The Magazine for ENERGY EFFICIENCY and WATER CONSERVATION in Cooling Systems

CHILLER & COOLING BEST PRACTICES

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March 2019

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COLUMNS

FROM THE EDITOR | Craft Brewing

Regional craft breweries have grown from 2,420 in 2012 to 6,266 in 2017, according to the Brewers Association. They all use chillers, compressed air and nitrogen generators for different processes. Their ability to optimize these self-generated utilities can have a significant impact on profitability.

Dogfish Head Craft Breweries, established in 1995, was one of the first large U.S. craft breweries. As they've grown, they've learned a lot about coolant piping. They've used schedule 40 and 80 PVC, threaded steel pipe and welded steel pipe. Leaks, cracks and external condensation causing unsanitary mold growth were experienced. Our lead article is about their adoption of pre-insulated plastic piping, provided by GF Piping Systems.

Breweries need to store beer at 40 °F to keep the taste of beer from changing due to chemical reactions like oxidation which can occur at higher temperatures. This can place demands on chillers and create significant total costs of ownership (TCO). Chris Swarr, from Johnson Controls, provides us with an excellent review of advancements in chiller free-cooling technologies. These technologies can drive chiller TCO down.

Coppertail Brewing Co., in Tampa, Florida, was experiencing reliability issues with their chiller. This created production downtime and lost revenues. They turned to the company servicing their compressed air system, Compressed Air Systems, Inc., for a solution. Tony Hergert, from nano-purification solutions, has provided us with an article about the chiller system assessment performed. The resulting new chiller system provides Coppertail Brewing Co. with reliability (zero downtime) and a lower energy bill.

We decided to do a bit of research on refrigerants. Our resulting article titled, "The State of Refrigerants in Commercial Chillers," reflects a first-step in our research. We interviewed several chiller manufacturers and a refrigerant compressor manufacturer. I hope you enjoy it and are able to update your library of acronyms (GWP, CFC, HCFC, HFC, HFO…)!

Improving quality, reliability and efficiency, by optimizing self-generated utilities, is the focus of the 2019 Best Practices Expo & Conference, taking place October 13-16, 2019 at the Nashville Music City Center. Visit www.cabpexpo.com

Thank you for investing your time and efforts into **Chiller & Cooling Best Practices.**

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RESOURCES FOR ENERGY ENGINEERS

CHILLER & COOLING TOWER TECHNOLOGY PICKS

YORK® YZ Magnetic Bearing Centrifugal Chiller Expands Capacity Range

Johnson Controls has extended the capacity range of its award-winning YORK® YZ Magnetic Bearing Centrifugal Chiller to include chillers beyond 1,000 tons (3,516 kW), now up to 1,350 tons (4,747 kW) of refrigeration. In early 2018, the YORK YZ Chiller, the first chiller fully optimized for ultimate performance with a next generation, low-global warming potential (GWP) refrigerant — R-1233zd(E), was launched with a capacity range of 165 to 1,000 tons (580 to 3,516 kW).

After capturing the 2019 AHR Innovation Award in the Cooling Category, the Johnson Controls booth at 2019 AHR Expo showcased an extended capacity YORK® YZ Chiller.

"In 2018, the YZ chiller set a new bar for efficiency, sustainability and energy savings," said Bill Jackson, President of Global Products and head of corporate strategy for Johnson Controls. "In 2019, we're pushing the bar even higher. Expanding the capacity of the YZ demonstrates our continued commitment to delighting our customers at every turn and never resting on our past achievements."

The extended capacity, AHRI-certified YORK YZ Chiller uses an integral, variable speed drive and advanced magnetic bearing technology that features a single moving assembly suspended in a magnetic field that does not require lubrication. This technology requires 80% fewer moving parts than traditional oil- or refrigerant-lubricated drivelines. The result is enhanced reliability, reduced maintenance and improved efficiency.

"The YZ chiller is a groundbreaking advancement in engineering that was built on decades of industry-leading chiller experience," said Laura Wand, Vice President and General Manager, Global Applied Equipment, Johnson Controls. "Our engineers challenged themselves to reimagine what a next-generation chiller could be, and the result was a system that is fully optimized for ultimate performance. We're thrilled to build on the success of the chiller and expand the line's capacity."

The YORK YZ Chiller uses an optimized single-stage design to provide industry-leading, real-world energy efficiency. The chiller's system simplicity, high reliability, lower maintenance and wide operating map are all thanks to the advanced lubrication-free magnetic bearings that can handle any operating condition, and now that technology is available at even higher capacities. For more information on the YZ chiller, visit YORK.com/Next.

About Johnson Controls

Johnson Controls is a global diversified technology and multi-industrial leader serving a wide range of customers in more than 150 countries. Our 120,000 employees create intelligent buildings, efficient energy solutions, integrated infrastructure and next generation transportation systems that work seamlessly together to deliver on the promise of smart cities and communities. Our commitment to sustainability dates back to our roots in 1885, with the invention of the first electric room thermostat. We are committed to helping our customers win and creating greater value for all of our stakeholders through strategic focus on our buildings and energy growth platforms. For additional information, visit http://www.johnsoncontrols.com.

About Johnson Controls Building Technologies & Solutions

Johnson Controls Building Technologies & Solutions is making the world safer, smarter and more sustainable – one building at a time. Our technology portfolio integrates every aspect of a building – whether security systems, energy management, fire protection or HVACR – to ensure that we exceed customer expectations at all times. We operate in more than 150 countries through our unmatched network of branches and distribution channels, helping building owners, operators, engineers and contractors enhance the full lifecycle of any facility. Our arsenal of brands includes some of the most trusted names in the industry, such as Tyco®, YORK®, *Metasys®, Ruskin®,* Titus®, Frick®, PENN®, Sabroe®, Simplex® and Grinnell®. For more information, visit www.johnsoncontrols.com.

Johnson Controls featured its extended capacity YORK YZ Chiller at 2019 AHR Expo.

RESOURCES FOR ENERGY ENGINEERS

CHILLER & COOLING TOWER TECHNOLOGY PICKS

SPX FLOW's APV Plate Heat Exchangers Offer Efficient Heat Transfer

SPX FLOW's new APV plate heat exchangers provide high thermal efficiency, ease of operation and straight forward maintenance. The units are available as gasketed, for particularly challenging process conditions, hybrid welded models.

APV Gasketed Models

APV gasketed heat exchangers use optimized plate designs to maximize heat transfer, while also offering the flexibility to be reconfigured to changing process needs. They are suitable for a wide range of applications including crude stabilization, dehydration, gas sweetening, gas or liquid refrigeration duties, and high capacity utility cooling solutions. In addition, the latest plate designs and materials provide high thermal efficiency in a compact design, resulting in a minimum footprint where space and weight considerations are essential.

Easy operation and maintenance are assured with features such as the APV EasyClip system, which makes the process of changing gaskets more efficient using a glue-free system. Intelligent, hydraulic PLC-driven frames are also available to enable rapid maintenance with improved safety, while also removing the risk of damage to plates caused by manual operations. Repeatable, error-free maintenance of the unit reduces risk of cracks, improves safety and offers substantial operational savings through reduced downtime and increased productivity.

SPX FLOW's APV Plate Heat Exchanger.

APV Hybrid Models

The compactly designed APV Hybrid welded series heat exchangers are precisely engineered to maximize process availability with a tube on one side and plate on the other. They offer robust performance with the ability to operate under extreme pressure and temperature conditions. They have no elastomer gaskets and provide excellent heat transfer efficiency up to 662 ˚F (350 ˚C) and 580 psig (40 barg).

APV Hybrid heat exchangers are designed with exceptional heat recovery performance with lower running costs. They are easy to clean, and by using optimized plate corrugation patterns, are low fouling thereby reducing maintenance overheads.

The corrosion-resistance units offer long service life, while a compact footprint makes them easier to install with reduced foundation requirements and lower initial engineering costs compared with equivalent or alternative technology. For easy maintenance, the housing is easily opened. To ensure thermal efficiency is maintained, it can be fully and easily cleaned.

As with all SPX FLOW solutions, APV heat exchangers can be expertly customized to match process requirements. A comprehensive, global service network further supports the heat exchangers.

About SPX FLOW, Inc.

Based in Charlotte, North Carolina, SPX FLOW, Inc. (NYSE:FLOW) innovates with customers to help feed and enhance the world by designing, delivering and servicing high value solutions at the heart of growing and sustaining our diverse communities. The company's product offering is concentrated in rotating, actuating and hydraulic technologies, as well as turnkey systems, into the food and beverage, industrial and power and energy end markets. SPX FLOW has approximately $2 billion in annual revenues with operations in more than 30 countries and sales in more than 150 countries. For more information, visit www.spxflow.com.

CHILLER & COOLING TOWER TECHNOLOGY PICKS

CAREL Solutions Help Save Energy, Reduce Emissions In 2018

CAREL has reported the number of CO_2 projects with DC inverter technology has tripled since 2017 along with the purchase of natural refrigerants instead of traditional gases. The increase translates to savings of €1 million. Additionally, CAREL estimates the solutions sold with natural refrigerants in 2018 saved nearly 3,000 MWh of energy, with almost 1,500 tons less CO_2 equivalent released into the environment.

CAREL also reports a reduction in polluting gas emissions in 2018 based on refrigerant leaks from low Global Warming Potential (GWP) solutions. It estimates that 2018 projects cut environmental emissions by 2,500 tons of CO_2 equivalent to R404/A solutions of equal capacity, which represents net and tangible savings of 4,000 tons of CO_2 equivalent. The reduction equates to no cars driving through central London for 20 days.

