

APRIL 2016

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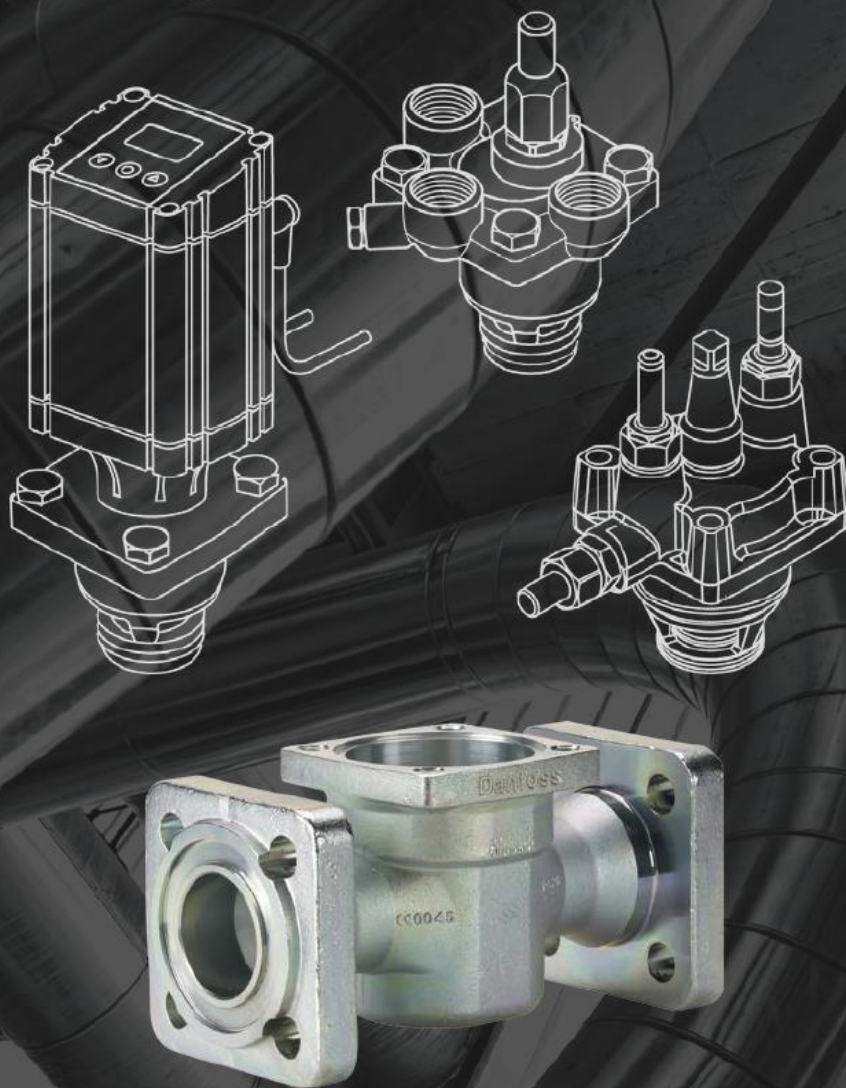
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Editor's note by Michael Garry

THE CASE FOR AMMONIA IN GROCERY STORES



In last month's issue we talked about how low-charge ammonia systems are starting to reinvent industrial refrigeration, and in this issue we pick up on that theme in our cover story on Campbell Soup.

Campbell, which has been making soup since 1869, was one of the first industrial companies to deploy low-charge ammonia packages to improve the safety of its plants, and it is continuing to install them in place of R22 systems at its Pepperidge Farm plants.

Now that food processing and cold storage companies are beginning to take advantage of low-charge ammonia technology, a new question has been making the rounds: Can low-charge ammonia systems also be used in commercial settings like office buildings and supermarkets?

What makes low-charge ammonia systems potentially feasible for a commercial environment is, first, that it uses much smaller quantities of ammonia, and two, the ammonia can be sequestered in the high-side of a system while a secondary fluid like glycol or CO₂ is used in the evaporator side where the cooling takes place. This design addresses ammonia's

key drawback: its toxicity as a liquid and pungent odor.

At a supermarket, allowing a whiff of ammonia to enter the store would be a customer-relations nightmare, even if the gas poses no threat to anyone, apart from the unpleasant smell. But if that contingency can be avoided, ammonia offers the same efficiency and environmental advantages that it does in industrial settings.

The International Institute of Ammonia Refrigeration (IIAR), long a bastion of industrial refrigeration, is now turning its attention to the commercial side, encouraging the use of low-charge systems in non-traditional venues like grocery stores. Cognizant of the safety issue, the IIAR is conducting research on ammonia releases in urban settings to evaluate the risk to the public.

IIAR is also supporting the commercial use of low-charge systems by expanding its IIAR-2 safety standard to include a section on packaged systems and equipment in its recently updated edition.

Meanwhile, there is slow movement among food retailers to try out ammonia/CO₂ systems that keep the ammonia on the

roof and use only CO₂ inside the store. For example, the Defense Commissary Agency (DeCA) is running a commissary at its Lackland Air Force Base in San Antonio, Texas, with an NH₃/CO₂ system that went fully operational last August.

Whole Foods Market has also been testing an NH₃/CO₂ system (from Zero Zone) at a store in Dublin, Calif., that opened last year.

At the IIAR Conference last month, John Collins, industrial sales manager for Zero Zone, presented a Technical Paper on "Expanding the Use of Ammonia Refrigeration" in which he used the Whole Foods store as a case study of what is possible.

Collins also pointed out that deploying ammonia systems in commercial buildings requires further code and standard development, as well as improvements in education and training on low-charge systems, and a reduction in equipment costs.

It will be fascinating to see whether low-charge ammonia systems can gain acceptance in the commercial sector, while competing with other natural refrigerant solutions like transcritical CO₂ and hydrocarbons. **MG**

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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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The Case for Ammonia in Grocery Stores

Editor's note by Michael Garry

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The venerable food manufacturer, which pioneered the use of low-charge ammonia refrigeration packages, continues to install them in place of HCFC and HFC systems at its Pepperidge Farm bakeries

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Publisher **Marc Chasserot**
marc.chasserot@shecco.com
[@marcchasserot](#)

Editor **Michael Garry**
michael.garry@shecco.com
[@mgarrywriter](#)

Contributing Writers **Pilar Aleu**
Matthew Cullinen
Nina Masson
Elke Milner
James Ranson
Andrew Williams
Justina Tamasiunaite

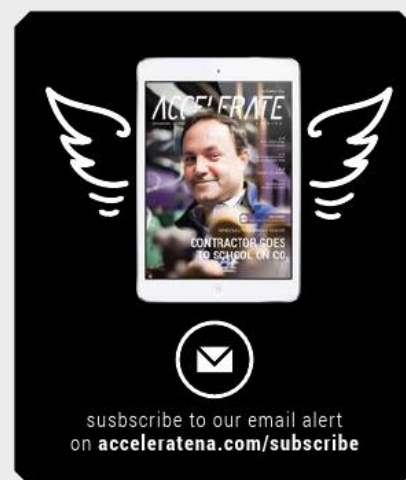
Events Coordinators **Silvia Scaldaferrì**
Anastasia Papagiannopoulou

Advertising Manager **Franziska Menten**

Art director **Mehdi Bouhjar**

Graphic Designers **Charlotte Georis**
Anna Salhoffer

Photographer **Ben Beech**



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|---|---|
| <p>1 April 4-5, New York, NY
 The Future of Energy Summit
 http://about.bnef.com/summit/
 twitter: #BNEFSummit @BloombergNEF</p> | <p>7 April 13- 14, Tacoma, WA
 Northwest Facilities Expo 2016
 http://www.fenw.facilitiesexpo.com/
 twitter: @Facilities_Expo</p> |
| <p>2 April 4-6, Tempe, AZ
 National Frozen & Refrigerated Foods Association (NFRA) Executive Conference
 http://nfraexecutiveconference.org/
 twitter: @EasyHomeMeals</p> | <p>8 April 13-15 , Chicago, IL
 2016 National Automatic Merchandising Association (NAMA) OneShow
 http://www.namaoneshow.org/
 twitter: #NAMAOneShow16 @NAMAvending</p> |
| <p>3 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>9 April 13-15 , Montreal, Canada
 SIAL Canada
 http://sialcanada.com/sial/en/index.sn
 twitter: #SIAL2016 @SIALCANADA</p> |
| <p>4 April 10-13 , Scottsdale, AZ
 BuildPoint 2016
 http://www.buildpointevent.com/
 twitter: #bp2016event @BuildPointEvent</p> | <p>10 April 16- 20, Las Vegas, NV
 IARW-WFLO Annual Convention and Expo
 http://www.gcca.org/iarw-wflo-convention-details/</p> |
| <p>5 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>11 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> |
| <p>6 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> | |



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 4-6, Tahoe City, CA

Utility Energy Forum 2016
<http://utilityforum.org/>

twitter: #2016UEF @UtilityForum

4

May 11-12, Washington, D.C

Energy Efficiency Global Forum (EE Global 2016)
<http://www.eeglobalforum.org/>

twitter: #energyefficiency @ToSaveEnergy

5

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>

6

May 18-19, Anaheim, CA

Southern California Facilities Expo 2016
<http://www.fesc.facilitiesexpo.com/>

twitter: @Facilities_Expo #fenw2016

7

May 18-19, Conroe, TX

Houston Industrial & Tool Show
<http://www.expoindustrialshows.com/houston.htm>

8

May 21-24, Chicago, IL

NRA Show
<https://show.restaurant.org/Home>

twitter: #NRAShow @NRAShow

9

May 22-26, Mashantucket, CT

Eastern Energy Expo 2016 - AREE / OESP / PPA Trade Shows - Atlantic Region Energy Expo
<http://easternenergyexpo.com/>

10

May 24-25, New York, NY

BuildingsNY 2016 (BuildingsNY and GreenBuildingsNY)
<http://www.buildingsny.com/>

twitter: #buildingsny @BuildingsNY

11

May 25-26, Seattle, WA

34th West Coast Energy Management Congress (EMC)
<http://www.energyevent.com/>

twitter: #EMCexpo



- 1** June 1-4, Toronto, ON
Grey to Green Conference & Trade Show
<http://greytogreenconference.org/>
twitter: @GRHCna
- 2** June 8-11, Detroit, MI
CNU 24: Detroit - Congress for New Urbanism
<https://www.cnu.org/cnu24>
twitter: @NewUrbanism
- 3** June 13-14, New York, NY
The NAPHN 2016 Conference & Expo: Decarbonize Our Future Today
<http://naphnetwork.org/2016-naphn-conference-is-announced/>
twitter: #naphn16 @NAPHN_info
- 4** June 16-17, Chicago, IL
ATMOsphere America 2016
<http://www.atmo.org/events.details.php?eventid=44>
twitter: #ATMOAmerica @ATMOEvents
- 5** June 20-22, Chicago, IL
Global Cold Chain Expo 2016
<http://www.globalcoldchainexpo.org/>
twitter: #GCCE2016 @coldchainexpo

- 6** June 20-23, St Paul, MN
IDEA 2016 "Embracing Change", 107th Annual Conference and tradeshow
<http://www.idea2016.org/>
- 7** June 20-23, Chicago, IL
FMI Connect
<http://www.fmiconnect.net/>
- 8** June 25-29, St. Louis, MO
ASHRAE Annual Conference
<https://www.ashrae.org/membership-conferences/conferences/2016-ashrae-annual-conference>
- 9** June 29-30, St. Louis, MO
NEBFM'16 - 11th Annual Northeast Buildings & Facilities Management Show & Conference
<http://www.proexpos.com/NEBFM/index.php>
twitter: #NEBFM16 @NEBFM



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SHORT TAKES

— By Michael Garry

IIAR WORKING ON STANDARD FOR CO₂



The International Institute of Ammonia Refrigeration (IIAR) is working on a new standard for carbon dioxide applications.

Work on the CO₂ standard, called IIAR C2, "is just getting underway," said Bob Czarnecki, chairman of the IIAR standards committee and retired head of refrigeration engineering for Campbell Soup Co., at an educational program on the newly revised IIAR-2 standard held at the IIAR Industrial Refrigeration Conference & Exhibition in Orlando, Fla., last month.

"It's a couple of years out," Czarnecki said.

The American National Standards Institute (ANSI) has given the IIAR approval to work on this standard.

The IIAR is addressing two other new standards, IIAR-6 and IIAR-9. IIAR-6 will cover inspections, testing and maintenance and is expected to be out for public review in May 2016, said Czarnecki.

IIAR-9 will encompass RAGAGEP (recognized and generally accepted good engineering practices) and "what part of new and revised standards do existing facilities have to comply with," said Czarnecki, adding that it was about 18 months away. "A draft is waiting for standards committee review in June." ● MG

CARB RELEASES STRATEGY FOR SHORT-LIVED POLLUTANTS

California Environmental Protection Agency



The California Air Resources Board (CARB) on April 11 issued its long-awaited "Proposed Short-Lived Climate Pollutant Reduction Strategy," which includes ambitious goals to cut HFC emissions in California.

