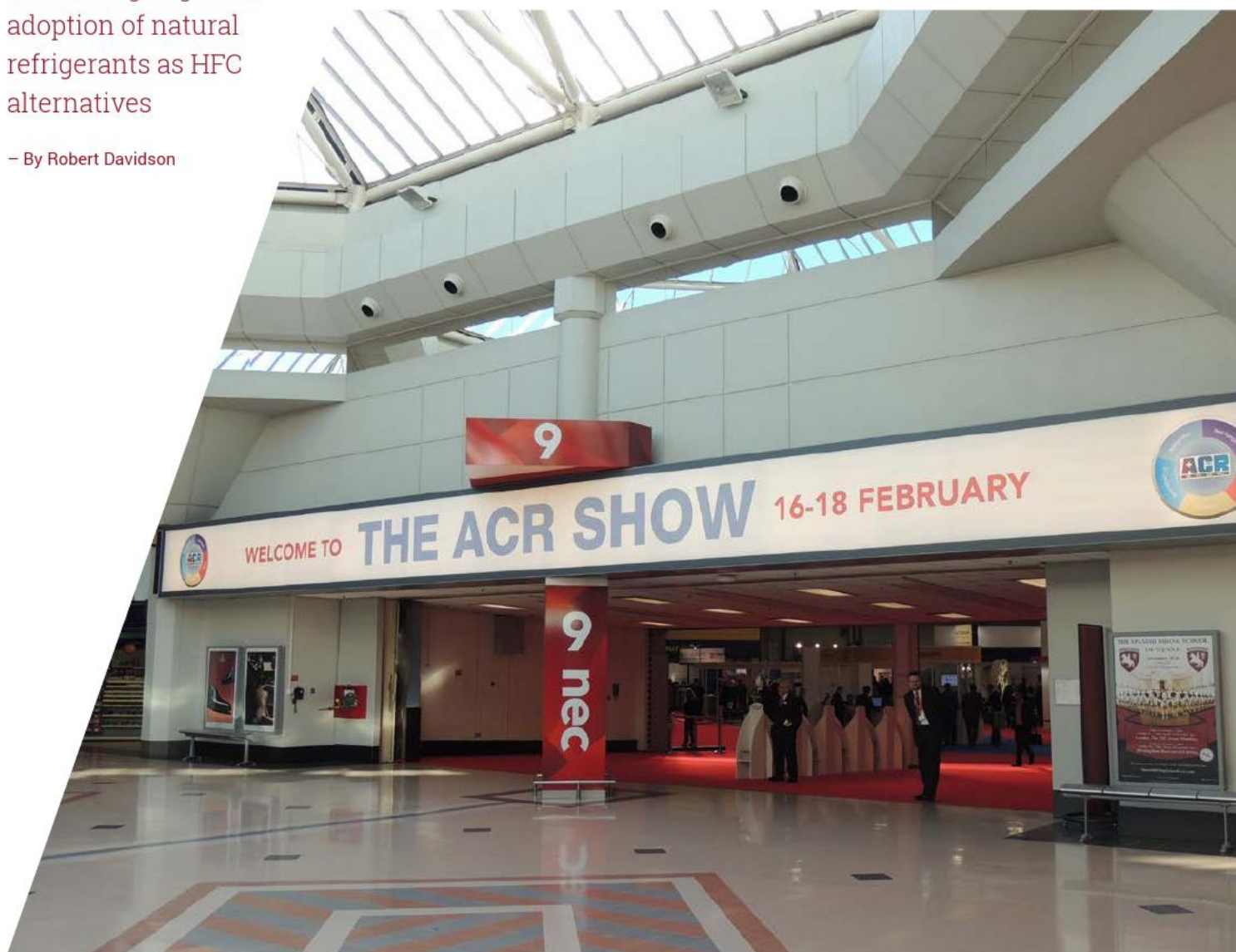


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EUROPE FEELS REGULATORY HEAT

F-gas restrictions are leading to greater adoption of natural refrigerants as HFC alternatives

– By Robert Davidson





The most aggressive policy initiative in the world to reduce the emissions of the potent greenhouse gases known as HFCs (aka F-gases) has been taken by the Brussels-based European Union (EU), an alliance of 28 mostly European countries.