In the face of a further increase in global warming, CAREL is contributing to the use of natural refrigerants by developing solutions that simplify their use and increase the efficiency of the system, said Matteo Dal Corso, CAREL Application Specialist - Retail Solutions.

"Solutions with natural refrigerants represent the present and no longer the future," Dal Corso said. "Now that the technologies we have developed in recent years are available it is time to focus on innovative features and services, possible thanks to very advanced devices, already installed and ready."

About CAREL

CAREL is a world leader in control solutions for air conditioning, refrigeration and heating and in adiabatic humidification and cooling systems. Our products are designed to generate energy savings and reduce the environmental impact of machines and plants. Our

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CHILLER & COOLING TOWER TECHNOLOGY PICKS

solutions apply to the commercial, industrial and residential sectors. CAREL has 22 branches and seven of its own production plants, as well as partners and distributors in 75 other countries. For more information, visit www.carel.com.

Bacharach MGS-400 Gas Detection Series

Bacharach, a leading provider of HVAC-R gas instrumentation, has unveiled the MGS-400 Gas Detection Series for commercial and industrial refrigerant and gas leak detection applications. The scalable system and mobile app user interface reduces maintenance time by 80% while lowering installation and commissioning costs.

The Bacharach, MGS-400 Gas Detection Series reduces installation time.

The ability to detect refrigerant leaks and quickly initiate alarm systems helps protect personnel, in addition to achieving compliance with safety standards like ASHRAE 15, CSA-B52 and EN 378. The MGS-400 gas detectors support safety compliance inside of machinery rooms, mechanical equipment rooms, chiller plants, cold storage facilities and walk-in freezers by monitoring for dangerous refrigerant leaks for numerous gases including HFCs, HFOs, HCFCs, CO_2, and NH_3 (ammonia).

MGS-400 Series refrigerant gas detectors are supported by a mobile app user interface, making configuration, calibration, and maintenance simple and intuitive. By reducing commissioning and installation time, it delivers on efficiency and cost savings while allowing for plug-and-play, pre-calibrated sensor installation and replacement in the field.

Using the mobile app and plug and play sensors, gas detectors are installed in significantly less time, for example, five minutes versus 25 minutes per detector without training. Calibration certificates can be generated from the mobile app and sent by email or shared to cloud storage platforms. Key MGS-400 Series benefits include:

Regulatory Safety Compliance

- Supports compliance for ASHRAE 15-2013, CSA-B52 and EN 378:2016.
- On-board audible and visual alarms.
- Alarm relay output to initiate mechanical ventilation or additional horn / strobes.
- High and low alarm levels to ensure appropriate response.
- Maintains audit trail by generating field calibration certificates through the app.

Reduced Installation and Maintenance

- Quick setup using mobile app to configure alarms and communications, initiate calibration and tests.
- Power and connect up to eight sensor points with the controller.
- Plug-and-play, field-replaceable, pre-calibrated sensors.
- On-board instrument diagnostics for effective on-site service.
- “Service Due” indicator and sensor exposure counter for easy proactive maintenance.
- Minimal training required due to simple user interface.

Optimized Performance

- Temperature compensated measurement of natural refrigerants and halogens down to -40 °F/C.
- Minimizes false refrigerants alarms with programmable alarm delays.

The optional MGS-408 Gas Detection Controller supports up to eight sensor channels and enables a centralized alarm and power system. With Modbus connectivity, the controller integrates with any facility’s existing building management or automation system.

The MGS-408 also connects with Bacharach’s MGS-250 IR-based refrigerant monitor and the dual-sensor MGS-550, allowing for flexibility of individual site requirements. Power and communication connectivity from the controller to all sensors can be done with a single cable in a daisy-chain design.

CHILLER & COOLING TOWER TECHNOLOGY PICKS

About Bacharach

Bacharach is a provider of cleantech solutions for gas and refrigerant leak detection and identification, refrigerant tracking, combustion and emissions analysis instrumentation, and high-purity oxygen gas analysis in commercial and industrial applications. Bacharach products make the heating, ventilation, air-conditioning, refrigeration (HVAC-R), and process industries safer, cleaner, and more energy efficient, enabling customers to increase productivity, reduce costs, and protect lives and the environment. For more information, visit: www.mybacharach.com.

SPX Cooling Video Highlights Sizes and Capacities of Marley® NC® Cooling Towers

SPX Cooling Technologies, Inc. has released a new video describing the differences in size and capacity between its three Marley® NC® cooling tower model platforms: the Marley NC8407 – a single-story tower; the Marley NC8414 – a modular, two-story tower; and the Marley NC8422 (NC Everest®) – the largest tower with the highest capacity of the three models.

The video showcases the sizes of the cooling tower models side-by-side using computer-generated schematics and a life-size human figure standing next to each tower to provide context. The towers are then shown from a side- and top-down view and their dimensions are displayed: the towers range from 12 feet in height (NC8407) to 27 feet 1 inch (the NC8422), and range in width from 11 feet 11 inches (NC8407) to 22 feet 5 inches (NC8422). Next, they are shown side-by-side and their cooling capacity is displayed, with the towers capable of a maximum 736 tons of cooling (NC8407), 1,455 tons of cooling (NC8414) and 2,189 tons of cooling (NC8422).

With the video, one can better understand the differences in size and capacity between three typical model platforms of the Marley NC cooling tower. The video can be viewed at https://spxcooling.com/video/marley-nc-series-size-and-capacity-comparison.

About SPX Cooling Technologies, Inc.

SPX Cooling Technologies, Inc. is a leading global manufacturer of cooling towers, evaporative fluid coolers, evaporative condensers and air-cooled heat exchangers providing full-service cooling solutions and support to customers in the heating, ventilation and air conditioning (HVAC), industrial, refrigeration and process cooling markets for nearly a century. SPX Cooling Technologies and its product brands are part of SPX Corporation. For more information, visit www.spxcooling.com.

About SPX Corporation

SPX Corporation is a supplier of highly engineered products and technologies, holding leadership positions in the HVAC, detection and measurement, and engineered solutions markets. Based in Charlotte, North Carolina, SPX Corporation had approximately $1.4 billion in annual revenue in 2017 and more than 5,000 employees in 14 countries. SPX Corporation is listed on the New York Stock Exchange under the ticker symbol "SPXC." For more information, visit www.spx.com.

Ensuring Reliable Process Cooling at COPPERTAIL BREWING CO.

By Tony Hergert, nano-purification solutions

It's no secret that craft beers, stouts, ales and porters have rapidly changed the beverage landscape in the United States. Leading the revolution are micro- and regional breweries like Coppertail Brewing Co. in Tampa, Florida. One of the biggest challenges brewers such as Coppertail (www.coppertailbrewing.com) face is maintaining the dedication to their brand's mission and their loyal following, while expanding their reach and growing market share. That challenge means not compromising on ingredients and utilizing the best equipment available for the fermenting, brightening and packaging of their product. But, for any growing business, reliability, uptime and power costs must be quantified in order to maximize margins to make the business viable. So, when a four-year old chiller began misbehaving at Coppertail Brewing, a call was made to their long-time compressed air systems solution and service provider Compressed Air Systems (https://www.compressedairsystems.com) in Tampa who reached out to nano-purification solutions to investigate and sort out their process cooling challenges, once and for all.

Coppertail Brewing Co. is a growing microbrewery with beers on tap, as well as packaged/growlered beer to go.

Providing Florida-brewed Beer to the Masses

Coppertail is an independently owned production brewery and tasting room and was founded on the desire to bring more quality, Florida-brewed beer to the thirsty masses.

The brewery became operational in the summer of 2014. The company's staff brews on a state-of-the-art 50-barrel (bbl) Rolec brewhouse. In all, it has 1,000 bbls of fermentation space with tanks ranging from 30 to 200 bbls. The company expects increases in production of 40% due to a new channel to market through a supermarket chain and new high-speed canning line to fulfill this requirement.

Coppertail's tasting room features a full service bar with 20 taps and a wine list. It sells Coppertail merchandise and packaged/growlered beer to go. Its kitchen makes small plates to share, as well as full meals for one. It also has a loft space available for private events that features a six-tap bar and large balcony that overlooks downtown Tampa.

Mark Lauterwasser of nano purification solutions, Derrick Gough of Coppertail Brewing Co., and Kyle Randall of Compressed Air Systems (left to right).

ENSURING RELIABLE PROCESS COOLING AT COPPERTAIL BREWING CO.

Brewery Process Cooling Assessment

To assess the Coppertail process cooling system, Kyle Randall of Compressed Air Systems (CAS), along with Mark Lauterwasser and Don Joyce from nano, met with Derrick Gough from Coppertail.

One takeaway from their meetings was the current chiller was unreliable and required some type of service once a week to keep running. Since the chiller was out of warranty, Coppertail was spending money each week to keep it running in addition to wasted internal resource to complete many maintenance tasks. Chiller outages would last for one to two days and could happen once or twice per quarter. Downtime costs for the brewery can be as high as $20,000 worth of product per day. As such, lost revenue potential stood somewhere between $80,000 and $320,000 per year in product and more in sales, excluding lost productivity or personnel losses.

Another takeaway from the series of meetings related to crash cooling, which is a process many breweries use to clarify beer before bottling. Cooling rapidly to near freezing temperatures allows any particulate e.g., yeast, etc., which could remain in the beer, to coagulate and sink. Crash-cooling product at Coppertail was a major constraint and amount of cooling needed varied from product to product, tank-to-tank, and season to season. Energy consumption was extremely high since the existing chiller had only two 30 kW compressors and two circuits. Due to the typical operation of the facility, Coppertail needed to run its old chiller at full load at all times during production and was unable to cycle off a compressor – regardless of demand.