Among the proposals in the strategy is a prohibition on refrigerants with global warming potential (GWP) of 150 or greater in new stationary non-residential refrigeration equipment, and a prohibition on refrigerants with a GWP of 750 or greater in stationary air conditioning, residential and non-residential.

The start date for the refrigeration rule would be Jan. 1, 2020, and for the air conditioning rule, Jan. 2, 2021. There would be a prohibition on the sale of new refrigerants with a GWP of 2,500 or greater (this would not include reclaimed or recycled refrigerants). For more details on the Proposed Strategy and its development, see "California's Master Plan to Slash HFC Emissions – And the Role of NatRefs," *Accelerate America*, December 2015/January 2016.

CARB will conduct a public workshop to discuss the Proposed Strategy and receive input from stakeholders on April 26. The Proposed Strategy will be presented to the CARB Board at a public hearing on May 19. CARB will accept comments until May 26, 2016. ● MG

CALIF. LEGISLATURE BUDGETING LOW-GWP INCENTIVE PLAN

In its newly released "Proposed Short-Lived Climate Pollutant Reduction Strategy," the California Air Resources Board (CARB) supports the creation of a financial incentive program to defray the potential added cost of installing new low-GWP commercial refrigeration equipment or converting existing high-GWP systems to lower-GWP options.

California's Governor Brown included \$20 million for this financial incentive program in his 2016-2017 proposed budget. The California legislature's budget subcommittee #3, chaired by Assemblyman Richard Bloom, a strong advocate for environmental protection, will be primarily responsible for reviewing the portions of the budget relating to the potential natural refrigerants incentives program. The final budget will be enacted budget in June.

"One of the advantages of an incentive program is that it could fund early adoption of low-GWP technologies, with substantial long-term effects on avoided emissions," said CARB's Proposed Strategy. ● MC



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PREDICTIONS FOR AMMONIA

Professor Pega Hrnjak sees a robust future for low-charge packaged ammonia systems in industrial refrigeration – and potential for ammonia secondary chillers in a range of applications

– By Michael Garry



Pega Hrnjak

Last month at the IAR Conference and Exhibition in Orlando, Fla., *Accelerate America* sat down with Professor Predrag (Pega) Hrnjak for our second discussion on the direction of ammonia refrigeration.

(The first discussion took place a year ago on the other side of the country in San Diego; [see "Pega on the Power of Low-Charge Ammonia," *Accelerate America*, April 2015.](#))

Born in Belgrade, Yugoslavia, Pega is one of the leading researchers, teachers and experts in the refrigeration industry. He started his activities in the U.S. during the 1980s, and in 1993 joined the faculty of the University of Illinois, Urbana, Ill., where he is a professor in the Department of Mechanical Science and Engineering.

He is also Director of the University of Illinois's Air Conditioning and Refrigeration Center, an NSF-funded, industry-university cooperative research center, and is president of Creative Thermal Solutions (CTS), his private research-and-development company, also based in Urbana.

In the following interview, he offers new insights into the application of low-charge ammonia cooling systems in industrial and commercial scenarios.

“ I think ammonia could play a significant role in HVAC applications.

Accelerate America: Where is the growth in low-charge ammonia systems taking place?

in charge reduction. I wish it would come from smaller plants using HFCs.

Accelerate America: What is your opinion of low-charge packaged units?

of the charge. And, you can place them locally near the cooling loads. The only disadvantage is that when you have multiple units, maintenance technicians need to go from unit to unit on the roof, instead of doing all activities in a machine room.

I think you will see more and more pre-made, packaged systems. That is the direction to go. There is almost always better craftsmanship in the factory as well as better control and lower costs with faster delivery time, in principle. This is how every industry has developed: by increasing the quality and lowering the cost.

So what we are seeing now is a reduction of custom-made industrial refrigeration systems and an increase in pre-made, factory-built packaged systems that one can almost buy off the shelf.

Pega Hrnjak: I believe the growth at this point is coming from owners of larger ammonia systems interested

Pega Hrnjak: I like packaged units whenever possible because of the shorter length of the lines and the reduction

Accelerate America: Are packaged units as efficient as central systems?

packaged systems should have even higher efficiency.

Accelerate America: Would you need multiple packaged units to deliver large industrial capacities?

Accelerate America: Are CO₂-only transcritical systems becoming more suitable for industrial applications?

two refrigerants and two types of oils in a cascade system increases the complexity and is a burden. When we make CO₂-only systems operate more efficiently, it is a simpler solution. And packaged CO₂ systems will be equally good and better than custom-made systems in machine rooms.

Pega Hrnjak: It's very tough to perfectly compare them, but I'd say the efficiencies are similar. If manufactured well, packaged systems should have even higher efficiency.

Pega Hrnjak: Yes, but also in a single machine room of large industrial plants there are multiple compressors and condensers.

Pega Hrnjak: I think we will see more and more transcritical systems. Ammonia/CO₂ is more energy-efficient than CO₂-only. But, having

continued on p.14 →

→ **Accelerate America:** What is the opportunity for ammonia in chillers?

brine. One could use an ammonia/glycol chiller in industrial cooling or in comfort cooling for a large hotel lobby or airport. The advantage of CO₂ is that it can be used in large and small capacities, in industrial refrigeration or supermarkets, and in HVAC applications.

Most chillers don't currently use ammonia as the primary refrigerant; they use R22, R410A, or R123 and R11 in old centrifugal chillers. But ammonia, being indisputably efficient, can easily replace especially the first two refrigerants. They all use secondary liquids, so there is a market that is prepared for using chillers. A relatively new refrigerant, R1233zd, which is characterized as non-toxic and nonflammable with a GWP close to zero, will be very strong competition for ammonia in chillers, especially centrifugal. New oil-free centrifugal compressors using magnetic bearings will make it even more competitive.

In the chiller market for air conditioning, there are typically smaller units that use reciprocating, scroll or screw compressors. That is a potential market for ammonia chillers. Hermetic or semi-hermetic ammonia compressors would be a great boost in that direction.

Accelerate America: So you think ammonia will be used in comfort cooling?

Thermal Solutions we have developed a chiller system using microchannel condensers that has an ammonia charge of 2.3oz/ton (18g/kW). But we need to promote regulations that would lift restrictions on a charge as low as say 3kg in a unit that can provide a minimum capacity of 100 kW. Then ammonia would be really competitive in the HVAC market with R22 systems.

Pega Hrnjak: In chillers, ammonia cools some secondary liquid – it could be CO₂ or glycol or some other

Pega Hrnjak: I believe so, and I'm working on that approach for comfort cooling. It's possible, and I believe it is very reasonable. At Creative

“ I like packaged units whenever possible because of the shorter length of the lines and the reduction of the charge.

When using hydrocarbons, with less than 150 grams (some say even more) one can put a unit anywhere in a building. We don't have that freedom right now with ammonia, even though ammonia presents fewer concerns than R290 from a flammability viewpoint. We just have the ASHRAE-15 standard, which allows ammonia equipment to be used outside the machine room if the charge is less than 6.6 pounds.

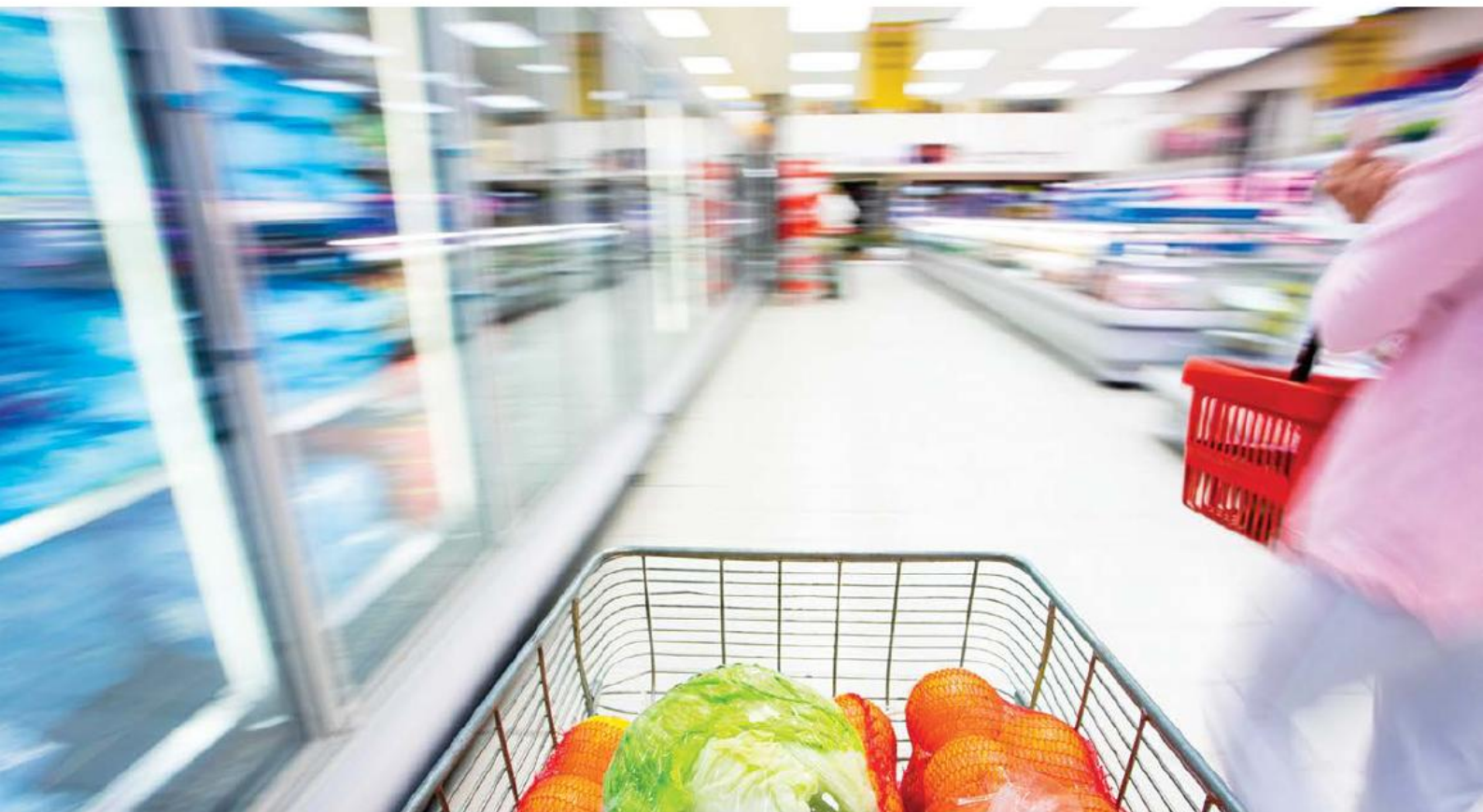
Accelerate America: With a very low charge of ammonia, the health risk posed by a leak would be low. But in a supermarket, a leak could still produce an odor. Is that enough to be a problem?

contact with skin or eyes, but not as a vapor. The vapor has an odor only, which can be create a panic, but that is a different type of problem. In any case, most of the chillers are outside, on the roof because it is easy to remove heat by air.

Pega Hrnjak: I would say, keep the ammonia outside, not in the areas with high concentration of people and just use a secondary fluid inside. Ammonia can be dangerous as a liquid in

I think ammonia could play a significant role in HVAC applications because there are three realistic natural refrigerant options: ammonia, propane and CO₂. Propane chillers, used outside, could give you almost the same performance as ammonia. But propane is heavier than air while ammonia is lighter; thus in the case of any leak ammonia gas will rise up, far from populated zones. Heavier gas can be trapped close to the floor and reach potentially dangerous concentrations. **MG**

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CO₂'S ENERGY ADVANTAGE

With proper system design and the latest in technology, CO₂ systems come out on top in energy comparisons with HFC systems – even in warmer climates

– By James Knudsen

Interest in carbon dioxide as a refrigerant in food retail applications has never been greater than it is today. Much of that interest has to do with CO₂ systems' favorable impact on the environment, which includes a negligible contribution to global warming from the refrigerant as well as greater energy efficiency.

Moreover, the efficiency benefit of CO₂ systems is also serving as a financial justification for making an investment in this technology, despite higher initial costs.

To understand the environmental benefits of CO₂ refrigeration compared to traditional HFC systems, it is useful to use Life Cycle Climate Performance, or LCCP; this is a standard method of comparing technologies by measuring their approximate generation of greenhouse gas (in pounds of CO₂ equivalents) in both direct releases and indirect release through power plant consumption.

Traditional HFC refrigeration systems produce strong direct and indirect contributions. The direct release of HFCs is impactful because of HFCs' high Global Warming Potential (GWP), or heat-trapping capacity, relative to CO₂. The release of refrigerant should never be intentional (it is currently illegal in most jurisdictions), yet it routinely happens over the life of a food retail refrigeration system, primarily through leaks. While these leaks can be minimized, the use of a low GWP refrigerant such as CO₂ can render this effect negligible because of CO₂'s GWP of 1, compared to about 4,000 for an HFC refrigerant like R404A.