The first F-gas Regulation was adopted in 2006 and succeeded in stabilizing EU F-gas emissions at 2010 levels. A subsequent regulation, which replaced the first and took effect January 1 2015, strengthened the existing measures and introduced a number of far-reaching changes. By 2030 it will cut the EU's F-gas emissions by two-thirds compared with 2014 levels.

"This represents a fair and cost-efficient contribution by the F-gas sector to the EU's objective of cutting its overall greenhouse gas emissions by 80%-95% of 1990 levels by 2050," according to the European Commission, which oversees the EU.

Until now, however, many HVAC&R industry players have reported that the EU's F-gas Regulation has had only a subdued impact on the European marketplace. But as the decisive year of 2018 looms closer – with its deadline for reducing the use of high-GWP HFCs by 44% – the search for alternatives such as natural refrigerants is intensifying.

This shift was evident at the ACR Show and the Institute of Refrigeration (IOR) Conference, held side-by-side at the National Exhibition Centre in Birmingham, U.K., February 16-18. *Accelerate Europe*, a sister publication to *Accelerate America*, was on hand to report on the impact of the regulations on the adoption of natural refrigerants CO₂, hydrocarbon and ammonia.

This EU F-gas regulation is beginning to drive Europe in two directions. First, it forces companies using high-GWP HFCs to reconsider which refrigerants to use, with clear suspicions as to the future role of HFOs. Second, it acts as a reward for the early adopters of natural refrigerant technology, who are in a comfortable position to weather the coming regulatory storm.

EMBRACING CO₂

The European market is perhaps most notable for its early adoption of CO₂ transcritical refrigeration in the supermarket sector, where 5,500 stores now operate these systems. At the IOR Conference, a case study presented by U.K. refrigeration-equipment manufacturer Arctic Circle showed the willingness of supermarkets to take on CO₂ as an alternative to HFCs.

Ruben Duarte, international sales manager for Anaheim, Calif.-based Fieldpiece Instruments, noted how its business of manufacturing leak detectors for refrigeration applications is growing to incorporate CO₂ leak detectors. "There's more demand for a CO₂ detector in Europe, Canada and Japan than in North America," he said. "So we created a product for international markets, but we expect the United States to grow right behind everyone else."

A mix of factors is driving the demand for CO₂ products, said Duarte. "The world is becoming more environmentally conscious and everyone knows HVAC&R is a sector that is responsible for a large amount of greenhouse gases. So you have those who want to do the right thing and you have businesses that want to accommodate this growing demand. Due to this combination, we expect the CO₂ market to grow exponentially in the next ten years."

ECODESIGN HELPS HYDROCARBONS

Stefano Bellada, segment manager of air conditioning & refrigeration heat-exchanger manufacturer SWEP, noted that it was not just CO₂ but hydrocarbons that are growing in commercial refrigeration applications. "The market is growing for new advanced systems across the world, such as for our water-loop systems which utilize hydrocarbons."

Hydrocarbons stand to gain in light-commercial applications as a result of another EU regulation, the Ecodesign Directive, which sets out minimum mandatory requirements for the energy efficiency of a wide range of products, and includes mandatory energy-rating label requirements.

Paul Anderson, commercial director for Gram, a U.K.-based maker of light commercial and other refrigeration equipment, spoke about the implications of the Eco-design regulations coming into effect July 1, 2016.

continued on p.46 →

BULLISH ON A GLOBAL PHASE DOWN

Following on agreements reached in Dubai last November, the Montreal Protocol will be working in 2016 on a plan to phase down production of HFCs on a global basis.

At the Institute of Refrigeration (IOR) Conference held in Birmingham, U.K., last month, Ray Gluckman, who offers consulting services on climate change mitigation and refrigeration, was bullish about the prospects for this plan. "It is likely we will see the HFC phase down become a global consensus in 2016 among all 197 countries in the world."

When questioned on whether a global phase down could potentially undo the work the European Union has been doing to reach its targets, Gluckman replied:

"It would actually make it easier if it's a global phase-down because of production and consumption targets. Production is only in a discrete number of factories, most of which are in China. So provided these can be controlled, then you're not putting the [HFC] gas into the market. The problem with Europe going alone with its F-gas Regulation is [that] the EU cannot control the production of HFCs outside of Europe, [so] when [European] F-gas prices go sky-high, the temptation to smuggle [cheaper HFCs into Europe] might increase."