The team agreed Coppertail required a more energy-efficient and reliable process cooling system able to serve the full plant requirement during its 16-hour, five-day operation effectively, including their projected production increases yet, have backup ability in the event of a failure.

nano proposed the installation of a nano model NCS-1004-US, a 43-ton, air-cooled, cycling chiller with four 21 kW compressors and two cooling circuits. The NCS-1004 at full capacity can remove 515,712 BTU's at a 30 ˚F supply/40 ˚F return, and perhaps most notably, is the ability of the chiller to also run comfortably at 25%, 50% 75% and 100% of load, while reducing amp draw and inrush electrical current which effectively allows Coppertail to reduce chiller operating costs at Coppertail by 25%.

Cooling for Fermentation, Brightening Tanks

The new chiller was installed at Coppertail in fall 2018 and provides chilled water to eight fermentation and three finishing tanks called bright tanks. Expansion plans call for Coppertail to brew beer with 20 tanks.

Since the unit would be running in a hot and humid environment, it was important the unit could be installed outdoors on the roof of the brewery. With IP65 controls as standard, outdoor installation even in a tropical climate would not be a problem. A video of the installed unit is available at https://www.youtube.com/watch?v=Hq_l4othrus. (Video compliments of CAS.)

"The Florida market is a great opportunity to sell canned beverages since so many of our customers enjoy their drinks at the beach, around pools and on boats," said Gough. "Cans are a recycle-friendly product which is important to our younger, environmentally-conscious customer-base. Coppertail is listening and we are installing a canning line which can produce 600-plus cases per hour as compared to our bottling line which

Compressed Air Systems installed the nano model NCS-1004-US 43-ton, water-cooled, cycling chiller on the roof of Coppertail's microbrewery.

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BEST PRACTICES EXPO & CONFERENCE EVENT SCHEDULE

SUNDAY, OCTOBER 13, 2019

9:00AM–3:00PM	Exhibitor-Only Pre-Registration
9:00AM–6:00PM	Exhibitor Move-In
3:00PM–6:00PM	Conference Registration Open
6:00PM–8:00PM	Welcome Reception

MONDAY, OCTOBER 14, 2019

7:00AM–11:00AM	Exhibitor Registration and Move-in
8:30AM–10:00AM	Opening Session
10:15AM–12:15PM	Conference Session #1
12:00PM–6:00PM	**EXPO FLOOR OPEN**
1:30PM–2:30PM	Energy Treasure Hunt Workshop #1
2:45PM–4:45PM	Conference Session #2
TBD	Networking Event!!

TUESDAY, OCTOBER 15, 2019

8:00AM–9:30AM	Plenary Session
9:45AM–11:45AM	Conference Session #3
12:00PM–6:00PM	**EXPO FLOOR OPEN**
1:30PM–2:30PM	Energy Treasure Hunt Workshop #2
2:45PM–4:45PM	Conference Session #4
5:00PM	Energy Treasure Hunt Raffle Winners Announced!!**

WEDNESDAY, OCTOBER 16, 2019

7:00AM–12:00PM	Exhibitor Move-out
8:00AM–10:00AM	Conference Session #5
10:15AM–12:15PM	Conference Session #6

4 TRACKS PER CONFERENCE SESSION

TRACK 1:
COMPRESSED AIR SUPPLY STRATEGIES

TRACK 2:
COMPRESSED AIR DEMAND REDUCTION

TRACK 3:
BLOWER & VACUUM OPTIMIZATION

TRACK 4:
COOLING SYSTEMS & ENERGY MANAGEMENT

Registration

Conference registration includes, within the specified day, workshop and conference tracks, meals and expo hall access. **Register at www.cabpexpo.com**

	Before 9/13/19	After 9/13/19
Single Day Conference Pass	**$290**	**$350**

- October 14 Workshops, Lunch, Opening Session, Expo Hall & Evening Reception
- October 15-16 Breakfasts, Lunch, Conference Sessions, Expo Hall & Evening Reception

Full Conference Pass	**$550**	**$675**

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2019 EXPO HALL OPEN HOURS	**FREE**

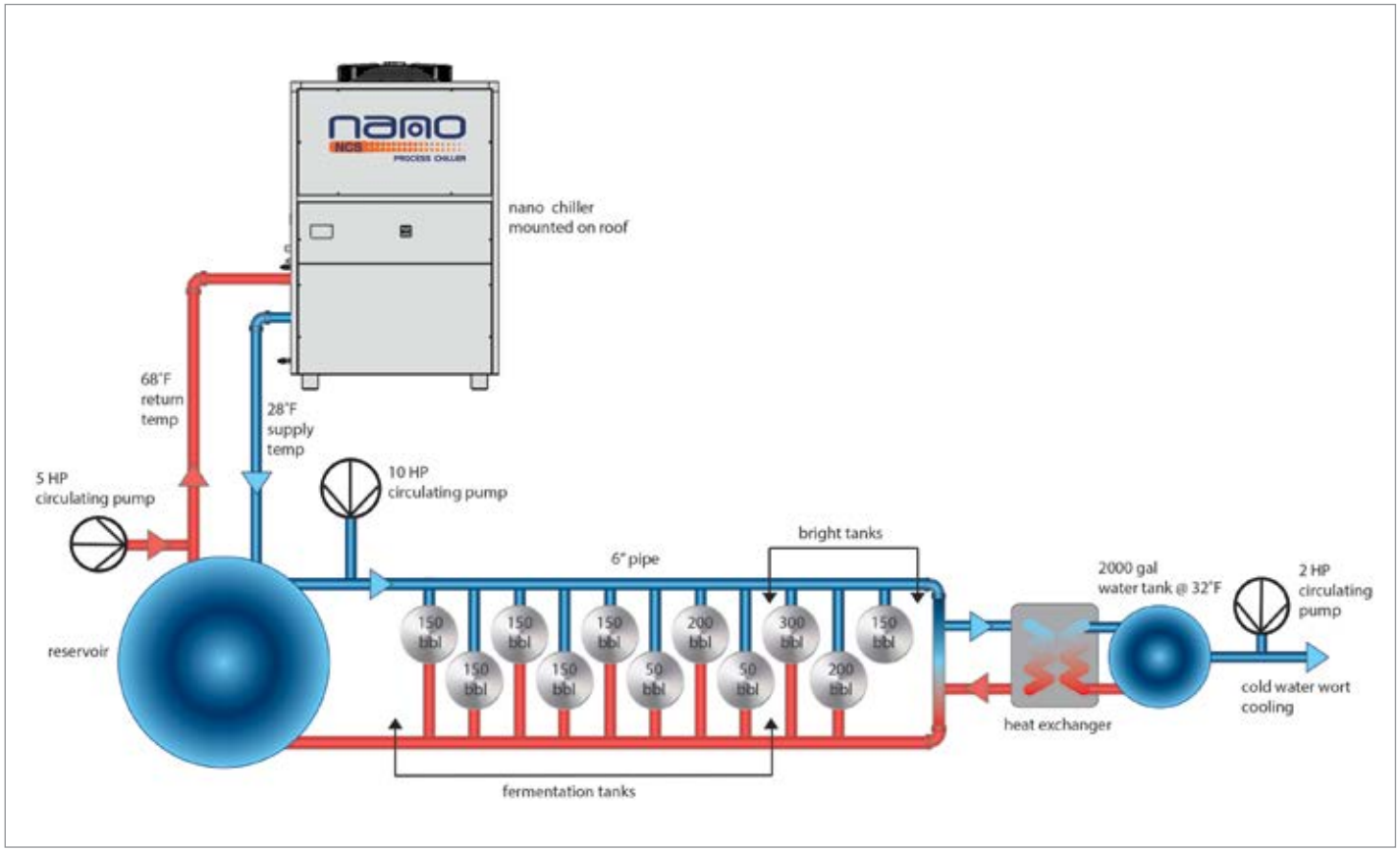
- October 14-15 12:00 PM – 6:00 PM

ENSURING RELIABLE PROCESS COOLING AT COPPERTAIL BREWING CO.

currently bottles approximately 200 cases per hour."

With the demand for more product and the ability to produce more beer comes the requirement for the better reliability necessary to crash cool and package the product in a timely fashion.

"The nano NCS1004 chiller is an entirely different machine from what Coppertail had been using," said Randall. "The old chiller utilized troublesome, dual reciprocating compressors and HX circuits. With an integrated backup circuit and multiple cycling compressors on the NCS-1004, Coppertail has had zero down production time since installation and the multiple circuits and compressors are only brought up and employed as required. Our initial power studies have shown potential energy savings of approximately 25-30 percent. At $.10 per kW, bottom line energy costs and with the lower



The roof-mounted nano chiller supplies process cooling water at the appropriate temperatures to Coppertail's eight fermentation tanks (left) and three bright tanks (far right). Water is supplied at 28 °F and returned at 68 °F for continued cooling.

"Due to great swings in ambient temperatures and product temperatures in their tanks, which can contain any number of different styles of beverages, the chiller is able to make all the adjustments on the fly."

— Mark Lauterwasser, nano-purification solutions

inrush current required to start the multiple, smaller, scroll compressors, the unit will pay for itself quite quickly."

In making its cost savings calculations, the team determined each of the 11 crash-cooled product tanks at the brewery require approximately 10 kW of refrigeration to crash cools the product from 70 ˚F to between 27 ˚F and 30 ˚F. The old chiller would have required at least three or more tanks operating in standby mode to afford the ability to cycle off a reciprocating compressor.