LCCP's indirect component stems from the energy used in operating refrigeration equipment. The less energy needed to operate the equipment, the lower its contribution to climate

change. Since both direct and indirect components in a traditional HFC system are of approximately the same magnitude, even a relatively inefficient low-GWP system can provide climate benefits.

FINANCIAL JUSTIFICATION THROUGH ENERGY EFFICIENCY

While environmental impact is a critical consideration, financial justification is perhaps more important to the wide adaptation of CO₂ systems, because CO₂ systems in North America are substantially more expensive than traditional refrigeration systems. Complicating this discussion are technologies typically used in CO₂ systems that can also be applied with great effect in traditional HFC systems; these technologies are discussed below.

This higher cost is due to several factors: CO₂ systems operate at high pressures, which adds to the cost to components; they are more complicated than traditional HFC systems, requiring such equipment as a gas bypass line with a valve, a high-pressure transcritical valve at the outlet of the gas cooler, and additional controls; and CO₂ systems do not yet have the purchasing volume in North America to drive down component and installation costs. In order to be financially justified, these systems need to overcome this initial capital outlay by providing ongoing operating cost reductions.

There are other, more favorable financial considerations with CO₂ systems, such as easing long-term regulatory and social impacts, but these are more difficult to quantify. It is easier to use a more simplified financial model that considers only energy efficiency to justify the additional capital outlay.

“In CO₂ systems, the temperature of the waste heat is much higher [than in HFC systems].”



James Knudsen is the regional segment manager, North America, Food Retail, Danfoss. An experienced refrigeration executive specializing in global marketing, business development and product strategy, Jim is the holder of five U.S. patents.

He can be reached at james.knudsen@danfoss.com

Strictly due to its physical properties as a refrigerant, CO₂ has some inherent energy challenges compared to HFC refrigerants. These challenges stem from CO₂'s high working pressure (over 1,000 psi vs. around 200 psi for R22) and its performance in the heat rejection and expansion process. While these disadvantages seem to be significant, with as much as a 20% energy penalty, they can be mitigated through the system's design.

On the other hand, there are properties of CO₂ that help the system's efficiency in food retail applications, including excellent volumetric efficiency (more than six times the cooling effect per volume as R22), low compression ratio (the ratio between inlet and outlet pressures at the compressor), and low viscosity (making it easier to pump). Additionally, new technology has been developed that takes advantage of the unique properties of CO₂ to improve efficiency.

SAVING ENERGY IN CO₂ AND HFC SYSTEMS

As mentioned above, some energy-saving technologies used in CO₂ systems can also be applied with great effect in traditional HFC systems. These items can make the initial cost of a CO₂ system seem even higher than that of a basic HFC system, but can be considered separately and financially justified in any system. Many retailers have found that implementing advanced energy-saving technologies in their HFC systems to be well worth the cost.

There are three key technologies that fall into this category. The first is electronic expansion valves with case controllers, which allows the suction pressure to be optimized to minimize the load on compressors as conditions change. The second is variable speed drives that allow the compressor and condenser

capacity to more closely match changes in load. The third is heat reclamation that uses waste heat in the refrigeration cycle.

Heat reclamation, particularly in HFC systems, is used primarily to supplement a facility's hot water requirements due to the low temperature of the waste heat. In CO₂ systems, the temperature of the waste heat is much higher, allowing it to be used for hot water, comfort heating, dehumidification reheat, or regeneration of desiccant, and more.

TECHNOLOGIES FOR CO₂

CO₂-specific technologies leverage the system's design to improve efficiency, particularly in warm climates. For example, booster systems arrange the compressor piping to allow the low-temperature compressor "boost" the suction pressure for the medium-temperature compressor, saving work and energy. Parallel compression deploys a portion of the medium-temperature compressor's capacity to recover and recompress, at a lower compression ratio, the flash gas formed after the compressed vapor exiting the gas cooler condenses into liquid. A large portion of the flash gas in the receiver would otherwise be considered lost capacity for the system; reclaiming it with a minimum amount of work in a parallel compressor can increase system efficiency by as much as 20% during supercritical operation (when ambient is over 88°F).

The most recent development is a device called an ejector. An ejector uses the high-pressure compressed vapor from the gas cooler to increase the pressure of the flash gas, allowing it to be introduced into the suction side of the parallel compressors,

continued on p. 18

→ which in turn reduces the work needed to compress the gas. This technology is very effective in dealing with one of the most inefficient aspects of CO₂ transcritical refrigeration, which is the inherent disadvantage of these systems in warm climates.

When you incorporate all of the technologies available to both transcritical and HFC systems, transcritical still comes out with a 10% higher efficiency advantage ([see chart, this page](#)).

It should be noted that while the energy improvements in cooler climates may be lower, the overall efficiency of transcritical CO₂ systems increase with cooler ambient temperatures (i.e., less time operating in supercritical mode).

Not included in this summary is the use of adiabatic or evaporative condensers/gas coolers, which can provide another 5% of efficiency to either system. Moreover, with additional attention to system design, a transcritical CO₂ gas cooler can be configured to use up to 80% less water than an HFC condenser. The performances of this technology vary substantially with local climate and are specific to their overall system. That said, it is another interesting technology to consider.

While this analysis is far from rigorous for all applications, its purpose was to summarize the technologies available and give a clear view of what is possible today – which is that transcritical CO₂ technology is ready to be deployed in nearly any climate, and can provide substantial environmental and financial benefits.

JK

TECHNOLOGY IMPACT ON WARM-CLIMATE ENERGY EFFICIENCY, TRANSCRITICAL CO₂ VS. HFC *

TECHNOLOGY	TRANSCRITICAL CO ₂	HFC SYSTEM
Basic refrigerant efficiency	-20%	Baseline (basic system)
Electronic expansion valves with case controllers	+10%	+10%
Variable speed drives on compressors and condensers	+5%	+5%
Heat reclaim	+10%	+5%
CO ₂ booster system technology	+5%	
Parallel compression	+10%	
Ejector technology (gas and liquid)	+10%	
Total energy advantage vs. basic HFC system	+30%	+20%
Total energy advantage vs. advanced HFC system	+10%	
* Full-year estimates, based on warm climates such as those experienced in the southern U.S.		

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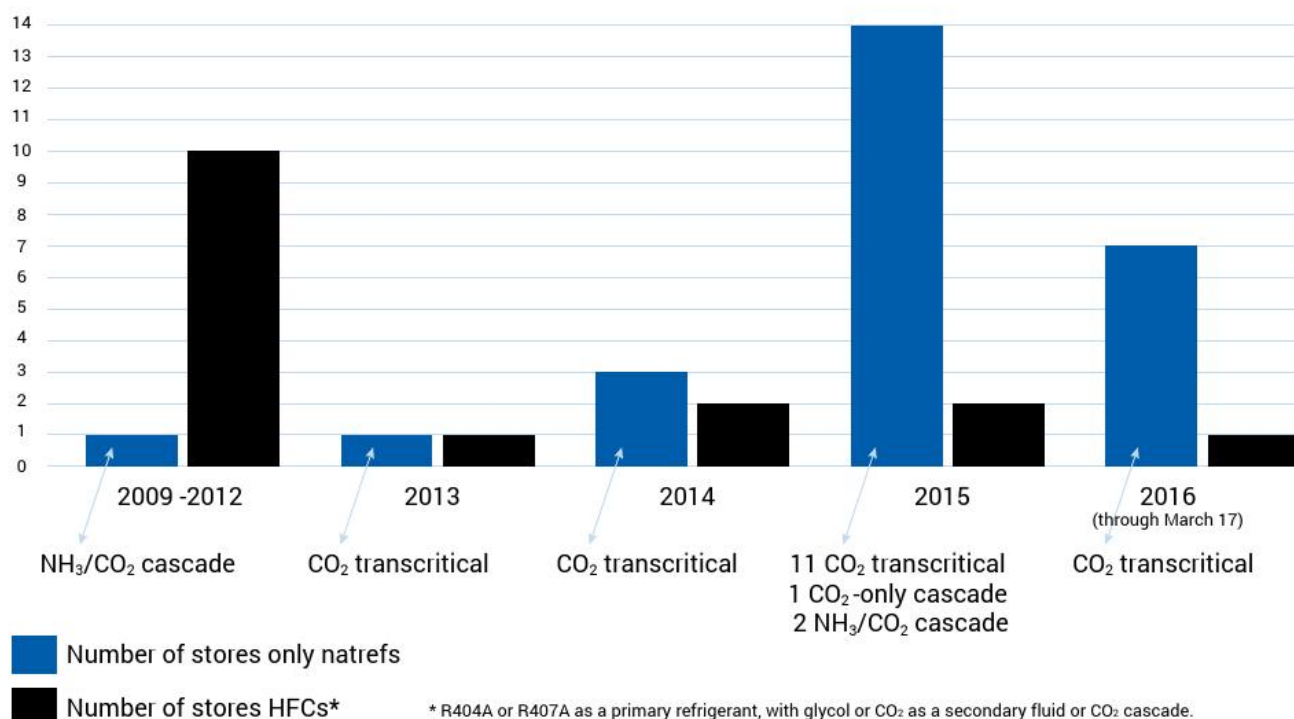


Platinum Stores Evolve to Natural Refrigerants

To achieve platinum certification from the U.S. EPA's GreenChill Partnership, a store must use refrigerants in its commercial refrigeration system that have a global warming potential under 150; alternatively, a store must achieve an average HFC refrigerant charge of no more than 0.5 lbs. of refrigerant per 1,000 BTU per hour of total evaporator cooling load, and a store-wide annual refrigerant emissions rate of no more than 5%. Certification lasts for one year, after which recertification can be achieved annually

under the same requirements. GreenChill also certifies stores as gold or silver, using more lenient requirements.

Since GreenChill began awarding platinum certification in 2009, the number of stores using only natural refrigerants has risen, while the number using HFCs as a primary refrigerant has dropped.



Best of the Best

Each year, the GreenChill Partnership recognizes one platinum store as the best of the group; here are their refrigeration configurations, which the last four years have been natural refrigerants-only.

YEAR	CERTIFICATION STATUS	PRIMARY REFRIGERANT	MEDIUM TEMP°	LOW TEMP°	SYSTEM
2009	new	R404A	glycol secondary	CO ₂ secondary	compact chiller
2010	recertified	R404A	glycol secondary	CO ₂ secondary	compact chiller
2011	new	R407A	CO ₂ secondary	CO ₂ cascade	hybrid CO ₂
2012	new	NH ₃	NH ₃ -CO ₂ secondary	CO ₂ cascade	NH ₃ -CO ₂ cascade
2013	new	CO ₂	CO ₂ transcritical	CO ₂ transcritical	CO ₂ transcritical
2014	new	CO ₂	CO ₂ transcritical	CO ₂ transcritical	CO ₂ transcritical
2015	recertified	CO ₂	CO ₂ transcritical	CO ₂ transcritical	CO ₂ transcritical

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."

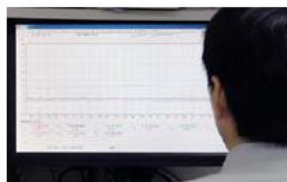
(Mr. Kazunori Hiura, Director, Facilities Department)



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)



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.

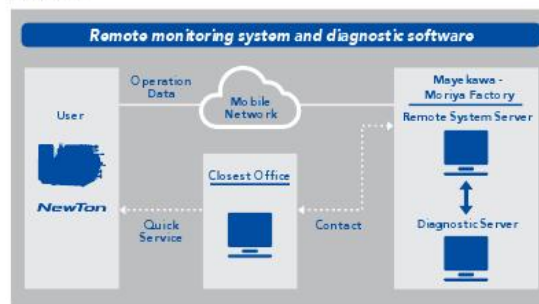
Deciding Factor for Adopting NewTon:

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.



Results after Installation

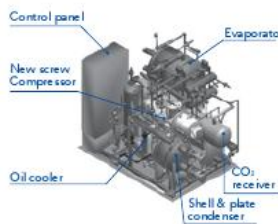
Power consumption has been reduced at overall centers by 15 to 18%, and an individual cooling unit by approximately 30%.

"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.



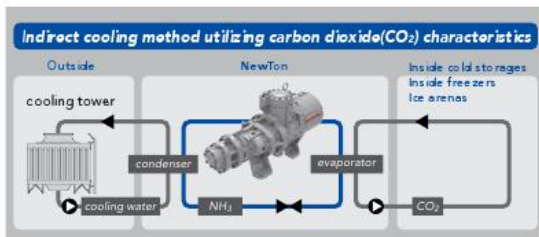
NewTon Evaluation:

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.



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CAMPBELL'S LOW-CHARGE RECIPE

The venerable food manufacturer, which pioneered the use of low-charge ammonia refrigeration packages, continues to install them in place of HCFC and HFC systems at its Pepperidge Farm bakeries

— By Michael Garry





Bing Cheng, Campbell Soup

continued on p.26 →

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→ On July 9, 1962, the pop artist Andy Warhol debuted one of his most famous works, “Campbell’s Soup Cans,” showing 32 contiguous canvasses of the company’s iconic red-and-white cans in a four-by-eight grid, each can labeled with a different variety of soup.