→ As of that date, "every commercial refrigerator or freezer that is manufactured for sale within Europe will by law have to have the energy label on it, like a domestic refrigerator," he said. "Then every year, the standard increases and companies have to better themselves."

Anderson noted that the legislation was music to Gram's ears, as it has been pushing efficiency boundaries for years. Its hydrocarbon-based Superior Model refrigerator – recipient of seven industry rewards for efficiency in 2015 – is testament to this continual innovation. "The Superior model is actually 35% more energy efficient than the previous leading model, which also utilized hydrocarbons," he said.

While propane (R290) is now Gram's standard for light-commercial refrigerators, it also has models using isobutane (R600). Some customers still ask for R134a equipment, but this trend is very much on the slide, not just in the U.K. but globally, said Anderson.

"There are countries in Europe that will not take to hydrocarbons as of yet, but that is changing. I've seen that in Dubai and the Middle East, where energy efficiency wasn't considered five years ago but now people are asking for energy-rated products. Everyone is looking to enhance the planet – and we have got to be a part of that."

AMMONIA IS HERE FOREVER

Operators of U.K. training companies – the Grimsby Institute of Refrigeration and Polar Pumps – commented at the conferences on the impact that the EU legislation is having on the demand for training on natural refrigerant equipment.

"Half of those we train are for ammonia and this seems to be growing," said Peter White, director of Polar Pumps. "The industry is changing as refrigerants have gone from CFCs, HCFCs, HFCs and now onto HFOs. People want a bit of security; ammonia has been here forever and it will stay here forever."

Polar Pumps does not currently offer hydrocarbons or CO₂ training but would look into doing so if demand were to increase, said White.

Jason Clark, the Grimsby Institute of Refrigeration's senior training consultant, detailed the factors behind its ammonia and hydrocarbons training courses. "The industry leads and we follow along. There's no point us providing training if there is no industry demand. And as the industry introduces natural refrigerants, the training sector will follow. I think it is just a matter of time." ● RD



Shaping Refrigeration Systems for Tomorrow

NewTon

Introduction of the NewTon refrigeration system that uses natural refrigerant has resulted in CFC phase-out measures and an average of 15 to 18% reduced electricity consumption at Maruha Nichiro Logistics, Inc.

Refrigeration equipment update back story

CFC Phase-Out Plan

The impetus to proceed with updating low-temperature refrigeration equipment to use natural refrigerants across the entire Maruha Nichiro Group was due to the CFC Phase-out Plan.

"Because production of HCFC (Freon 22) will end completely in 2020, the Maruha Nichiro Group as a whole decided to proceed with CFC phase-out as an overall policy for existing equipment and when building new cold storage facilities. In line with this plan, the refrigeration equipment in main logistics centers is being updated to use natural refrigerants one by one. We are using this as an opportunity to improve the strength of our business."

(Mr. Kazunori Hiura, Director, Facilities Department)

Deciding Factor for Adopting NewTon:

Completeness as an energy-efficient system

So far, the equipment has been updated in the Toyomi (Tokyo), Funabashi (Chiba), Rokko (Kobe), Chikko (Nagoya), and Kawasaki No. 1 (Yokohama) logistics centers.

"The deciding factor for NewTon was its completeness and the amazingly strong numbers for energy efficiency shown when compared to competitor products. After the Funabashi Logistics Center, we decided to implement the system in order of priority." (Mr. Hiura)

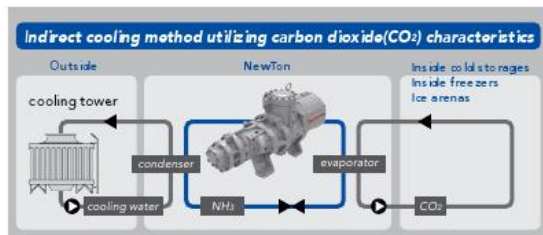
Renovation work is generally difficult. However, one of the reasons Mayekawa has been selected is for their wealth of installation experience.

NewTon Evaluation:

Improved safety and maintenance control

One of NewTon's features is its low ammonia charge of only 25 kg*, and its indirect cooling method which makes it necessary to only use ammonia in the machine room.