Coppertail may not have all of its tanks full, or at the same point of fermentation. The old chiller needed three tanks to be offline before it was possible to shut down a refrigeration compressor. The new chiller, however, can shut down compressors and save money if only a tank or two happens to be offline.

The new unit is estimated to save 21 kW for every two tanks taken off line. The decision to take a tank offline depends on the brewing schedule, what products are being brewed, and other factors – adding to the importance of greater process cooling flexibility as part of the process. In addition, the new chiller with additional capacity can process eight to ten tanks at any given time, increasing capacity while cutting power costs. Additionally, the chiller is expected to allow Coppertail to save an additional 5% of energy given the efficiency of rotary scroll compressors and the use of the no-frost heat exchangers.

"Due to great swings in ambient temperatures and product temperatures in their tanks, which can contain any number of different styles of beverages, the chiller is able to make all the adjustments on the fly," said Lauterwasser. "What also helped was the service record of CAS. If not for their past stellar service record at Coppertail, the brewery may have gone another direction."

Going the extra distance is what separates CAS from many distributors. Since reliability was so critical, CAS worked with Coppertail to install PLC-based controls used to control actuators and valves for the fermentation and brightening tanks – all of which can be remotely monitored from workstations and tablets.

"We can look at performance, flow, refrigeration temperatures, control valves, heat exchanger delta P's, fermentation tank temperatures, etc. all from home if necessary. After our previous challenges, these capabilities have given us peace of mind like you wouldn't believe and allows us to troubleshoot without necessarily being in front of any of the mechanical equipment," Gough said.

Striking the Right Balance

Energy savings, high reliability, service before, during, after the sale combined with a system that enhances Coppertail's product and brand…not an easy goal to achieve but the partnership of Compressed Air Systems, nano-purification solutions and Coppertail Brewing achieved just that balance. BP

About the Author

Tony Hergert is a managing member of nano-purification solutions. For more information, visit www.n-psi.com.

All photos courtesy of Kyle Randall of Compressed Air Systems. For more information visit Compressed Air Systems (https://www.compressedairsystems.com)

To read similar ***Chiller System Assessment articles,***
visit www.coolingbestpractices.com/system-assessments

DOGFISH HEAD CRAFT BREWERY Solves Cooling System Problems

By Angela Sampaio, GF Piping Systems

DogFish Head Craft Brewery uses nearly 3,800 feet of pre-insulated plastic piping system from GF Piping Systems. Inhibited food-grade glycol runs through the entire system for cooling the beer and in the distillery production process.

Understanding and emulating how an existing business achieved success is often one of the biggest advantages to new business start-ups. Dogfish Head Craft Brewery, one of the first large craft breweries in the United States, has become recognized as a leader in this burgeoning industry. New breweries look to Dogfish Head's model for implementing ideas that work without experiencing the irksome (and often expensive) trial and error growing pains.

Established in 1995 in Rehoboth Beach, Delaware, by Sam and Mariah Calagione, the brewery's success can be attributed to always searching for improvement in every area – from honing what they call their "off-centered" ales to new production techniques. Since its founding, Dogfish Head has grown rapidly with 14 expansions and now employs over 350 coworkers.

"Benefits from the system installation were dramatic. Condensation problems were instantly gone with improved sanitary conditions visually apparent."

— Angela Sampaio, GF Piping Systems

Dogfish Head has proudly been focused on brewing beers with culinary ingredients outside the Reinheitsgebot since the day it opened as the smallest American craft brewery 23 years ago. It has grown into a top-20 craft brewery and has won numerous awards throughout the years including Wine Enthusiast's 2015 Brewery of the Year and the James Beard Foundation Award for 2017 Outstanding Wine, Spirits, or Beer Professional.

Coolant Piping Issues Add Up

As with many manufacturing operations that require cold refrigeration, Dogfish Head quickly discovered that leaks and puddles are common byproducts of cooling systems.

They hoped to change that in 2002 with a facility expansion and move to a 100,000-square-foot converted cannery in Milton, Delaware. At that time, the number of options for coolant piping was limited. First, they installed schedule 40 PVC for the main cooling lines. With the food-grade glycol running at 26 ˚F (-3 ˚C), the PVC cracked. Repairing pipe and worrying about system failures unfortunately became a normal routine.

With the goal of eliminating these types of problems, Dogfish Head went through a series of pipe system changes in the cooling operation, which included trying a thicker schedule 80 PVC, then, threaded steel pipe, and finally, welded steel pipe. With each method they tried, some advantages were gained while other problems were created. The brewing crew found that threaded steel piping leaked, even though it was a much stronger alternative to PVC and that welded steel was cumbersome and expensive to install. There were also condensation problems with both types of steel piping that caused unsanitary mold growth.

Unique Piping System Installed for Brewhouse

In 2006, Dogfish Head expanded again – this time with a retrofit of its old cold water tank for the 100-barrel (bbl) brewhouse. Management learned about a new type of system for secondary cooling – a pre-insulated plastic piping system called COOL-FIT® ABS Plus, from GF Piping Systems (GF). They decided to try the new system using a small 2-inch (d63) diameter size.

After receiving manufacturer training, the brewery's own maintenance crew installed most of the system. Installation went smoothly and quickly. The significant installation time saved in labor allowed the new lines to start up more quickly than anticipated.

"We had good cold water to supply wort cooling in the 100-bbl brewhouse. We made COOL-FIT our standard and began using it throughout the brewery," said Brian Hollinger, Vice President of Operations.

Benefits from the system installation were dramatic. Condensation problems were instantly gone with improved sanitary conditions visually apparent. This new cleanliness, devoid of drips, was also evidence of improved thermal efficiency. Hollinger said pre-insulated plastic piping became the engineering standard for Dogfish Head due to its efficiency, durability and lower maintenance on insulation.

"It comes in as a piece of insulated pipe so we don't have any extra work of insulating pipe," he said. "With other systems, pipe insulation is applied after installation, requiring maintenance over time and a regular cleaning program due to mold growth. The covering offered by GF eliminates that problem by completely inhibiting mold growth."

M. Davis & Sons, Inc., a Delaware-based contractor, has been involved with many of the brewery's installations over the last 10-12 years, well before the craft brewery craze even started. In 2002, when Dogfish Head moved to the remodeled cannery in Milton, M. Davis was brought in to make the piping interconnections on the original bottling lines and tanks using stainless steel tubing

COOL-FIT is easily joined using cement and a flat brush. Pictured is Mike Sharp, Leadman for M. Davis & Sons, Inc., the Delaware-based contractor most heavily involved with the COOL-FIT installation at Dogfish Head.

DOGFISH HEAD CRAFT BREWERY SOLVES COOLING SYSTEM PROBLEMS

to all their different equipment and tanks, and get the system up and running.

"Making piping connections of all styles really helped Dogfish Head grow to the brewery they are now," said Tom Lupinski, M.Davis Project Manager. "When they needed to add the chilled water aspect to their equipment, that's when we became involved with COOL-FIT – the product they now use for all their cooling lines."

With their previous experience installing carbon steel and other types of metal systems, M. Davis appreciates the ease of working with the system.

'With this system, you don't need to be an actual welder, which requires years of experience and special certification," said Lupinski. "It is also much lighter in weight than other systems, making it easier to install and there is no need for any specialty tools – just a simple paint brush. You clean the surfaces to join with COOL-FIT cleaner, apply the COOL-FIT cement with a flat brush, and then go from there. The system fuses together very easily. The joining time is much simpler and it doesn't need hotworks to get it installed. That's a big key benefit."

Shown is one of 16 new 60-foot tanks in the Bay 7 Loop Project. The expansion included a run of 1,000 feet of COOL-FIT piping to convey chilled water to keep the beer tanks cold.

Supply Line Calls for 1,000-Foot Piping Loop

The most recent COOL-FIT installation at Dogfish Head was the Bay 7 Loop Project in the summer of 2017 where M. Davis was responsible for the entire project. Using empty warehouse space, the expansion project involved adding a 1,000-foot loop of the piping to create a supply line to 16 new 60-foot high tanks. Starting at the pumps, they created a new feed and supply and return line from the pumps out to the 16 tanks.

"GF came out and trained us, showed us how the pieces went together and also helped us with the fixed point locations that we had to install, which was a little new to us. Every so many feet, we had to install an expansion joint with the two fixed locations on either side of the expansion joint so the piping can move freely. Once we had the training and did the routing, it went together pretty easily."

To check for leaks after installation, the piping system is filled with water and then pressurized. By walking along the pipe any leaks or drips are quickly identified. A gap in the piping at each joint allows easy access for quick rebuilding.

"With this leak detection system, you can clearly see which joints are good and if there are any leaks, you can easily modify it," said Lupinski. "On the Bay 7 project, we probably did thousands of joints and had only one leak in the whole system that we had to address. I was expecting a lot more. The glue fusing system really did its job along with the crew that put it together."

Since the first installation in 2006, pre-insulated plastic piping has been used exclusively for every Dogfish Head glycol expansion culminating in nearly 3,800 feet of pipe in virtually every cooling area of the facility.

Brewhouse 2 and Brewhouse 1 incorporate knockout exchangers using large COOL-FIT size D160 pipe for the 300-foot header. Smaller D90 size pipe runs of about 100 feet are used for cooling in Brewhouse 2, then drop to even smaller D63 size in Brewhouse 1 with another 150 feet of pipe.