The paintings, which were produced by a printmaking method, helped define pop art as a significant new movement, and contributed greatly to the cultural zeitgeist of the 1960s.

Little did Warhol know that the Campbell Soup Company, established in 1869, would prove to be an innovator in its own right – not only as a dominant player in soup, cookies, sauces and other food categories with annual sales over \$8 billion, but as a pioneer in the use of safe, environmentally friendly low-charge ammonia refrigeration systems.

Low-charge ammonia systems have emerged in the past few years as a growing trend in industrial refrigeration, as cold storage and food processing companies seek to reduce the amount of ammonia in their systems well below the 10,000-pound mark that in recent years has triggered high levels of regulatory scrutiny and insurance costs. Some operators are turning to low-charge ammonia systems as an alternative to R22 or HFC systems, which are also subject to regulation. (See [“Dawn of the Low-Charge Age,” Accelerate America, March 2016.](#))

Camden, N.J.-based Campbell, led by its longtime head of refrigeration engineering Bob Czarnecki, started implementing low-charge systems as far back as the 1980s, long before the Environmental Protection Agency started paying closer attention to ammonia plants.



“We wanted to bring the [ammonia] charge down as much as possible,” said Czarnecki, who retired from Campbell last August and still plays a major industry role as chairman of the IAR’s standards committee (see [story, page 30](#)). “We also wanted to bring the cost of installation down and use as little charge as possible to do the job.”

Czarnecki worked on many of Campbell’s low-charge systems with Ralph Tator, a refrigeration consultant and design engineer for Severn International who was instrumental in the development of the systems. “With Campbell, it’s how do we keep lowering the charge and still have a good system and a good design,” he said. “And that’s what we’ve done. Now the industry is catching up.”

Added Tator: “The reason we got there was because Bob Czarnecki wanted to go to low charge.”

Campbell’s food production facilities are now separated into two broad categories: thermal plants, which include soup, sauces (Prego), salsa (Pace) and beverage (V8), among other products; and bakeries, which encompass seven Pepperidge Farm plants in the U.S. and Kelsen Group cookie





plants in Denmark. The company also has production plants in Canada, Australia, Malaysia and Indonesia.

One of the first large industrial facilities where Campbell implemented a low-charge system in the early 1990s was a Swanson frozen-food plant located in Fayetteville, Ark. (Campbell sold the Swanson frozen food business in 1998.) The facility needed a larger -50°F blast freezer, but its existing receiver was too small to accommodate more ammonia. So Czarnecki decided to change the evaporator design to reduce the charge.

"We went to a top-feed, bottom-return coil, which drained by gravity," he said. "We didn't allow a lot of liquid in the [evaporator] coils, and we were able to make the [receiver] vessel work." The new system reduced the amount of ammonia by at least 10,000 pounds. "This had so many advantages that we never went back the other way again."

In the late 1990s, Czarnecki began installing low-charge packaged units using ammonia as a primary refrigerant and glycol as a secondary refrigerant. One of the first installations was at a new tomato processing plant in Stockton, Calif. "We

wanted to make something portable and keep the charge low," he said.

Mounted outside the tomato facility, the low-charge system was used for process cooling; its ammonia charge was less than 500 lbs., about 1.5 lb./ton. It employed a cooling tower, which lowered the charge more than an evaporative condenser would have.

At many of its thermal plants, Campbell in the late 1990s and early 2000s converted large-charge ammonia systems to low-charge configurations in process cooling, freezers/coolers and HVAC.

Compared to the cost of a large-scale ammonia engine room, the cost of ammonia packages is less, said Czarnecki. "With packages you streamline the equipment, there aren't as many pipes and valves, and you limit the ammonia to a small area which also improves safety."

On the other hand, a low-charge plant using pumped secondary fluids typically experiences an energy penalty compared to large-charge systems. "But if you do it right it's not terrible," said Czarnecki. "And it's so much nicer not to have to worry about bringing ammonia into your [refrigeration areas]."

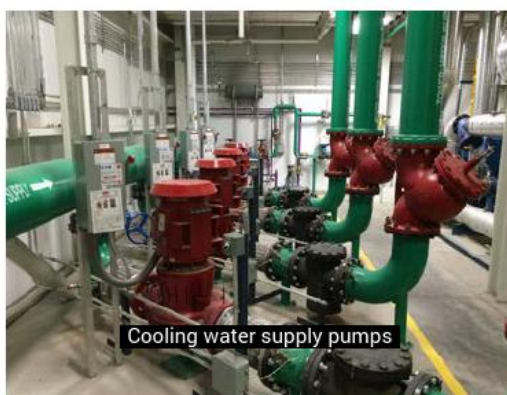
Under its current strategy that emphasizes low-charge ammonia chiller packages circulating glycol, most of Campbell's thermal facilities now use less than 10,000 pounds of ammonia and minimize the circulation of ammonia in refrigeration applications.

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LOW-CHARGE AMMONIA SYSTEM IN RICHMOND, UTAH, PEPPERIDGE FARM PLANT



Screw compressor for HVAC glycol chiller



Cooling water supply pumps



Penthouse freezer coils



HVAC glycol chiller package



Cooling towers for ammonia packages



Penthouse freezer

→ In recent years, one of Campbell's primary applications of low-charge packaged systems has been as a replacement for HCFC and HFC systems. An early example of that was a New Jersey ingredient facility whose R22 system was "kaput," said Czarnecki. By installing a packaged unit with less than 500 lbs. of ammonia, Campbell was able to get the operation certified with fewer restrictions than would have normally been the case in New Jersey, which heavily regulates ammonia.

Unlike many operators in industrial refrigeration, Campbell has tried to replace synthetic refrigerants with low-charge ammonia. "The idea is to get away from synthetics," said Czarnecki. "First people to convert from R12 to R22, then R22 to R134a and R404A, and now they're jumping out of HFCs. How many times do we want to do this?"

PASSING THE BATON

From 2004 until his retirement, Czarnecki worked closely with Bing Cheng, Campbell's principal utilities engineer, who focused on the HVAC side; following Czarnecki's retirement last year, Cheng assumed responsibility for refrigeration as well – and all of the low-charge ammonia projects – along with projects involving steam, water, compressed air and heat recovery systems. Cheng serves on the IIAR standards committee and on its CO₂ standard subcommittee.

Cheng's expanded responsibilities coincide with Campbell's effort to realign its environmental goals for 2025, one of which is the phase out of its remaining HCFCs and HFC refrigerants, a potent contributor to greenhouse gas emissions. Between Campbell's 2011 and 2014 fiscal years, the company cut its overall greenhouse gas emissions by 11.1%.

Reducing synthetic refrigerants stems from Campbell's commitment to cutting its GHG footprint and its involvement with the Consumer Goods Forum (CGF) a global consortium of packaged goods brands and retailers that has pledged to reduce use of HCFCs and HFCs as part of its broader sustainability agenda; Campbell's president and CEO, Denise Morrison, currently serves as the organization's co-chair.

Cheng, who prior to joining Campbell in 2004 worked on energy and conservation projects for power consulting firms Foster Wheeler and Sargent and Lundy, fits in well with Campbell's environmental culture. A father of a five-year-old son, he "would like to leave our corner of the world a little bit better for the next generation."

Since 2010, Campbell's low-charge program has focused on its Pepperidge Farm bakeries, where the company has been converting R22 refrigeration systems to low-charge ammonia packages. These plants – famous for such iconic brands as Milano cookies and Goldfish crackers – use refrigeration in process cooling, freezers/coolers and HVAC.

Pepperidge Farm operates seven bakeries, six of which have been converted or are targeted for conversion from R22 (or R507 in one case) to low-charge ammonia. Conversion from R22 to low-charge ammonia takes one year, from design to commissioning. One plant, in Bloomfield, Conn., has used ammonia (and HFCs for their HVAC loads) since its inception.

The bakeries are using low-charge equipment that is similar to that used by Campbell's thermal plants, though the bakeries have larger process loads. Another difference is that the thermal facilities have many 5-ton HVAC office units using HFCs, which Cheng plans to replace with ammonia/glycol or water chillers. "They are spread all over the plants so it will be challenging to get them all."

In some conversions to low-charge ammonia, a Campbell facility may have a relatively new (under five years old) HVAC unit using an HFC. The company will continue employing that unit until it fails, and then replace it with a new unit that will utilize chilled water or glycol.

Czarnecki and his team did a low-charge ammonia study for Pepperidge Farm in 2004. Initially, "nobody [at Pepperidge Farm] wanted ammonia," he said. "They were comfortable with R22. But we said we could make the units low-charge to improve the system's safety profile." Pepperidge Farm began its R22 conversion in earnest in 2010.

Because Campbell has had ample experience with low-charge ammonia in its thermal plants, converting to that technology from R22 in the Pepperidge Farm bakeries hasn't been "a big deal," said Cheng. "With the confidence we got early on, it made ammonia a lot more palatable to the Pepperidge Group." For the same reason, technician training has also not been much of an issue at these plants.

Certainly the enhanced safety of the low-charge systems helps to settle the nerves of the uninitiated. "We're talking less than 300-500 pounds of ammonia in these skids," said Cheng. "If you get a leak or release, it's not catastrophic or life-threatening, so it's manageable

and not frightening compared to a large ammonia system."

LESS THAN A POUND PER TON

Most of Pepperidge Farm's U.S. manufacturing plants are in the Eastern time zone, but it has one in the far west, in Richmond, Utah, which completed an R22 conversion to low-charge ammonia in early 2013.

The Richmond facility has two 560-ton ammonia chiller packages that circulate glycol at 42°F to HVAC units; and one 400-ton process chiller that delivers glycol at 27°F to mixers and cooling tunnels. The fourth package is a 120-ton freezer unit that creates -40°F temperatures for blast freezing product and bread storage areas. In total, the plant uses 1,475 lbs. of ammonia to accommodate the 1,640 tons of refrigeration, for a low-charge ratio of 0.9 lbs./ton.

All four prefabricated packages are housed in a new engine room – a "safe, secured area" with leak detectors and emergency ventilation, said Cheng. They are open packages mounted on steel frames.

The Richmond facility previously used a central R22 system for a blast freezer, storage freezer and for a portion of process cooling, as well as more than 40 R22 packaged units for HVAC and the rest of process cooling.

Campbell considered putting the low-charge packages closer to the refrigeration loads, but "our philosophy is to try and keep ammonia in one location and not have it spread around the plant," said Cheng. "That helps with maintenance, and potential leaks are contained in one secured area."

In cases where the need for cooling is located a long distance from an existing source of chilled water and/or glycol, Campbell has considered alternatives from its engine-room philosophy. For

continued on p.30 →

TIMELINE OF PEPPERIDGE FARM'S CONVERSION FROM R22 TO LOW-CHARGE AMMONIA



STANDARDS MAVEN

In addition to his more than 35 years of experience as a refrigeration engineer, for the past several years Bob Czarnecki has served as chairman of the standards committee for the International Institute of Ammonia Refrigeration (IIAR).

Czarnecki helped oversee major revisions to the IIAR 2 standard, known as the Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems. The revised standard was released last November and reviewed in detail in March at the IIAR Conference and Exhibition in Orlando, Fla.

In addition to the IIAR 2 revision, "under Bob's chairmanship, the standards committee has accomplished many of the goals established years ago, including publication of IIAR standards 4, 5, 7 and 8, and a number of revisions and addendums to existing standards," said Eric Smith, vice president and technical director for IIAR, at the conference. "He continues to lead us on the development of new standards and the formation of new subcommittees."

IIAR 2 includes for the first time a chapter (14) dedicated to packaged systems and equipment, which Czarnecki helped to pioneer as head of refrigeration engineering at Campbell Soup, from which he retired last August.

Czarnecki was named IIAR member of the year at the conference.



example, at its thermal plant in Napoleon, Ohio, it plans to soon install an enclosed ammonia HVAC chiller package outside the facility a good distance from the engine room. "The beauty is you can drop it anywhere," he said.

COST CONSIDERATIONS

The initial cost of a low-charge ammonia/glycol package is greater than an HFC replacement would be. Cheng called the higher cost "a major challenge."

It would have been easier and less expensive for Campbell to replace R22 with HFC equipment than with the low-charge ammonia skids, Cheng acknowledged. "A lot of times at the thermal plants, we could have put in a 5-ton R410A unit and walked away." But that would have run counter to Campbell's CGF commitment to stop using HFCs. "Luckily for me, as an organization we're not heading in that direction," he noted, adding that using low-charge ammonia "is the right thing to do."

While costing more, the low-charge ammonia packages at the Richmond plant are more energy efficient than the R22 systems they replaced. None of Campbell's plants recover heat from their low-charge ammonia packages. "However, we are evaluating heat-pump technology to create tempered hot water as a potential enabler project," said Cheng.