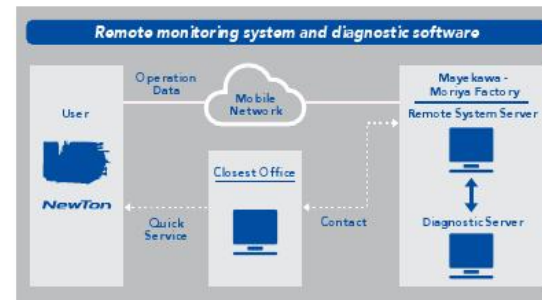
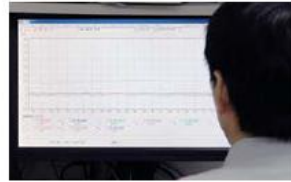
The system has received high praise for its consideration of safety. Its hazard removal equipment ensures double and triple safety measures that maintains safety even in the event of a leak.



A maintenance contract was concluded with the Kawasaki No. 1 Logistics Center as part of a new initiative.

"In conjunction with Mayekawa, equipment status can be monitored remotely. It's a relief to be able to see any abnormalities on a computer and check the status of other locations from headquarters. Also because you can check the status via data, there is no longer any need to use a specialist technician."

(Mr. Hiura)



Results after Installation

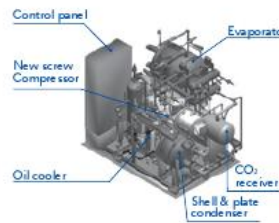
Power consumption has been reduced at overall centers by 15 to 18%, and an individual cooling unit by approximately 30%.

"Overall electricity consumption has been reduced monthly by 17.8% (July 2015) at the Kawasaki No. 1 Logistics Center. We've also achieved a reduction of approximately 20% for individual cooling units. At other centers, there are examples of energy saving on the order of roughly 15 to 18% and close to 30% for individual units." (Mr. Hiura)

Approximately 60 percent of electricity consumption at cold storage facilities is taken up by refrigeration equipment. Some centers spend as much as 50 million yen per year on refrigeration systems, with a 20% reduction resulting in nearly 10 million yen per year in savings on electrical costs. Customers are also very satisfied with operating conditions.

"In six months of running the system at Kawasaki No. 1, we've only had one warning. With some centers having experienced one or two warnings per month, we can truly feel the good results from using NewTon." (Mr. Hiura)

In 2015, equipment in the Kitano (Kyushu) and Sakishima (Osaka) centers was updated. There are plans to switch to natural refrigerant in as many centers as possible by 2020. Future plans include pursuing phase-out of CFCs, energy saving solutions, and maintenance contracts in order to improve operations and save manpower.



Maruha Nichiro Logistics, Inc.

As a member of the Maruha Nichiro Group, Maruha Nichiro Logistics Inc., whose slogan is "From the world to the dining table", is in charge of low-temperature logistics. With 34 logistics centers focused in main trading ports around the country such as Tokyo, Osaka, Nagoya, and Fukuoka, they have built a network that spans all of Japan. They handle a wide variety of chilled and frozen foods such as seafood, livestock products, and agricultural products, providing the absolute best in freshness and quality in their safe, reassuring, authentic foods. In order to comply with the total phase-out of CFCs by 2020, they are currently engaged in efforts to renovate low-temperature refrigeration equipment in their main logistics centers across Japan.



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Part of M&M Refrigeration's first major ammonia-CO₂ installation, at US Cold Storage's plant in Bethlehem, Pa. Here the three brown containers are cascade condensers, where liquid ammonia evaporates, cooling CO₂ gas into a liquid. Blue surge drums hold liquid ammonia at 11°F before it enters the cascade condensers.