Dogfish Head's success with COOL-FIT for secondary cooling has become a catalyst for its fast-growing popularity in the craft beer industry. Food and beverage industries around the globe depend heavily on proper temperature control and can benefit from lessons learned at Dogfish Head. BP

About Dogfish Head and Craft Brewery

Dogfish Head and Craft Brewery is 350-plus coworker company based in Delaware with Dogfish Head Brewings & Eats, an off-centered brewpub and distillery; Chesapeake & Maine, a geographically enamored seafood restaurant; Dogfish Inn, a beer-themed inn on the harbor; and Dogfish Head Craft Brewery, a production brewery and distillery featuring a tasting room and food truck.

Dogfish Head supports the Independent Craft Brewing Seal, the definitive icon for American craft breweries to identify themselves to be independently owned and carries the torch of transparency, brewing innovation and the freedom of choice originally forged by brewing community pioneers. Dogfish Head currently sells beer in 44 states and Washington D.C. and will expand into additional states in 2019. For more information, visit www.dogfish.com.

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M. Davis is a fifth generation industrial construction company leading the way as a new breed of industrial providers for global corporations, regional leaders and government agencies. With a focus on safety and quality workmanship, our complete construction, fabrication and maintenance capabilities produce customized, turnkey solutions for mechanical, electrical and control systems. We specialize in complex, unusual projects that require out-of-the-box thinking and ambitious solutions not found elsewhere. For more information, visit www.mdavisinc.com.

About GF Piping Systems

GF Piping Systems is a leading supplier of piping systems and instrumentation for the safe and reliable transport of liquids for industrial process control. Its thermoplastic systems feature non-corroding, energy-efficient, maintenance-free performance. Industries like food and beverage, cold storage, semiconductor, pharmaceutical, chemical processing and many others have found thermoplastics to be an excellent alternative to the frequent replacement costs of metal including stainless steel piping, which corrode and scale over time, and are unwieldy in overhead and rooftop installations. For more information visit www.gfps.com.

About the Author

Angela Sampaio is a Market Segment Manager, Cooling (Eastern Region) with GF Piping Systems.

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ADVANCEMENTS IN FREE-COOLING Keep Breweries Cool Year-round

By Chris Swarr, Johnson Controls

➤ The craft brewing industry has exploded over the past several years. According to the Brewers Association, in 2012 there were 2,420 regional craft breweries, microbreweries and brewpubs in the United States. By 2017 that number had nearly tripled to 6,266. The abundance of craft brewers has led to increased competition for market share among consumers, distributors and bars – leaving little to no room for error in the brewing process.

The Science of Brewing

Whether it's a small, local microbrewery or a large national brewery, temperature control plays an important role in the manufacturing process. While traditional chillers can provide adequate cooling for breweries, keeping them at a consistent temperature can be costly.

Craft Beer USA, states that beer stored at 100 ˚F for one week tastes as old as beer stored at 70 ˚F for two months or as old as beer stored

"Free-cooling can significantly reduce operating costs for facilities such as breweries that have year-round cooling requirements."

— Chris Swarr, Johnson Controls

at 40 ˚F for one year. The taste of beer changes dramatically at higher temperatures because of the chemical reactions taking place – primarily oxidation. Fortunately, there are alternative chiller solutions that provide advanced cooling technologies to increase energy savings and lower total cost of ownership (TCO).

A Closer Look at Free-Cooling Technology

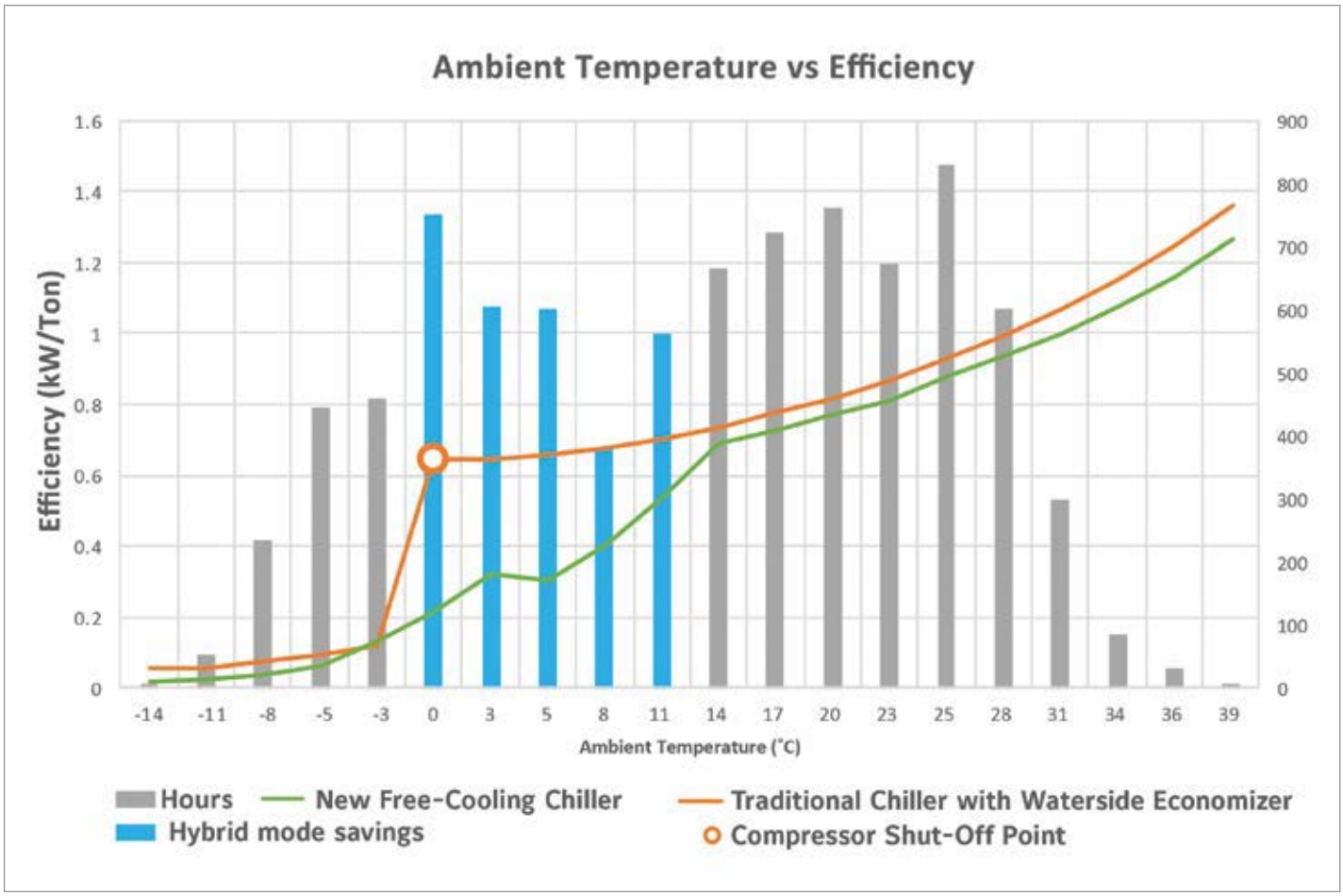
Free-cooling is the process of using low-temperature ambient air to chill the liquid in process or comfort cooling systems.

Free-cooling for chillers has been around for decades, with systems limited to providing cooling (and energy savings) during colder conditions. Additionally, chillers were historically limited to relatively low chilled liquid temperatures (55 ˚F and below).

Free-cooling can significantly reduce operating costs for facilities such as breweries that have year-round cooling requirements. However, not all free-cooling systems deliver the same savings. It is important to understand how recent advancements in free-cooling technology can deliver greater efficiency in savings all year long.

Advancements in Free-Cooling Technology

New regulations for energy standards to improve conservation efforts have generated incentives to utilize higher-chilled liquid temperatures. Innovations have been made to increase chiller efficiency and expand economizer hours using higher liquid temperature control. With chilled beams and larger coils, comfort cooling also favors the use of high chilled water temperatures. Likewise, industrial process cooling can frequently use higher liquid temperatures, depending on the application.



This chart shows how a free-cooling chiller's automatic controls help it outperform a traditional fixed-speed chiller and waterside economizer with fixed shutoff temperature for compressors.

ADVANCEMENTS IN FREE-COOLING KEEP BREWERIES COOL YEAR-ROUND

Proven solutions for reducing operating costs of facilities with year-round cooling requirements include field-erected systems consisting of a chiller plus a separate dry cooler, waterside economizers packaged on chillers and evaporative coolers used in combination with chillers. Free-cooling chiller technology integrates a waterside economizer with the condenser heat exchangers, allowing easy service access to all mechanical components and optimizing the footprint, when compared to systems with separate economizers. Some chillers feature a single temperature setpoint that permits easy adjustment as brewery capacity expands.