Campbell is working with Chuck Taylor and his refrigeration design firm CRT Design on its latest Pepperidge Farm R22 conversion at a plant in Lakeland, Fla. Campbell's maintenance costs for low-charge ammonia packages there will be much lower than those of the plant's aging R22 units. "They have a large amount of HVAC R22 units throughout the plant," said Cheng. "The maintenance budget to maintain these units is increasing each year. That's a big cost we will avoid once the new R22 conversion project is complete."



Bob Czarnecki at the IIAR Conference in March

In Lakeland, Campbell is installing, for the first time in its network, an ammonia/CO₂ cascade package for one freezer application. "We're putting our foot in the door with CO₂ packages," said Cheng. "I'm excited about the opportunity to use CO₂. It's a good natural refrigerant option, with operational and economical benefits."

While Campbell is making a statement with its embrace of low-charge systems, and a number of other companies are starting to adopt them, Czarnecki observed that some food processing operations in the U.S. continue to rely on large-charge systems. "You hear the buzz about low-charge, but not everyone is doing it."

But for Czarnecki, the development and adoption of low-charge ammonia systems are far from over. "The work is so evolutionary; there's a lot of ground to be gained. It's a good way to go, whether you put it centrally or spread it over the plant. It's a safer way to go."

● MG

SYSTEM SPECS

Pepperidge Farm's manufacturing plant in Richmond, Utah, uses the following components in its low-charge refrigeration systems:

- Two HVAC ammonia packages
- One process-cooling ammonia package
- One pump recirculation ammonia freezer package using evaporator coils in freezer rooms
- Gravity-drain freezer coils
- Ammonia charge: 1,475 lbs.
- Total capacity: 1,640 tons
- Ammonia compressors
- Cooling towers
- Glycol plate heat exchangers
- Chilled water heat exchangers

A LONG TIME COMING

Ralph Tator has been designing low-charge ammonia systems with up to 600 tons of refrigeration for 40 years, but for a long time much of his work was overseas.

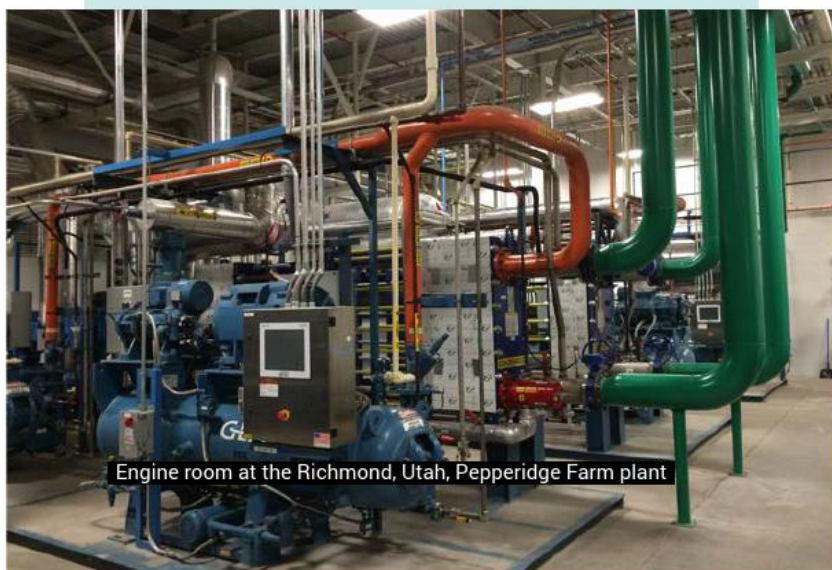
"I did a lot of business in places like Greece, Egypt and Syria," said Tator, now a semi-retired refrigeration consultant and design engineer for Severn International. "We built ammonia packages there with secondary fluids. They were low charge, three-quarters of a pound per ton, mostly critically charged so they were simple to operate."

At that time, Tator took his low-charge design talents abroad because "there wasn't any interest" in the U.S. That changed in the early 1990s when he hooked up with Bob Czarnecki of Campbell Soup, which began installing Tator's systems in its plants. Tator's last job with Campbell was converting a Pepperidge Farm plant in Richmond, Utah, to low-charge ammonia packages in 2013.

Now low-charge ammonia systems are gaining serious interest in the U.S. "It's taken 20 years, but the refrigeration industry moves very slowly," he said. "It isn't the engineers, it's the contractors who aren't going to take risks and develop new systems."

Tator is currently doing research into secondary brines in an effort to identify those that would increase the efficiency of a low-charge ammonia system. While Campbell has found low-charge ammonia chillers with glycol to be more efficient than R22 systems, those low-charge units are typically less efficient by 12% to 15% than direct, pump-recirculated ammonia systems, said Tator.

Still, the industry is "really looking at [low-charge systems]," he said. "Over the next two to three years, you'll see most of the systems be some kind of brine system."



Engine room at the Richmond, Utah, Pepperidge Farm plant



Transcritical rack at Migros store

MIGROS PUSHES THE CO₂ ENVELOPE

By installing parallel compressors and ejectors in one store, the Swiss retail giant boosted the efficiency of a transcritical CO₂ system by 45% over that of the previous HFC system

– By Nina Masson

Migros Group, the retail conglomerate based in Zurich, Switzerland, has one of the more interesting business models in the global retail marketplace.

For one thing, the company's cooperative retailing division, which consists of 10 entities, is owned by its members – about a quarter of Switzerland population of eight million, who can vote in the cooperative's general assembly. In addition, Migros' M-Industry division (industry and wholesaling) produces more than 90% of the goods (more than 20,000 products) sold in its retail outlets.

Along with supermarkets of various sizes, the Migros portfolio includes petrol stations, electronics stores, DIY stores, garden centers, fitness centers, banks, bookshops, sports shops and more. The 91-year-old company is not only Switzerland's largest retailer and supermarket chain (43% of its 2013 revenues of \$27.98 billion came from its Swiss supermarkets), but also its biggest employer.

“We knew there were risks, financially and from a technology perspective, but Migros decided to take this risk.”

Migros Group's energy and climate commitments are primarily guided by a strategy – dubbed Generation M – that binds all Migros companies and includes ambitious targets to reduce energy consumption and environmentally harmful emissions by 2020. Chief among its 2020 goals: reducing electricity consumption by 20% and fossil fuel consumption by 55%, as well as reducing the climate impact from refrigerants by 60%.

“Generation M signifies a balanced approach towards our activities concerning economic, ecological and social consequences to ensure the long-term success of the Migros Group,” explained Daniel Duss, head of building and technology at Migros Lucerne, one of the 10 entities in the Cooperative Retailing division, at his meeting with *Accelerate Europe*, a sister magazine to *Accelerate America*, at the firm's Lucerne headquarters. “For us, it is very important that Migros offers a broad range of sustainable products and services, and that it sets high standards for climate protection and resource efficiency.”

Progress with refrigerant emissions is measured year-on-year to verify that the group is on track to meet its 2020 targets, added Duss, who is responsible for planning new stores and refurbishing existing ones. To that end, Migros is pursuing an ambitious program to install CO₂ transcritical technology, including a test of a system fortified for warm climates with a parallel compressor and ejectors.

Migros would like parallel compression and ejectors to catch on throughout the retail industry. “We knew that if this project would fly, others – including our competitors – would benefit from this, too,” Duss said. “That's alright for us – others should be able to do so.”

MIGROS FOOD STORES

	TYPE	NO. OF STORES	SIZE OF STORE (SQ. FT.)
SWITZERLAND	M	310	8,503
	MM	212	24,434
	MMM	47	84,368
	Other supermarkets	11	12,755
	Migrolino (c-store)	254	NA
FRANCE	MM	1	14,176
	MMM	2	58,071
GERMANY	Tegut	280	11,291



A GREEN COOLING LEADER

Mindful of the harmful effects of synthetic refrigerants, the Migros Group is committed to using natural refrigerants in its supermarkets and in other Migros companies. Migros phased out a large proportion of HCFCs in 2014, and has made CO₂ applications a standard across its supermarkets, with the aim of adopting the technology in new and existing stores.

By 2014, Migros was using CO₂ transcritical in 455 of the 2,000 systems in operation throughout its 863 supermarkets in Switzerland, Germany and France. ([See chart, this page.](#)) Around a third of Migros supermarkets have at least one CO₂ cooling system. For its work with environmentally friendly refrigerants, Migros was named a Green Cooling Leader by the Environmental Investigation Agency in 2014.

“Our aim remains 100% CO₂,” said Duss. “But knowing when we will reach this goal would be to read tea leaves. I only know that we have an ambitious five-year plan, and that for every single construction project we will discuss the question of which type of CO₂ system we will best use.”

continued on p.34 →

“Our aim remains 100% CO₂.”

→ Migros Lucerne alone operates 53 stores with refrigeration systems, out of which 28 use CO₂ as a refrigerant. Last year it replaced three existing systems with CO₂ and in 2016 will do another five. Its use of natural refrigerants goes even further than that; in 2010, all three buildings in its headquarters in Dierikon, near Lucerne, were changed from R22 to ammonia-based cooling systems. And Migros is using propane in new plug-in refrigeration systems, though it has not yet looked into optimizing refrigerant emissions in transport and other refrigeration or heating applications.

IBACH STORE OPTIMIZES TRANSCRITICAL

Being aware of the importance of further establishing CO₂ technology and of eliminating its drawbacks in warmer climates, Danish refrigeration engineering firm Frigo-Consulting was looking for a partner to take ejectors one step further.

The refurbished Migros store in Ibach, Switzerland, provided such an opportunity to install and optimize a CO₂ system with parallel compression and ejectors, the world's first CO₂ ejector system.

The advanced CO₂ refrigeration system supplies cooling capacity to 558 feet of medium- and low-temperature cabinets and 3,014 square feet of cold rooms and freezers. Two identical CO₂ booster units provide a total of 250 kW of refrigeration capacity. Frigo-Consulting developed the solution together with Italian rack supplier enEx, which provided the ejectors. Swiss system contractor Alpiq Intec West installed the system in November 2014.

Results are highly encouraging after one year of operation. The facility has boosted efficiency by at least 25% compared to traditional CO₂ systems, and by 45% compared to the previous HFC-based system.

“This is a quantum leap for CO₂ refrigeration systems in terms of efficiency not only in Switzerland but beyond, especially in wiping away the so-called ‘efficiency equator’ for CO₂ transcritical systems in warmer ambients,” said Marcus Hoepfl, managing director of Frigo-Consulting International.

He is convinced that it is only a matter of time before ejector technology becomes more widespread and ultimately state-of-the-art in retail and industrial refrigeration.

Migros Lucerne echoes this enthusiasm. “Frigo-Consulting’s team convinced us that with this innovative solution we could save a lot of electricity,” said Duss. “This was our largest driving force. We knew there were risks, financially and from a technology perspective, but Migros decided to take this risk. Today, we know that the system will be amortized in a very short period of time and that any additional costs became small enough to make it a worthwhile investment.”

As a result of the system’s reliability and efficient operation, Migros Lucerne installed another CO₂ ejector system, with two more in the planning stage. As regards its long-term strategy, the retailer plans to use ejector technology in medium- to large-sized stores, while smaller store formats up to 10,764 square feet will use standard CO₂ booster technology.

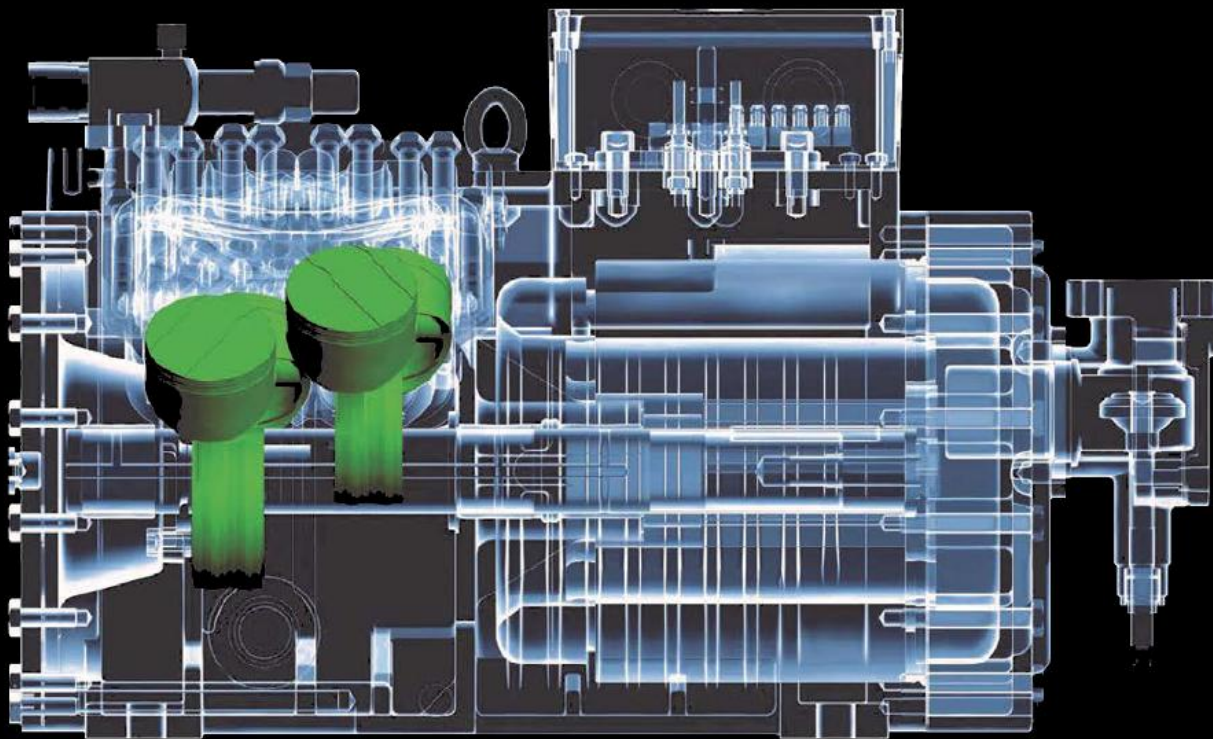
Migros and Frigo-Consulting have formed a beneficial relationship, both parties agree. The fact that Frigo-Consulting has engineered a greater number of CO₂ transcritical than subcritical installations has gone hand-in-hand with the drive of customers such as Migros. “It was our conscious decision to take the risk and move towards transcritical systems, and there was also a smooth pressure coming from progressive customers,” explained Hoepfl.