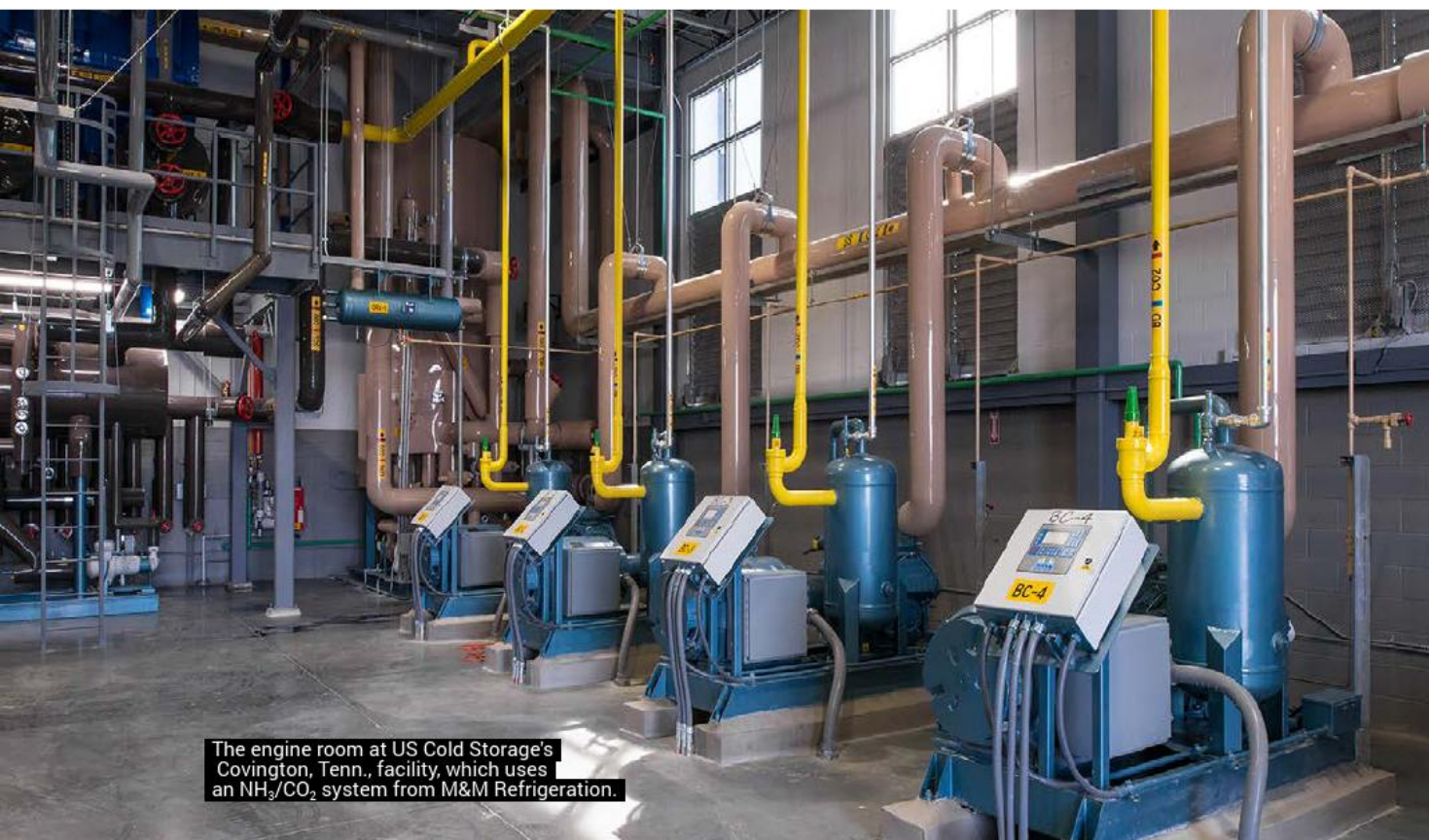
PIONEER OF LOW CHARGE

M&M Refrigeration's NH₃/CO₂ cascade systems defied the skeptics and led to the mainstreaming of reduced ammonia charge in industrial refrigeration

— By Michael Garry

When M&M Refrigeration installed its first ammonia/carbon dioxide cascade refrigeration systems in cold storage facilities in 2005, the pushback from entrenched industrial refrigeration interests was considerable.

"The word was that it couldn't work, would never work, that anyone using it is making a big mistake," said Duffy McConnell, the owner of M&M, who started the company in 1969 at age 20 after two tours of service in the Navy's construction battalion division during the Vietnam War. "But we were trying to set ourselves apart, and offer a better mousetrap."