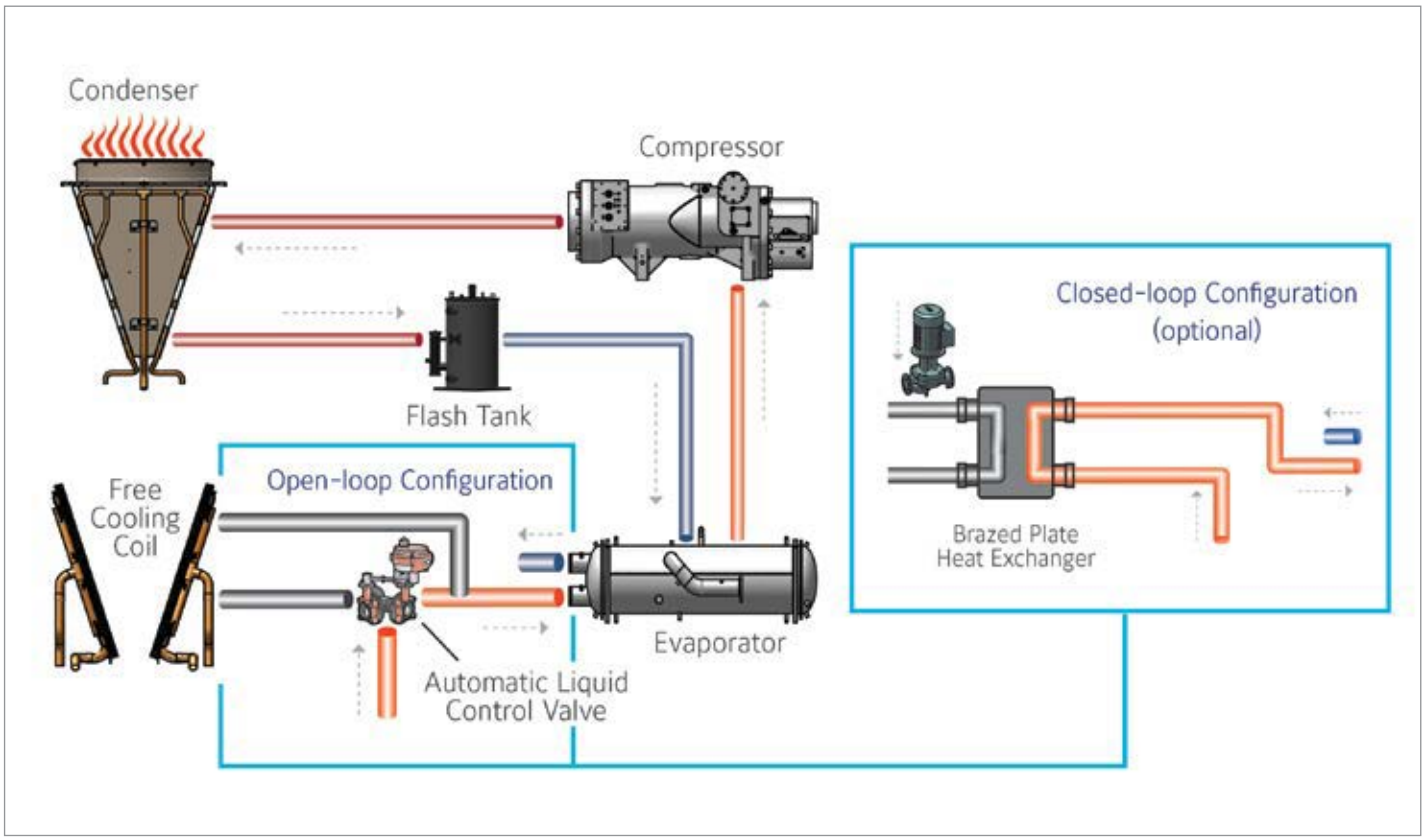
Chiller design has evolved to respond to expanded operations with a wider range of chilled liquid temperatures. These changes require flexible controls that keep compressor operation within acceptable conditions for enhanced reliability. Integrating variable-speed fan controls and variable-speed compressors into the chiller has helped this process, further improving energy efficiency.

Keeping Breweries Cool in Warmer Climates

The most recent advancement in free-cooling chiller technology combines new control strategies with mechanical advances to further enhance chiller performance at design and off-design conditions. The chiller's mechanical improvements include variable-compression ratio compressor control, which prevents wasting energy on over-compression at reduced ambient temperatures and variable-speed drives (VSD) for both the compressors and fans.

Intelligent controls continuously evaluate and optimize compressor and fan speeds to minimize total energy use by the chiller. In addition to optimizing compressor and fan speed at all conditions, the controls also automatically transition between different operating modes, depending on ambient temperatures and cooling requirements.

For example, the chiller operates in a mechanical mode when it is too warm to use ambient air for free cooling. In this mode, the chiller



In mechanical mode, the chiller operates as a standard chiller during warm temperatures by utilizing an automatic liquid control valve to bypass the free-cooling coils to reduce chilled fluid pump head pressure and save energy.

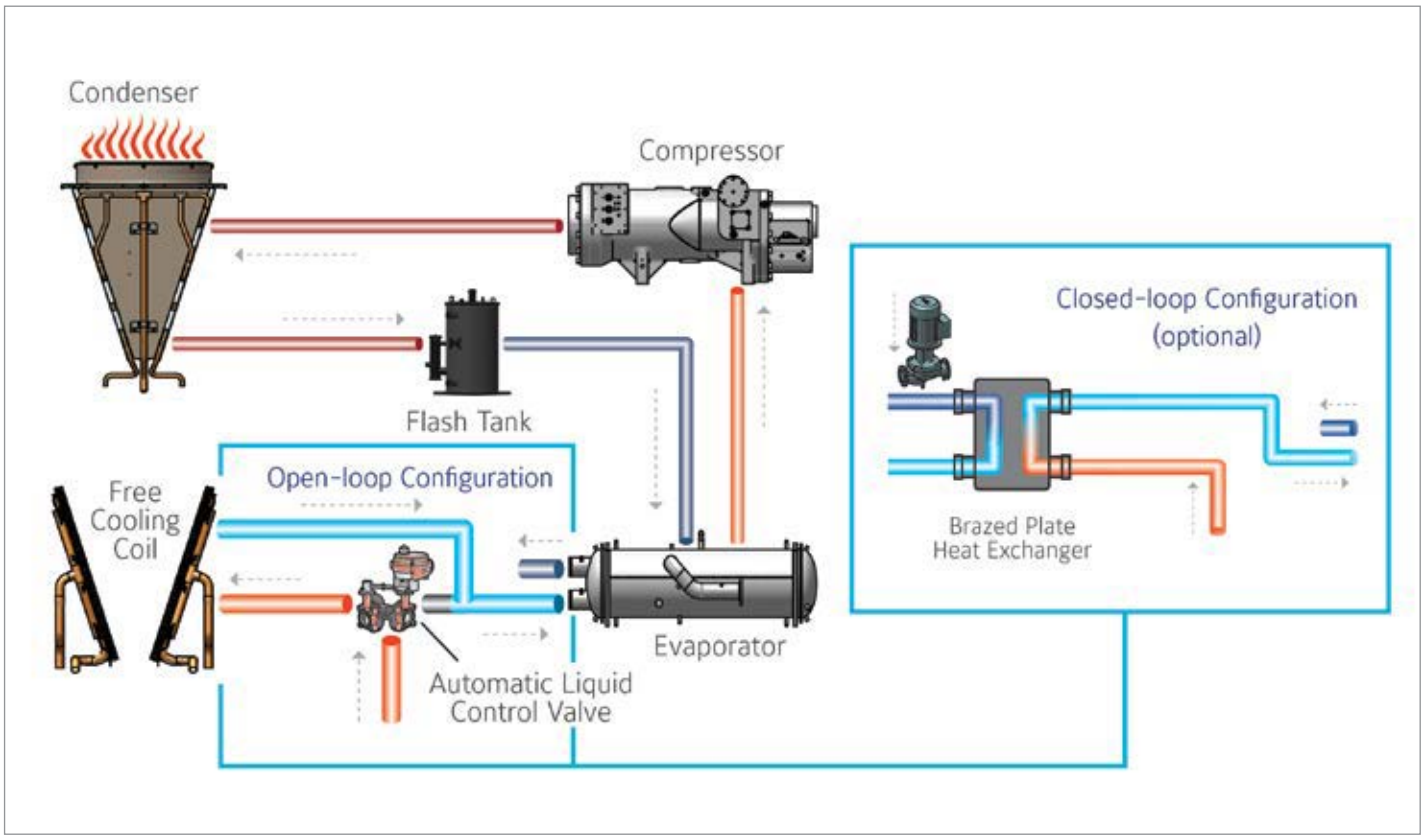
performs as a standard chiller. An automatic liquid control valve bypasses the free-cooling coils to reduce chilled fluid pump head pressure and save energy, allowing breweries to save on operating costs while ensuring product is kept cold in warmer climates.

Additional Energy Savings with Hybrid Mode

When a chiller operates in hybrid mode, it optimizes energy use through simultaneous operation of the compressor(s) and free-cooling coils. With VSD compressors, power consumption is minimized by reducing the compressor speed as the free-cooling coils deliver partial cooling. The controls automatically adjust fan speed to optimize the free-cooling benefit while ensuring reliable compressor operation.