“When testing new technologies, there is a big need for brave customers ready to invest in the latest technologies and who do not solely look at the very short-term return on investment,” Hoepfl said. “Migros is a good partner for this.”

Duss said that one of the retailer’s largest triggers for action is simply having proactive engineering partners who approach them with new refrigeration technologies and concepts to test and then commercialize. “We will always listen if our partners come to us asking us to field-test a new solution that is more energy-efficient than the previous one and that will at some point also become more cost-competitive.” **NM**



Frigo Consulting's Markus Hoepfl



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Bitzer

EPA PROPOSES NEW SNAP CHANGES



Agency would allow propane in new applications, but make it unacceptable in others, while delisting HFCs in cold storage warehouses

– By Justina Tamasiunaite and Michael Garry

The U.S. Environmental Protection Agency on March 29 released the latest refrigerant proposal under its Significant New Alternatives Policy (SNAP) program, expanding the list of acceptable refrigerants and banning the use of certain gases that contribute to climate change.

In particular, the proposal would make propane acceptable in commercial ice machines, new water coolers and very low-temperature refrigeration equipment. It would also exempt propane from the venting prohibition under section 608 of the Clean Air Act when propane is used as a refrigerant in commercial ice machines, water coolers or very low-temperature refrigeration equipment.

But the proposal would make all ASHRAE A3 (flammable) refrigerants, including propane, unacceptable in retrofits of “residential and light commercial air conditioning and heat pumps – unitary split AC systems and heat pumps.” Under this rule, no flammable refrigerants could be placed in systems designed for and used with non-flammables.

These acceptability and delisting changes would take place 30 days after publication of a final rule.

Notably, the EPA also proposed delisting a range of refrigerants – including R404A, R407A, R410A, and R507A – for new cold storage warehouses, as of Jan. 1, 2023. If

enacted, this delisting would support the adoption of low-charge ammonia systems and ammonia/CO₂ systems.

The new proposal “would reduce the use and emissions of some of the most harmful HFCs, which are thousands of times more potent than carbon dioxide, and approves safer, more climate-friendly alternatives to protect public health and our environment,” said EPA Administrator Gina McCarthy.

OTHER DELISTINGS

The proposal would also make the following unacceptable:

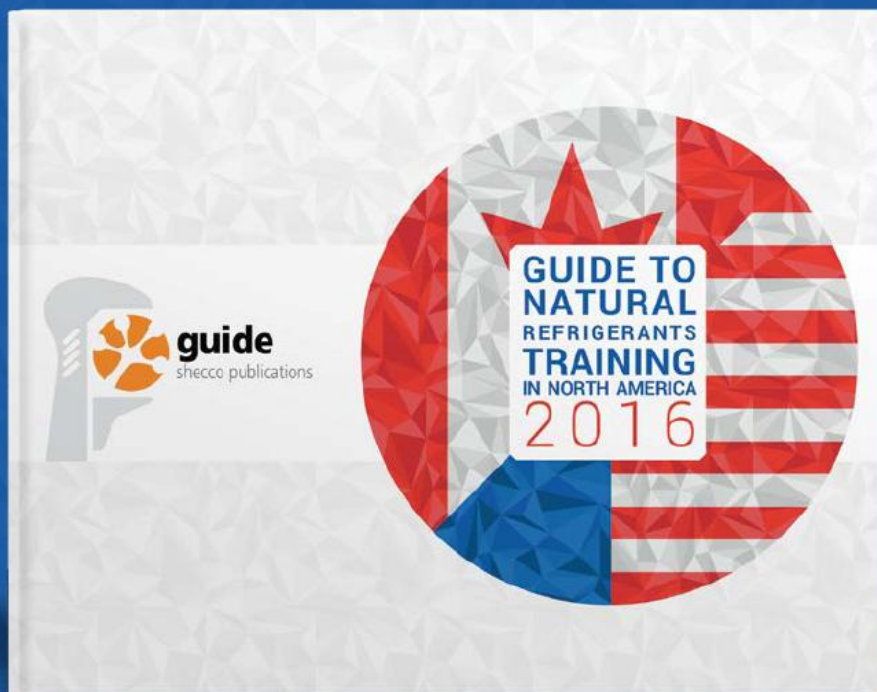
- » Propylene and R443A in new residential and light commercial air conditioning and heat pumps, cold storage warehouses, centrifugal chillers, and positive displacement chillers, all 30 days after the publication of a final rule.
- » A range of refrigerants, including R404A, R410A, R134a, R407C, and R507A, in new centrifugal chillers and positive displacement chillers, as of Jan. 1, 2024, subject to “narrowed use limits.”
- » A range of refrigerants, including R404A, R410A, R134a, R407A, R407C, and R507A, in new refrigerated food processing and dispensing equipment, and those refrigerants (except for R407A) in new household refrigerators and freezers, as of Jan. 1, 2021.

At the AAA Refrigeration Service Symposium held in early April in Tarrytown, N.Y. Rajan Rajendran, vice president of systems innovation center and sustainability, Emerson Climate Technologies, noted that the proposal to delist R407A – commonly used as an R22 or R404A substitute in commercial refrigeration – in retail food refrigeration only applies to processing and dispensing equipment “that use a nozzle” for ice cream, frozen carbonated beverages and the like; it does not apply to rack systems or stand-alone commercial units (for which other refrigerants are delisted per the final SNAP rule announced last July).

Rajendran also pointed out that Canada issued its own refrigerant proposal in March, in which a maximum GWP of 1500 would be set for refrigerants used in stand-alone low-temperature units and in medium and low-temperature central rack systems; a 650-GWP maximum would be set for refrigerants in medium-temperature stand-alone units.

All interested stakeholders will have a chance to submit comments on the EPA SNAP proposal during a 45-day period starting after its publication in the Federal Register. The proposal is available here: <http://1.usa.gov/1Vs2WV4> ● JT & MG

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MULTINATIONALS TACKLE CLIMATE CHANGE WITH NATREFS

Overcoming training and servicing issues, Refrigerants, Naturally! members install millions of stand-alone refrigeration units that use CO₂ or hydrocarbons around the globe

– By Justina Tamasiunaite

Global multinationals Unilever, Red Bull, the Coca-Cola Company, PepsiCo and SABMiller announced last month that they have put over 4.5 million HFC-free stand-alone refrigeration units into operation worldwide, collectively avoiding more than 27 million metric tons of CO₂-equivalent emissions.

The companies collaborate as members of the Refrigerants, Naturally! group to phase out HFCs from their refrigeration equipment, including beverage and ice cream coolers and vending machines, as part of an effort to tackle climate change.

“Our focus is replacing F-gases only with natural refrigerants, including ammonia, carbon dioxide and hydrocarbons, and we focus particularly on plug-in point-of-sale refrigeration equipment,” said Julia Both, network manager of Refrigerants, Naturally!, during a March webinar on “Breaking down barriers in the servicing and maintenance of natural refrigerant systems,” organized by the United Nations Environment Program (UNEP).

The webinar – part of a broader series on issues related to the Montreal Protocol and ozone layer protection – was attended by Refrigerants, Naturally! members Coca-Cola, Red Bull, Unilever and SABMiller.

Coca-Cola, which uses CO₂ as its natural refrigerant of choice, is moving toward its goal of phasing out HFCs, which it had

hoped to do by the end of 2015. “We are not yet 100% there,” said Antoine Azar, global program director at Coca-Cola. “We have some technical challenges, but we are going towards our goal.”

So far Coca-Cola has 284 CO₂ cooler, vending machine or fountain machine models certified and ready to be used. By the end of 2015, the Coca-Cola Company had deployed more than 1.8 million HFC-free units.

“We have natural refrigerant equipment everywhere in the world where we operate today,” said Azar. “Our equipment is distributed among developed and developing countries and in hot, humid or cold climates. So really, wherever you can find a Coca-Cola can, there is possibly HFC-free equipment working in that country,”

The company hasn’t faced any major issues in servicing CO₂ equipment, noted Azar. “Of course, when you start working with a new technology, there are always some adjustments to be done. But frankly speaking, CO₂ today can be serviced either in the field or in some cases in the service center.”

HYDROCARBON USERS

David Hasenschwandter, global sustainability manager at Red Bull, said a lack of experienced or qualified service partners to maintain its natural refrigerant systems

had proven to be an obstacle in the Middle East and Asia, particularly in India. Red Bull’s uses the hydrocarbon isobutane (R600a) to refrigerate its natural refrigerant coolers.

Hasenschwandter said Red Bull has organized training sessions for service partners in Mumbai and Bangalore, attended by cooler manufacturers from both India and Europe.

Berty Jakob, senior research and development manager at Unilever, shared the company’s experience using hydrocarbon refrigeration equipment.

“In the area of refrigerants, we made a commitment in the year 2000,” Jakob said. “And by 2014 we already had over 12,000 hydrocarbon cabinets in place. We were very consistent and persistent in the way we moved ahead. As of today, Unilever has 2.2 million hydrocarbon cabinets.”

Unilever prefers to use hydrocarbon refrigerants R290 and R600a for low-temperature applications. Jakob said that R290 refrigerants are 9% more energy efficient than HFC refrigerants.

Jakob said that hydrocarbon cabinets had proven to be as reliable as HFC cabinets. “We have more than 10 years experience of working with hydrocarbon cabinets, and we have never had any safety issue.” **● JT**



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PROPOSED RMP RULES PROMPT AMMONIA INDUSTRY RESPONSE

At IIAR Conference, GCCA's Lowell Randel assesses impact of EPA's proposals for new safety requirements, and outlines industry's position

— By Mark Hamstra

The ammonia refrigeration industry is voicing some concerns over the Environmental Protection Agency's proposed changes to its Risk Management Plan (RMP) requirements for facilities that use ammonia and other regulated chemicals.

Of the approximately 2,500 facilities regulated by the RMP, an estimated 20% are regulated because of their use of ammonia, according to Lowell Randel, vice president of government and legal affairs at the Global Cold Chain Alliance.

"That's a big regulation for us," Randel said last month in a presentation at the IIAR 2016 Industrial Refrigeration Conference & Exhibition in Orlando, Fla.

The proposed RMP rule changes were drafted following an Executive Order issued by the Obama Administration to review and enhance safety procedures at facilities that make or use potentially hazardous chemicals. The Executive Order — E.O. 13650 — was prompted by the 2013 fertilizer plant explosion in West, Texas.

Some industry operators said they have seen an increase in violations and fines at cold storage facilities recently, providing incentives to transition to low-charge ammonia systems, which are less regulated under RMP rules.

The EPA is seeking changes to the RMP in 19 areas, some of which Randel described as potentially “problematic” for the industrial refrigeration industry. On the other hand, the EPA is also proposing that the industry have four years to meet the new requirements.

The proposal that “poses the most potential costs and questionable benefits,” he said, would require that operators get an independent, third-party audit within a year of a reportable accident or catastrophic incident.

“The EPA has some concerns that there may be some bias” if a company does an audit internally, Randel said, adding, “I know many of you do that with great success and effectiveness.”

Under the proposal, an auditor could only perform audits and no other services for the company, though Randel said most auditors “do work on RMP programs or provide other value-added services to facilities.”

IIAR thinks the proposed requirement could be “really problematic” because of a potential lack of availability of qualified auditors meeting the new criteria, he said.

“We’re going to be making strong comments to the agency.”

“We’re going to be making strong comments to the agency on that,” said Randel.

Randel also said the IIAR is taking issue with the EPA’s proposal requiring that the audit team include a professional engineer (PE).

“PEs are great, but I think restricting the audit team so that PEs are leading it or on it is not necessarily the restriction that is needed, or most warranted,” he said.

OTHER RULES

In addition to the audit requirements, the EPA’s proposed RMP rules that could impact industrial refrigeration companies include: root-cause analysis of accidents or near misses; coordination with emergency responders; and information sharing.