The engine room at US Cold Storage's Covington, Tenn., facility, which uses an NH₃/CO₂ system from M&M Refrigeration.

M&M persevered, and today it has 55 NH₃/CO₂ installations under its belt, most of them in the U.S., along with several in Mexico and overseas, making it the clear leader in this category.

M&M, based in Federalsburg, Md., was among the first to introduce the idea that large food processing and cold storage plants did not always need to employ vast amounts of ammonia in their refrigeration systems – that the quantity could be reduced by a factor of 10 by confining the ammonia to the machine room and using CO₂ as a refrigerant in the processing and storage areas.

Reduced charge is very appealing to large end users that would ordinarily use more than 10,000 pounds of ammonia, which subjects companies to government regulation (OSHA's PSM and EPA's RMP) that are "becoming just unbelievable," said McConnell. "The marching orders are: efficiency No. 1, reducing charge No. 2."

Moreover, the confinement of ammonia to the machine room makes the operation safer for employees and ensures the integrity of foods being stored or processed, saving companies on insurance costs.

FIRST BIG CUSTOMER

US Cold Storage was M&M's first big NH₃/CO₂ customer when it installed the system in its Bethlehem, Pa., cold storage facility in 2005. (See "Shaking Up Industrial Refrigeration," *Accelerate America*, April 2015). Since then, US Cold has put the M&M system

in seven more locations throughout the U.S., most recently in 2014 at a cold storage warehouse in Covington, Tenn. US Cold's NH₃/CO₂ systems use between 5,000 and 8,000 pounds of ammonia and between 20,000 and 48,000 pounds of CO₂.

"US Cold took a big chance on us," said McConnell. "But it proved out."

A year before that first big project in Bethlehem, M&M had cut its teeth with the NH₃/CO₂ technology at a much smaller facility, Brooklyn, N.Y.-based Agger Fish (since relocated to New Bedford, Mass.), which used it for plate freezing.

"Once we knew it would work on a smaller scale, a larger scale didn't scare us at all," he said. In fact, while the NH₃/CO₂ system works down to 10-20 TR, usually it's used for a few hundred tons up to 1,000 tons, in temperatures ranging from -58°F to 20°F.

The initial industry resistance to NH₃/CO₂ slowed its growth quite a bit. But about five years ago, the technology turned a corner and has now entered the mainstream of industrial practices. "When we get inquiries, they want ammonia but they want CO₂ also," said McConnell. NH₃/CO₂ is not the dominant part of M&M's business – traditional ammonia is – "but it's getting there. It's a bigger percentage each year."

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SWITCHING TO NH₃/CO₂

For years Eastern Fisheries, a seafood processor based in New Bedford, Mass, used nitrogen to freeze scallops via an IQF (individually quick frozen) process. But in 2014, the company switched to CO₂.

Unlike nitrogen, which is continuously sprayed and used up, CO₂ recirculates, saving Eastern Fisheries a great deal of money. "The nitrogen cost per year was a big bill for us," said Paul Joly, vice president operations for Eastern Fisheries, in a conversation with *Accelerate America* at Seafood Expo North America in Boston March 7.

The CO₂ used now for IQF is part of a cascade ammonia/CO₂ system supplied by M&M Refrigeration. The NH₃ stays in the machine room, forming liquid CO₂ refrigerant that is sent out to the evaporator in a Skaginn IQF tunnel processing line. The 99 TR capacity system produces a temperature of -58°F and processes 6,500 pounds of scallops per hour.

Eastern Fisheries spent a year studying its options before deciding on the M&M/Skaginn systems. "We were not familiar with the CO₂ part of it," said Joly. "M&M recommended it and it works great; we've had no issues at all."

Eastern Fisheries also uses ammonia in a plate freezer system that block-freezes scallops.

The NH₃/CO₂ system was more expensive than the nitrogen system but, by eliminating the cost of nitrogen and saving energy costs, "the long-term investment is there," said Joly. Eastern Fisheries helped defray the initial cost with incentive funding from NSTAR (now part of Eversource Energy).

Siggi Skulason, a sales and service executive with Iceland-based Skaginn, said he is seeing more and more NH₃/CO₂ systems used with Skaginn's tunnel equipment in the U.S. "It's not something you're spraying out; it's a closed loop," he said at Skaginn's booth at the Seafood Expo. In addition, "everybody wants to walk away from ammonia [in the evaporator]."