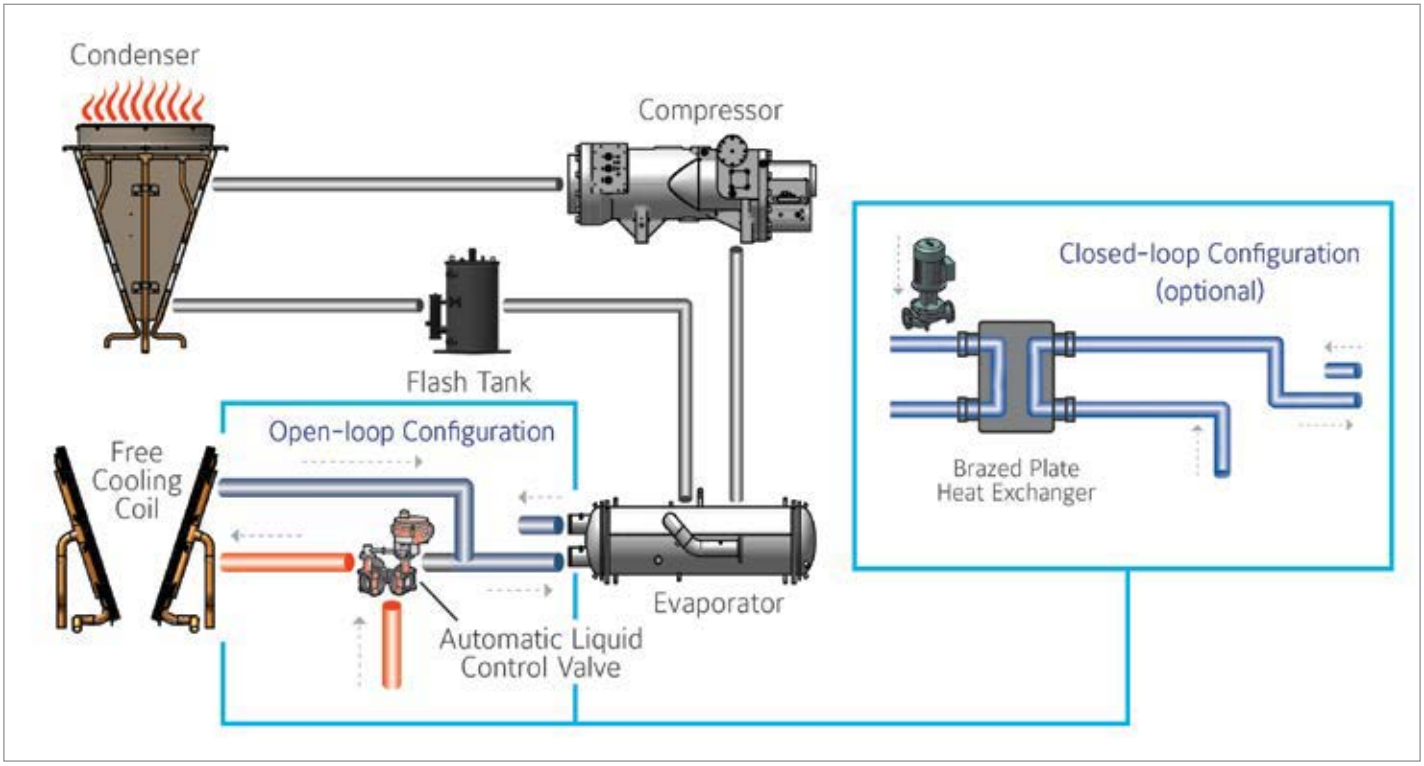
Across a wide range of ambient conditions, the power used in VSD-optimized hybrid mode is less than the power consumed by turning off compressors and running fans at full speed to meet cooling demand with free cooling alone. In those cases, hybrid mode outperforms simple waterside economizer free-cooling systems. Internal chiller control logic automatically selects the optimal operating mode to assure maximum energy efficiency. When either cooling load or ambient temperature are below design condition, the variable-speed screw compressors and condenser fans modulate to optimize energy use.

Free-cooling mode operates at lower ambient temperatures, when the required cooling load can be most efficiently delivered by free-cooling coils. Compressors shut off and VSD fans modulate to meet the cooling setpoint. The controls determine the optimum conditions, moving between different operating modes to minimize energy use while assuring reliable operation. Additionally, starting in free-cooling mode at very cold ambient conditions only requires fan motors to start, reducing the possibility of nuisance trips that can occur at low-ambient and/or high-wind conditions. This technology provides significant chiller optimization that delivers significant energy savings to breweries.



In hybrid mode, chillers optimize energy use through simultaneous operation of the compressor(s) and free-cooling coils.

ADVANCEMENTS IN FREE-COOLING KEEP BREWERIES COOL YEAR-ROUND



Free-cooling mode operates at lower ambient temperatures since free-cooling coils most efficiently deliver the required cooling load. A closed-loop is recommended when an installation requires water in the building loop.

Most chiller installations circulate building loop glycol through the free-cooling coils directly. This is the most efficient and lowest cost solution but requires glycol in the building loop to prevent freeze damage to the free-cooling coils. For installations that require water in the building loop, a closed-loop configuration should be used. The closed-loop configuration uses a glycol-water heat exchanger and circulating pump to isolate the free-cooling glycol loop from the building water loop. Use of a three-way valve used in the open loop to divert glycol into the free-cooling coils is no longer required.

Optimizing Operations at Breweries

These advancements in technology enable a chiller to deliver the lowest annual operating cost to breweries. Using the highest leaving water temperature provides greater savings and more cooling capacity in the same footprint as traditional systems. The combination of warmer chilled liquid temperatures and intelligent fan and compressor control during peak load provides more operating hours with free or partial free cooling to deliver the lowest operating cost – making it an ideal solution for breweries in warmer climates.

Confirming the benefit of the system is simple. Tools, such as an Annual Energy Calculator (AEC), provide an easy to read, comprehensive report that can be shared with owners and operators to accurately estimate total energy cost. Free-cooling chiller technology helps breweries significantly improve operations to save energy and manufacturing costs year-round, regardless of the ambient temperature, while maintaining the coolness and freshness of their product. BP

About Johnson Controls

Johnson Controls is a global diversified technology and multi-industrial leader serving a wide range of customers in more than 150 countries. Our 120,000 employees create intelligent buildings, efficient energy solutions, integrated infrastructure and next generation transportation systems that work seamlessly together to deliver on the promise of smart cities and communities. Our commitment to sustainability dates back to our roots in 1885, with the invention of the first electric room thermostat. We are committed to helping our customers win and creating greater value for all of our stakeholders through strategic focus on our buildings and energy growth platforms. For more information, visit www.johnsoncontrols.com.

About the Author

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- Raise temperature specifications in cooling applications

"We'll save over $16,700 in utility bills each year because we upgraded to a new energy-efficient water-cooled, magnetic-bearing centrifugal chiller that keeps our 382,000 square-foot building at a consistent temperature all day long."

— Marty Rowe, Director Facility Services, Holladay Park Plaza Assisted Living ("Deschutes Brewery and Holladay Park Plaza Save with the Energy Trust of Oregon," August 2018 Issue)

"Optimization can be a significant project, but given the immediate savings and a typical payback period of less than four years, it makes good sense to undertake it."

— Ian Dempster, Optimum Energy ("Barriers to HVAC System Optimization and How to Overcome Them," October 2018 Issue)

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The State of Refrigerants in COMMERCIAL CHILLERS

By Kacie Goff

Snail mail. Rolodexes. Boomboxes. We've given up the familiarity of the past for the promise of the future. But is the same happening in the chiller industry? Is the push for lower global warming potential (GWP) refrigerants changing the industry as we know it? In some ways, yes. But, in the United States in particular, the change may be more gradual than it appears at first glance.

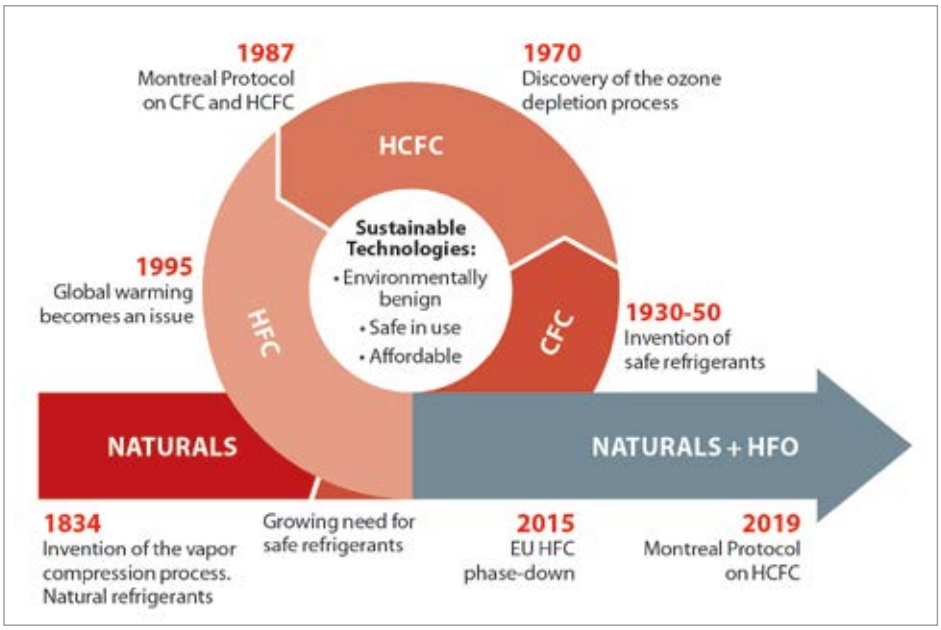
As the industry has moved away from chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) – with their ozone-damaging chlorine molecules – something has had to take their place. Since then, the three major players have been hydrofluorocarbons (HFCs), natural refrigerants, and hydrofluoroolefins (HFOs). Each comes with its own unique set of pros and cons.

So what's next? With three contenders in the ring, is there a clear-cut winner? Let's take a look.

Environmental Issues Drive Change

The commercial chiller and cooling game changed as soon as scientific evidence linked certain refrigerants to environmental detriments. Since then, both commercial chiller manufacturers and the companies that rely on them have had to consider not just the efficiency and cost of a refrigerant, but also its ozone depletion and global warming potential. In addition, different refrigerants can need different lubricating oils, which are important for long operation.