In addition, the EPA is piloting proposed rules on the use of “inherently safer technology” at chemical manufacturing facilities and certain other types of operations. These rules would not immediately apply to the industrial refrigeration industry, but are worth “keeping an eye on,” said Randel.

The safer technology rules would require the investigation and documentation of alternative technologies that facilities could employ. While the proposed rules don’t mandate that these technologies be implemented, they would “set up a situation where you are going to have to demonstrate to the agency why you didn’t” implement them, said Randel. “So, there’s going to be some undue pressure, and a lot of costs associated with these technologies.”

With regard to new rules proposed by the EPA requiring a root-cause analysis following an accident or near miss, Randel said the industry would work with the EPA to ensure that the parameters of what constitutes a near miss are clear.

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→ “At its core, if you have a near miss, doing immediate investigations and having root-cause analysis is probably good practice,” he said. “But this would be a new regulatory requirement, and it would require you to have a report and keep it on file for five years.”

ENGAGING WITH EMERGENCY RESPONDERS

The EPA’s proposals on coordination with emergency responders are another potential thorny issue for the industrial refrigeration industry. While the industry agrees on the importance of engaging with local emergency response teams, circumstances often prevent that from happening, said Randel.

“You all do a lot of due diligence to reach out to the response community, but the response community also has a responsibility to respond back to us, and we know that doesn’t always occur,” he said, citing the limited resources available to some local emergency response teams.

However, the EPA is “making it very clear” in the proposed rule that if a facility does not obtain an “affirmative engagement” with a local responder, that facility would need to itself become a responding facility, “and we all know that is very expensive, there are a lot of moving parts to that,” said Randel. (A “responding facility” must maintain compliance with certain mandatory elements of emergency response plans.)

“That’s something we have some concerns about,” he said. “If you are in a non-responding facility right now, and you are not having a good relationship with your local response teams, get good relationships now. Engage, engage, engage.”

The EPA is also proposing some new requirements for the sharing of additional information with Local Emergency Response Committees (LEPCs) and emergency responders.

Information sharing would also extend to rules mandating that facilities better share information with the public. That could include requiring facilities to conduct public meetings every five years, and within 30 days of an accident.

In the past, however, the industry has found that such scheduled meetings draw little public interest, said Randel.

“That’s another thing we are going to hit the agency on,” he said.

The deadline for comments on the proposed rules is May 13. Randel expects a final rule – which he called a “high priority” for the Obama Administration before it leaves office in January 2017 – by fall/winter 2016, and compliance by 2017.

OSHA RULES

Meanwhile the Occupational Safety and Health Administration (OSHA) is expected to draft some similar rules, although at a slower pace than the EPA, Randel said. OSHA takes eight years on average to get a new set of standards finalized.

OSHA’s new rules will likely include “a lot about” Recognized and Generally Accepted Good Engineering Practice (RAGAGEP), an area where Randel noted that the ammonia refrigeration industry has been a leader.

He also warned that OSHA’s monetary penalties are going up about 80% in value this year.

“OSHA penalties hadn’t changed in about 25 years, and some people said, ‘We need to scale that up to meet inflation,’” Randel said.

In addition, OSHA is looking at incentivizing its inspectors differently, and in a way that could result in higher fines and a greater focus on certain “high-priority” and “higher-value” inspections. In the past, inspectors had been incentivized based on the number of inspections they conducted, which might have resulted in faster – and presumably less thorough – inspections.

OSHA is also making an effort to publicize more of the significant violations it cites by issuing more press releases, Randel said.

Despite the potentially negative implications of some of the new rules, overall, Randel said the regulatory climate in the U.S. and globally is shifting in the industry’s favor.

“The trend is toward more regulations on HFCs [hydrofluorocarbons] at the national and multilateral level,” he said, “and natural refrigerants are seen as an alternative as they transition away from those.” **•MH**





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ICE, ICE BABY

At the Seafood Expo, seafood processors and equipment makers spoke of using CO₂ as a freezing agent, and CO₂ and low-charge ammonia in ice making

— By Michael Garry

It was a warm winter in the New England, but there was plenty of ice on hand at the Seafood Expo North America/Seafood Processing North America held at the Boston Convention & Exhibition Center from March 6-8.

Looking like a giant supermarket seafood department, the Expo featured all manner of fish and processing equipment, much of which has to do with freezing fish or keeping it on ice. Here are some examples of how natural refrigerants can do the job.

INTEREST IN CO₂

At the Seafood Expo, seafood processors and equipment manufacturers both reported a growing interest in using CO₂ as the freezing agent in the IQF (individually quick frozen) process.

For example, Eastern Fisheries, a seafood processor based in New Bedford, Mass., has switched from nitrogen for freezing scallops to CO₂, delivered by an ammonia/CO₂ cascade system supplied by M&M Refrigeration. (See "Pioneer of Low Charge," *Accelerate America*, March 2016.)

The liquid CO₂ refrigerant is sent from the M&M system to an evaporator in a Skaginn IQF tunnel processing line. The 99 TR capacity system produces a temperature of -58°F and processes 6,500 scallops per hour.

Siggi Skulason, a sales and service representative with Iceland-based Skaginn, said he is seeing more NH₃/CO₂ systems used with Skaginn's tunnel equipment in the U.S. in order to get away from ammonia near the fish.

Mayekawa, which was marketing its freezer tunnels and spiral freezers at the Seafood Expo, has also started to see interest in CO₂ as a freezing agent instead of Freon or ammonia, said Len Puhacz, sales manager, Green System Division, Mayekawa Canada. "They are getting away from Freon. And since the freezer is in the plant, they may want to remove NH₃ and use CO₂ to do so."



One source of the CO₂ for its freezers is Mayekawa's own NewTon NH₃/CO₂ packaged unit, which the company is beginning to market in North America in partnership with Cimco Refrigeration. The NewTon F model is designed for freezers, with a CO₂ supply temperature of -42°C and a cooling capacity from 70kW to 170kW.

MAKING ICE

The ice makers were out in force at the Seafood Expo. Chicago-based Howe, for example, markets a CO₂ flaked ice machine used in the seafood (and sometimes produce) departments of supermarkets like Sobeys, Roche Bros., Whole Foods, Wegmans and Kroger in stores that use transcritical, cascade or secondary systems. The machine acts like a display case, receiving liquid CO₂ from the engine room.

Vogt, Louisville, Ky., makes industrial ice makers that can use low-charge ammonia evaporators to produce 25-50 tons of ice per day, said Mike Ruckriegel, industrial market manager. The low-charge units don't generate as much ice as flooded or liquid recirculated units, "but some customers like low charge if they are facing regulatory requirements on ammonia," he noted.

The low-charge units, which typically receive ammonia from an engine room, use an evaporator that is 20% larger than flooded or recirculated evaporators to get the same refrigeration capacity, and tend to be more costly as a result.

Vogt is looking into using CO₂ as a refrigerant for the ice machines, drawing CO₂ from a cascade refrigeration system, said Ruckriegel. "Our customers aren't demanding it, but they are talking about it." **MG**



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PUTTING THE PIECES TOGETHER

At the IIAR Conference and Exhibition, the manifold industrial refrigeration components on display addressed low-charge, safety, efficiency, space saving and more

— By Michael Garry



It takes a lot of components to make an industrial refrigeration system, and they were all on offer at the 2016 International Institute of Refrigeration (IIAR) Industrial Refrigeration Conference & Exhibition in Orlando, Fla., last month.

Everything from low-charge packages and DX evaporators to liquid separators and screw compressors could be found on the exhibit floor, home to dozens of component makers, OEMs, contractors and training companies. Following are some prominent examples.

NEXT STEP FOR EVAPCO

Evapco, Taneytown, Md., is “shifting into second gear” in its marketing of its Evapcold, a line of self-contained low-charge ammonia refrigeration units, said Kurt Liebendorfer, Evapco’s vice president. Evapcold is being installed at Western Gateway Storage in Ogden, Utah. (See “Research + Sustainability = Low-Charge Ammonia,” *Accelerate America*, December 2015-January 2016.)

Liebendorfer explained that new buildings (greenfield projects), which account for about half of the market for Evapcold units, “have long funding, design and development phases,” up to a year, “and we’re progressing there.” He also expects Evapcold to be adopted in expansions of existing buildings. “We’ll have more announcements this year,” he said.

The Evapcold unit incorporates all parts of a refrigeration unit, including the evaporator. It employs a pumped recirculation system, but reduces the ammonia charge via smaller, enhanced evaporator tubes (5 inches in diameter) with a recirculation rate of

1.2-1. Evapco plans to introduce a DX evaporator for higher-temperature applications later this year.

Colmac Coil, Colville, Wash., has been gaining considerable interest in its Advanced DX low-charge ammonia evaporator, used for low temperatures in concert with a central machine room. Developed by Bruce Nelson, president of Colmac, the DX evaporator cuts the charge by a factor of 4-5 times compared with a conventional pumped ammonia system.

Colmac has recently 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.

At the IIAR Conference, Colmac showcased a “low profile” evaporator for industrial applications designed for “smaller processing rooms,” said Scott McMillan, CEO of Colmac Coil. The company also featured EC fans with built-in variable-speed control and a liquid air cooler for conveying glycol more efficiently in a low-charge ammonia system using secondary glycol cooling.

The liquid air cooler has an enhanced tube design that “changes the flow pattern of glycol inside the tube,” said McMillan. This reduces the pumping power required as well as improving the heat transfer of the glycol. “It’s another twist to low-charge design,” he added.

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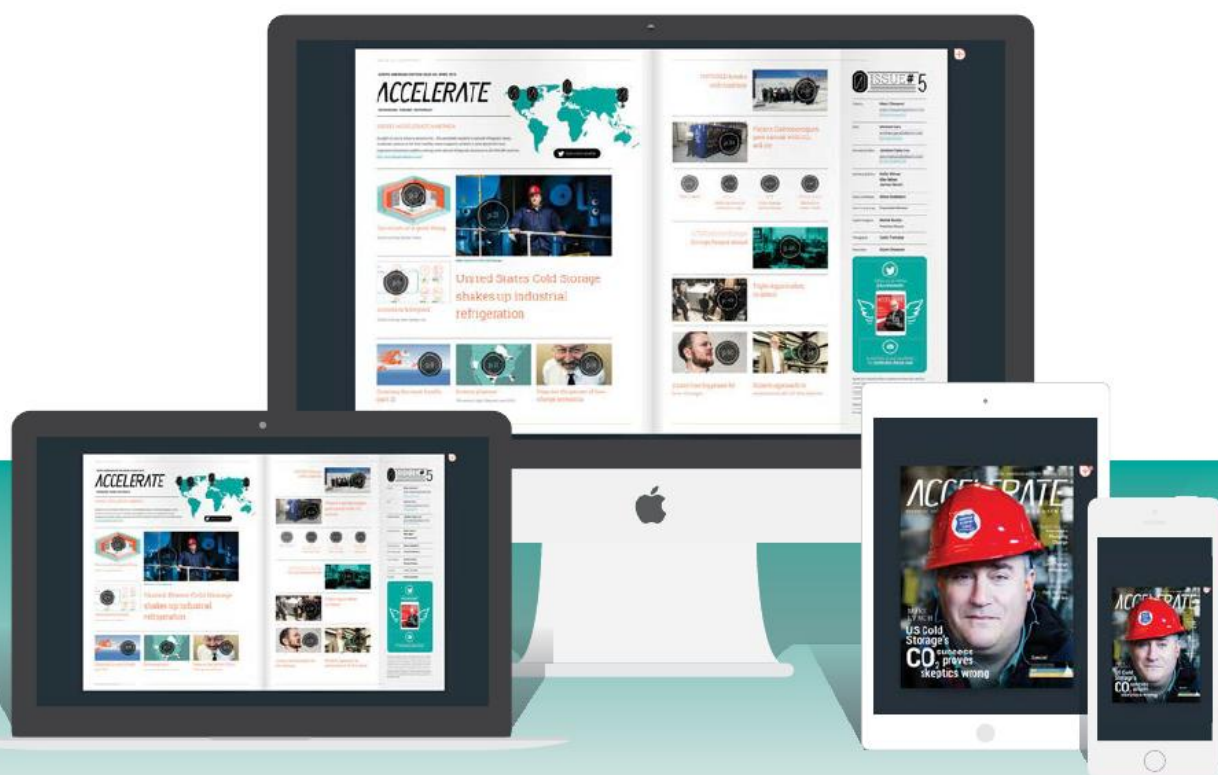
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→ ENERGY-SAVING SEPARATOR

At the Alfa Laval booth, the company featured its U-Turn liquid separator, designed to work with plate heat exchangers in ammonia applications. It has been used, for example, by the city of Montreal over the past year in municipal ice rinks. (See ["U-Turn On Ice," Accelerate America, March 2016](#).) It is also used in the food industry.

The u-shaped separator 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. The combination saves space, reduces ammonia charge and maximizes efficiency.