Skulason added that he knows two or three other seafood processors "thinking of going in that direction."



Duffy McConnell, M&M Refrigeration

→ McConnell believes that in large facilities NH₃/CO₂ systems are a better low-charge option than multiple low-charge-ammonia packaged units, which he described as "a lot of little engine rooms, so you have a maintenance nightmare from my perspective, and the efficiency is not there."

On the other hand, he acknowledged that packaged units could play a role in certain circumstances. "If you have a huge facility and have one room where you want a different temperature than the rest of the plant, then it makes sense," he said "Or possibly in a smaller facility."

MAINTENANCE AND TRAINING

In addition to designing, building and starting up NH₃/CO₂ systems, M&M increasingly does the installation and maintenance of the systems as well. "For a relatively new system like this, technicians are not always caught up with the technology, so we get a lot of calls for back-up maintenance," he said. M&M also trains new NH₃/CO₂ customers during start-up, and recently did its biggest general training session for 16 people, mostly engineers.

According to McConnell, the cost to design, build, install and maintain an NH₃/CO₂ system is no more than for a two-stage ammonia system. Moreover, a study of NH₃/CO₂ cascade systems showed that on average the technology is 5.8% more efficient than a comparable two-stage ammonia system. (See story, page 52.)

The efficiency is greater at colder temperatures, and declines at warmer temperatures. Thus food processors that use IQF or blast, plate or spiral freezers, at temperatures in the -40°F to -50°F range find the system very appealing (see story, this page), though cold storage in the -10°F to -30°F range is also a popular application of the technology (See chart, page 52). Most installations are in new facilities though some are done in expansions.

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NH₃/CO₂ SHINES IN EFFICIENCY STUDY

In 2008, Pacific Gas & Electric compared the efficiency of a large NH₃/CO₂ cascade refrigeration system with the efficiency of a conventional two-stage ammonia refrigeration system operating the same refrigeration loads and process temperatures.

The project used instrumentation and data acquisition equipment to monitor the real-time performance of an M&M Refrigeration NH₃/CO₂ system in a public refrigerated warehouse in Fresno, Calif. The warehouse included blast freezing (-58°F); freezer storage (-20°F); and coolers and docks (+20°F). A conventional ammonia system was modeled at the same temperatures for the same applications.

The efficiency of the NH₃/CO₂ system was measured in kW/TR. For the five months of monitored operation, the NH₃/CO₂ system at -58F and -20F showed a 28.7% better efficiency than the conventional system at those temperatures.

Overall, the NH₃/CO₂ system had a 5.8% efficiency advantage over the conventional system.

➔ M&M offers end users an energy initiative dashboard that consolidates information from multiple locations so an owner or manager can compare costs, energy consumption and efficiency targets.

M&M can monitor its customers' overall refrigeration performance from its Maryland headquarters. "Our service techs can make recommendations and adjustments on their cell phones," McConnell said. "It's pretty amazing." End users have that ability, though to a lesser degree.

McConnell also takes pride in M&M's refrigeration control systems, which include proprietary controls and PLC (programmable logic controller)-based controls. "Our private-label controls can do much more and are more cost effective than PLC, but some people want an open system," he said.

M&M's NH₃/CO₂ systems use a cascade design, though on occasion the company has built an ammonia system that uses CO₂ as a pumped secondary brine. "The energy saving is not there for that but it keeps the ammonia out of the [storage area]," said McConnell. "That's what a lot of companies are selling as an ammonia/CO₂ system." **MG**

M&M's NH₃/CO₂ Installations*

Year	End User	application	Low Temperature		Medium temperature		High temperature	
			capacity TR	temp. °F	capacity TR	temp. °F	capacity TR	temp. °F
2005	US Cold Storage phase 1, Bethlehem, PA	Storage			290	-30	165	20
2006	US Cold Storage phase 1, Fresno, CA	Storage/Blast Freezers	220	-58	450	-25	210	20
2008	Unitherm Food Systems, Bristow, OK	Spiral Freezer	25	-60				
2010	Wegmans Food Markets, Pottsville, PA	Storage					1000	20
2012	Circle Foods, San Diego, CA	Spiral Freezer	152	-38				
2013	Frialsa, Monterrey, Mexico	Storage/Blast Freezers			507	-30	60	20
2014	US Cold Storage phase 1, Syracuse, UT	Storage			406	-30	102	20
2014	US Cold Storage phase 1, Covington, TN	Storage			867	-30	272	20
2014	Eastern Fisheries, New Bedford, MA	IQF Freezer	99	-58				
2015	Linage Logistics, Charleston, SC	Storage			1421	-30		

*Partial list

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DOWNSIDED TRANSCRITICAL UNIT LOWERS FIRST COST OF EQUIPMENT

Hillphoenix's AdvansorFlex rack uses less expensive components to bring the price closer to that of traditional HFC technology

— By Michael Garry and Blanka Zoldi



People have often told us, 'Look, if we could buy CO₂ at the same price as [an HFC system], we would switch tomorrow,' said Scott Martin, director of sustainable technologies for Conyers-Ga.-based Hillphoenix.

Hillphoenix's new CO₂ transcritical system, the AdvansorFlex, designed for smaller-capacity stores, "is a step in that direction," he added.

Introduced in December 2015, AdvansorFlex is essentially a less expensive, downsized version of its predecessor, the Advansor, which has been widely installed in Europe and is making headway in the U.S. and Canada.

The new model achieves this cost saving by incorporating smaller, lower-cost components and a less expensive cabinet design than the traditional Advansor CO₂ transcritical booster system. "AdvansorFlex is ideal for smaller retailers who want the environmental benefits and energy savings of CO₂ refrigeration but don't have the square footage for a full-sized system," said Dustan Atkinson, product strategy manager for Hillphoenix.

Discount retailer Aldi, which has traditional Advansor racks in several stores, is the first customer for AdvansorFlex. "The Flex does what they need for their particular size store," said Martin.

AdvansorFlex's smaller footprint encompasses no more than three medium-temperature compressors (Bitzer reciprocating units) and two low-temperature compressors (Copeland scrolls). That combination "is the most economical compressor solution," said Martin.

The AdvansorFlex's capacity can't exceed 150 KBTUH for low temperatures, and 450 KBTUH for medium temperatures. This makes the system more suited for smaller grocery stores or convenience stores, although multiple units could be combined in a larger store, Martin noted.

Martin distinguished the AdvansorFlex from CO₂ condensing units that are widely used in Japanese convenience stores and in Europe, describing them as having smaller capacity than the AdvansorFlex.



AdvansorFlex

However, like a condensing unit, the AdvansorFlex has an enclosure that allows for both inside and outdoor placement.

LOWER OPERATING COSTS

In addition to lower first costs, the AdvansorFlex offers lower operating expenses. For example, like the Advansor, AdvansorFlex reduces energy costs by 5% to 18% compared to an HFC system, depending on the ambient climate, said Martin. Hillphoenix has installed AdvansorFlex units with an adiabatic condenser to improve efficiency in warmer climates, but has not yet added other technologies like ejectors that have a similar effect.

Installation costs of the AdvansorFlex are 12% to 18% less than a standard HFC system owing to smaller copper tube sizes, less insulation, less wiring and less labor.

According to Martin, the AdvansorFlex is easier to maintain, as it has fewer components to service. "But the high pressure considerations are all the same," he added.

Asked if it would be easier to retrofit an existing store with the AdvansorFlex, Martin said that it would, given the unit's smaller size. "It would be easier to find a place for it while transitioning."

Martin observed that, in considering a CO₂ transcritical rack, many retailers tend to look only at the first cost of the system, in isolation from the cost of cases, other components and installation, as well as energy and refrigerant costs, and the cost of regulation-induced refrigerant retrofits.

If all of these costs are combined in a total cost of ownership calculation, "the price differential [with conventional equipment] is much less," said Martin. "People haven't been looking at the overall costs up until now, but it's something that we have been trying to change. The more sophisticated buyers have always taken this holistic approach." **BZ & MG**

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Distribution at IAR Industrial Refrigeration Conference & Exhibition, March 20-23

Ad submission deadline: Mar. 4

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Ad submission deadline: Apr. 1

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Supplement to Issue #15

GUIDE to Natural Refrigerant Contractors in North America

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