"The U-Turn is starting to be well-known in the market," said Jesper Olsen, business and application manager for Alfa Laval, based in Lund, Sweden.

Because of its proximity to the evaporator or condenser, the U-Turn liquid separator reduces the pressure inside the heat exchanger and thus the energy expended by the compressor up to 4%, cutting costs, explained Olsen.

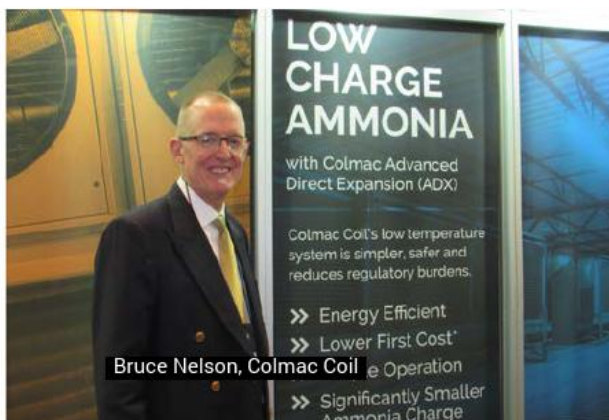
Danfoss, Baltimore, Md., displayed a larger version of its ICF Flex-line valve station for evaporators in cold storage or food processing plants. The modular unit is designed to improve the safety of an ammonia system. "It is a direct-weld solution, with no gaskets, making it easier to service," said Jim Hower, industrial refrigeration national sales manager for Danfoss.

The new model can accommodate up to 30 tons of capacity in low-temperature applications and 60 tons in medium temperatures.

Parker Hannifin, Broadview, Ill., showcased a new stainless steel



Jesper Olsen, Alfa Laval



Bruce Nelson, Colmac Coil

electronic valve for ammonia liquid feed and CO₂ (for which it is rated 52 bar). It also displayed a capacitive-based back-up module that, in the event of power loss, "fails closed or to a known position," said Andy Kuester, division marketing manager for Parker. "It's better than a battery back-up because batteries degrade."

Parker also highlighted a rapid purger V300 machine, which removes unwanted non-condensable gases; in its latest iteration, the machine tracks the amount of ammonia loss over time.

Bitzer U.S., Flowery Branch, Ga., highlighted its multiple screw compressor configuration for industrial applications in the range of 100-300 TR. Used in low-charge chillers, the compressors offer higher efficiency and redundancy compared with a single compressor with triple the horsepower. When load requirements drop, one or two of the compressors can be shut down, as compared to using a slide valve in a single compressor, which is less efficient.

The Garden City Ammonia Program (GCAP), a major training organization based in Garden City, Kan., will be re-launching the Spanish language version of its ammonia operator one class, said Miguel Bermudez, who will be teaching it. The first class will take place June 6-10.

Interest in the class has been coming from Latin and South America, as well as in the U.S. "There's a huge need for it," said Bermudez. "It's an untapped market." **MG**



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DRIVING CHANGE IN INDUSTRIAL REFRIGERATION

As a designer, builder and installer of industrial systems, Stellar is leading the way toward the adoption of low-charge ammonia equipment

— By Michael Garry

Refrigeration contractors can be the biggest influencers when it comes to whether an end user will install new technology. One of the most proactive contractors in industrial refrigeration is Jacksonville, Fla.-based Stellar, a fully integrated firm focused on design, engineering, construction and mechanical services worldwide. Stellar, which has been designing and building low-charge ammonia systems for more than a decade, is spearheading the adoption of these systems not only in the U.S. marketplace, but in the global marketplace, too. In the following interview, Luke Facemyer, Stellar's vice president of refrigeration engineering, explains the company's low-charge philosophy and strategy.

Accelerate America: Industrial refrigeration is an old industry that is slow to change. Is Stellar trying to bring about change through low-charge packaged systems?

system back in 2002. However, until recently, there wasn't a huge demand in the market for this type of system. Now more plant owners and facilities are realizing they not only want these low-charge chillers — they need them to reduce their facility's charge and risk. So, over the past three years specifically, the demand for low-charge packaged systems has changed — and increased — dramatically.

Accelerate America: Do you have a product line of these chillers?

equipment in addition to custom-designed equipment to match our clients' unique needs and applications. Our chillers are factory built and quality controlled, allowing for high-quality builds, enhanced safety and a compact and efficient design.

Accelerate America: How many low-charge chillers have you installed?

projects have employed glycol or chilled water as a secondary fluid;

Luke Facemyer: Slow-to-change is a great way to put it. Low-charge ammonia chillers aren't exactly new. In fact, Stellar designed and built our first cascade ammonia/CO₂

Luke Facemyer: Stellar offers standard off-the-shelf packaged refrigeration

Luke Facemyer: In the past 18 months, Stellar has completed about 25 low-charge ammonia projects. Primarily, these



Luke Facemyer, Stellar

“Just in the past 18 months, we’ve done about 25 low-charge ammonia projects.”

however, we’ve also completed projects utilizing CO₂ as a volatile brine. Most of our work is, and has been, for food facilities and pharmacy, but we have done low-charge projects for office spaces.

Accelerate America: What percentage of your business is in the low-charge area?

involved some sort of low-charge philosophy, whether it's DX or secondary CO₂. About 60% of the new food-processing projects we've completed have low-charge secondary systems, including full-enclosure units located outside or full packages in big, open machine rooms.

Accelerate America: Is better safety for employees what is driving low-charge adoption? What about tighter regulations?

to the machine room. These low-charge systems allow facilities to reap the benefits of ammonia's excellent thermodynamic properties while minimizing the charge and risk.

Accelerate America: So Stellar is really at the forefront of the industry shift to low-charge ammonia systems?

installs our low-charge ammonia systems, allowing us to drive change by tightly controlling the systems from the very beginning of the process.

Plus, all of our packaged equipment designs are available pre-insulated and pre-wired with factory-built enclosures for immediate startup, resulting in less on-site construction and shorter lead times. **MG**

Luke Facemyer: About 80% of the projects we have completed in the past year for cold storage warehouses have

Luke Facemyer: Safety — and the perception of safety — is the biggest focus in the refrigeration industry. This rings true even in the

Luke Facemyer: Absolutely. While other contractors may simply just install systems designed by another party, Stellar designs, builds and

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PANASONIC'S HUSSMANN ACQUISITION SIGNALS CONFIDENCE IN CO₂

The Japanese conglomerate eyes rollout of natural refrigerant technology in U.S. and beyond

— By Mark Hamstra and Marc Chasserot



Tetsuro Homma, Panasonic



anasonic Corp., the Japanese producer of refrigeration systems, display cases, consumer electronics and a host of other products, sees tremendous potential for the use of CO₂ in commercial refrigeration and plans to leverage its recent acquisition of U.S. refrigeration manufacturer Hussmann Corp. to expand its sales of the technology around the globe.

Panasonic has been deploying CO₂ condensing units in store formats ranging from convenience stores to supermarkets in Japan and other Southeast Asian countries for the past several years. In addition to its extensive CO₂ refrigeration deployment in Japan with convenience-store retailer Lawson, in 2014 Panasonic also launched a rollout with Lawson in Indonesia, and it has a test underway in Taiwan. Earlier this year Panasonic unveiled a test of its CO₂ refrigeration technology in Europe, with a pilot implementation in Denmark.

In an interview with *Accelerate America*, Tetsuro Homma, president, Appliances Company, Panasonic Corp., said the Osaka, Japan-based firm hopes to be able to use Bridgeton, Mo.-based Hussmann's established sales and service network to introduce its CO₂ refrigeration technology to foodservice and small-format food retailing businesses in the United States, Canada and Mexico.

"The last three or four years for us have been an experimental stage to prove that CO₂ should be a mainstream, next-generation refrigerant technology, and now we have confidence that CO₂ has potential to be the most popular technology in this industry," said Homma. "So we'll start to market not only in Japan and other Asian countries, but also Europe and the United States."

Homma cited the advantages of CO₂ as a natural refrigerant, including its lack of toxicity, its low global warming potential and its energy efficiency.

"We operate several stores in cooperation with our customers and officials, and we already have evidence that CO₂ refrigeration systems' power consumption is lower than other refrigerant technologies," Homma said. "We trust CO₂ is very effective for customers' costs."

Panasonic has a wide-ranging interest in energy efficiency. As reported on www.r744.com, a sister website of *Accelerate America*, Panasonic obtained more than 20% in power-consumption reductions (compared with the average nationwide figure in Japan) in 2015 after adding glass doors to its showcases.

“We already have evidence that CO₂ refrigeration systems' power consumption is lower than other refrigerant technologies.”

The study was conducted as part of the Japanese Ministry of Environment's energy saving initiatives.

Homma said Panasonic would seek to leverage its scale to help ensure that its CO₂ offering is price-competitive in the U.S.

SUITED TO SMALL FORMATS

Unlike the various CO₂ refrigeration systems already in use in some large commercial installations in North America, the transcritical CO₂ condensing unit technology Panasonic currently deploys in Asia is designed for small-format retail locations, such as convenience stores. Panasonic currently offers CO₂ units with 2, 10, 15 and 20 horsepower (HP). A large retail space might need up to 20 such units.

Panasonic was scheduled to begin trial production of a 30HP CO₂ unit, along with other variations of its small-store solutions, this year.

Homma confirmed that Panasonic's plans call for Hussmann to market two types of commercial CO₂ refrigeration technologies in North America — CO₂ transcritical for larger installations and CO₂ condensing units for smaller retail and foodservice locations.

Hussmann, in partnership with Quebec-based Systemes LMP, has already been marketing CO₂ transcritical refrigeration technologies — primarily to large-format retailers and other commercial customers — since 2014. Last year Aldi opened a store in West Seneca, N.Y., that operates the first Hussmann/LMP transcritical system in the U.S. Hussmann executives previously told www.r744.com that the Panasonic acquisition would have no impact on the Hussmann-LMP partnership.

The growth of small-format food retailing calls for “a new investment” in refrigeration technology for smaller types of stores, Homma said.

continued on p.54

→ He said the company understood that the refrigeration systems used in the U.S. are different from the low-HP CO₂ condensing systems Panasonic has deployed in Asia, but he added that the company was confident its experience with technology and engineering would help it transition to doing business in the U.S.

Panasonic's success with commercial refrigeration systems in multiple climate conditions throughout Japan, as well as its experience in small-format stores in Indonesia, have given it confidence that its systems will prove effective in the warm regions across the southern U.S. Some have questioned CO₂'s effectiveness in such climates.

"We don't feel there are any limitations by climate for CO₂ technologies," said Homma. "We have already introduced our system in Indonesia, where it is very warm and humid, and our system works really well. We trust our CO₂ refrigerant system is workable for U.S. customers nationwide."

OTHER TECHNOLOGIES

In addition, Panasonic could leverage Hussmann's network to market other Panasonic technologies, such as HVAC systems and cloud-based technology for controlling and monitoring store energy and refrigeration systems remotely.

"I trust we will have opportunities to promote our technologies to U.S., Canadian and Mexican customers, because Hussmann already has very good customer contacts, and a very good sales network, installation network and service network," Homma said.

He said Panasonic planned to continue to allow Hussmann to operate autonomously as a wholly owned subsidiary with the support of the Japanese parent, much like the successful, California-based aviation business Panasonic has been operating in the U.S. for the past 30 years. Panasonic will also retain the Hussmann name for its newest U.S. division.

"We have some experience in how to operate business outside of Japan, and how to respect autonomy," said Homma.

"We have some experience in how to operate business outside of Japan."

"We don't feel there are any limitations by climate for CO₂ technologies."

He said he recognizes the need for Hussmann to maintain its local customer connections.

"I would like to respect the current management team as much as possible, and I'd like to provide full support to make Hussmann successful in the U.S. foodservice and retail businesses," Homma said.

The \$1.545 billion acquisition of Hussmann, which was announced late last year and closed April 1, is part of a significant shift in business strategy for Panasonic, which generated revenues of \$70 billion (7.7 trillion yen) for the 12 months ending March 31, 2015. Long known for its consumer electronics and telecommunications products, the company has instead recently been redirecting its engineering resources toward more business-to-business technology solutions.

Homma said part of Panasonic's shift in strategy towards B-to-B includes a focus on the foodservice and food retailing industries. Panasonic had been looking for two years for a company to acquire in the industry to expand its reach, he said.

Hussmann's status as an end-to-end provider of products and services made it an ideal fit, Homma explained.

"We understand such a one-stop solution is very beneficial to this business, and Hussmann has this position," he said. "They also have very wide and deep customer relationships, not only in the U.S., but also Mexico, Canada and the Pacific regions [Australia and New Zealand]." Homma noted that there is no regional overlap between the two companies.

In addition, he said the corporate cultures of the companies are similar. "We [both] have a customer-focused business culture," Homma said. "I felt there was very good similarity, and we have a very good chemistry between the two companies, so I made the decision to welcome Hussmann as one of the Panasonic companies." ●MH & MC

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Distribution at IARW-WFLO Convention, April 17-19

Ad submission deadline: Apr. 1

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Supplement to Issue #15

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