The change wasn't just pushed by a general sense of wanting to protect the environment, either. The Montreal Protocol, which went into effect in 1987, mandated the phaseout of CFCs (https://www.epa.gov/ods-phaseout/phaseout-class-i-ozone-depleting-substances) by 1996. As HCFCs were also linked to environmental degradation, the Montreal Protocol was amended to include their gradual phaseout, too.



Refrigerant technology has shifted significantly in the last few decades. Image courtesy of Danfoss.

Until that point, a wide range of industries relied heavily on CFCs and HCFCs as primary refrigerants in all chilling and cooling operations. The rapid phaseout of CFCs and more gradual phaseout of HCFCs created an urgent need for a refrigerant that could deliver on three fronts. It needed to be efficient, it needed to be safe for the environment, and it needed to be safe for use in a wide range of facilities and processes.

Does such a magic elixir exist? We talked to refrigerant subject matter experts to find out.

HFCs: A Step in the Right Direction

As the commercial chiller and cooling industry moved away from both CFCs and HCFCs because of their ozone-depletion factors, they searched for a replacement – and found it in HFCs. With no chlorine and zero Ozone Depletion Potential (ODP), HFCs seemed like the ideal solution to the industry's need and the hole in our ozone layer.

That said, ozone depletion isn't the only environmental concern. Gases, when released to atmosphere, have the potential to create an insulating effect that contributes to global warming. To measure this environmental impact, refrigerants are labeled with a global warming potential (GWP). And while HFCs don't deplete the ozone, their GWPs are not negligible.

Take R-134a as an example. This HFC is widely used in a variety of applications. Brian Smith, Director of Global Marketing, Global Chiller Products, Building Technologies and Solutions at Johnson Controls said, "I'd estimate that the vast majority of the North American centrifugal chiller market is using R-134a."

Johnson Controls currently uses R-134a in their 10- to 300-ton water-cooled chillers using screw compressors, 300+ ton water-cooled chillers using centrifugal compressors

The YK Centrifugal Water Chiller from Johnson Controls uses R-134a, an HFC. Photo courtesy of Johnson Controls.

(they also use R-1233zd, a low-pressure HFO for this application), and 100- to 500-ton air-cooled chillers using screw and scroll compressors. Meanwhile, they're using R-410A, another HFC, for their low-pressure (under 100 ton) scroll compressors.

With widespread usage and an ozone depletion potential of zero, R-134a seems to be an ideal refrigerant. But, upon closer examination, one discovers that it has a GWP of 1,430. And as governments (particularly in Europe), companies, and individuals feel heightened urgency to minimize environmental impact, there is some need to move away from R-134a. The U.S. Significant New Alternatives Policy (SNAP) regulated that R-134a is "unacceptable in new [chiller] equipment, except as otherwise allowed under a narrowed use limit, as of January 1, 2024." For more about the policy, visit https://www.epa.gov/snap/substitutes-centrifugal-chillers.

SNAP was challenged and ultimately overruled on a federal level, but that hasn't stopped the changes it put into motion. As Mark Menzer, Director of Public Affairs at Danfoss, pointed out at a breakfast Danfoss hosted at AHR, California has adopted SNAP regardless of the federal ruling.

"California is leading the way, but other states like New York, Maryland, and Connecticut have already announced their intention to start phasedown programs as well," Menzer explains. "And the U.S. Climate Alliance, a group of like-minded state governors who banded together after the president announced the U.S. pullout from the Paris climate agreement, is also expected to make additional program announcements this year. Together, these states represent more than 40% of the US population and GDP."

What's more, the proposed bipartisan AIM Act would return control of refrigerant regulation to the EPA, most likely putting SNAP back in place. Between the shift in United States regulation and the global market's move away from HFCs, it's become clear that another

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solution is needed. For more about the AIM Act, visit https://www.congress.gov/bill/115th-congress/senate-bill/2448/text

Fortunately, more and more alternatives are coming to the market all the time. Smith points out there are lower-GDP R-134a alternates that minimize both efficiency losses and the need for retrofits. Smith, even as he sees a long road ahead for R-134a, said Johnson Controls sees R-454B, an R-410A low-GWP alternative, as a frontrunner for use in its scroll compressors in the future.

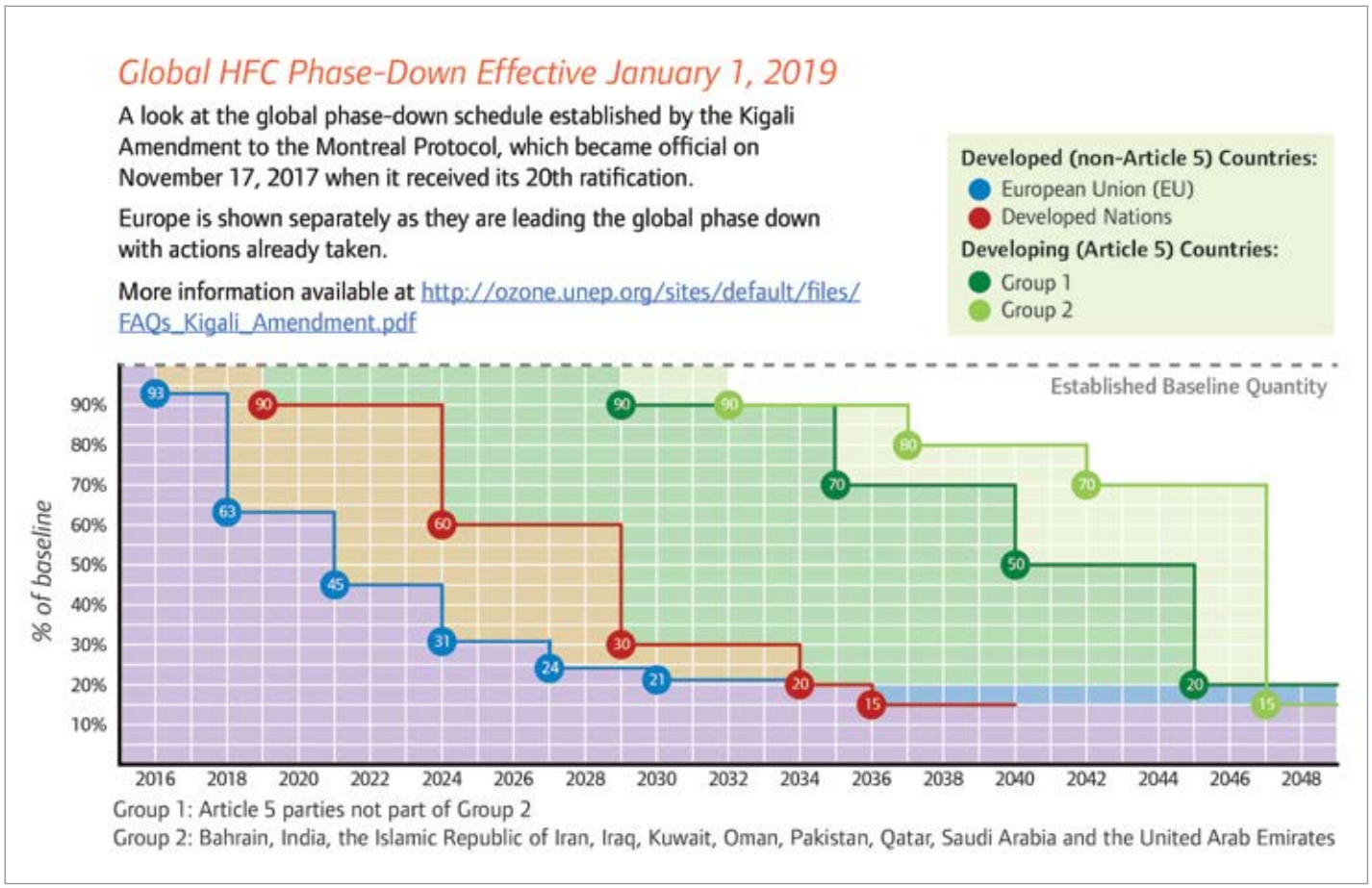
HFOs: An Ideal Solution – Sometimes

In the hunt for an alternative to high-GWP HFCs, the industry has found good news. Chris Tanaka, Portfolio Leader at Trane, said, "In nearly every case where refrigeration compressors are being used, there is a refrigerant available that can accomplish zero or very near zero GWP." Trane, specifically, has been exploring the increasing use of HFOs.

Danfoss anticipates change, and they say they're not alone. "When we look at centrifugal chillers and low-density refrigerants, there have already been major transitions," Jeff Staub, Director of Application Engineering at Danfoss, said.

In low-pressure applications, HFOs like R-513A and R-1233zd can be an ideal replacement for HCFCs. In medium-pressure applications, Danfoss is moving from R-134a to R-513A, another HFO. "We expect the use of R-134a to continue for the next three to five years or so, but we're seeing the transition to R-513A," Staub said.

Similarly, Carrier has made their water-cooled centrifugal AquaEdge and air-cooled rotary screw AquaForce 30XV chillers compatible with R-513A or R-134a. They are also offering a new centrifugal chiller called the 19DV that's compatible with the ultra-low GWP refrigerant R-1233zd(E). The AquaForce serves applications from 140 to 325 tons and can operate in ambient temperatures from -20 ˚F to 125 ˚F. As Greg Alcorn, Vice President and General Manager at Carrier Commercial HVAC, reported at AHR 2019, "Air cooled has come a long way."



Clearly, HFCs are on the way out. Photo courtesy of Trane.

Carrier's AquaForce 30XV chiller uses R-134a or the low-GWP HFO R-513A. Image courtesy of Carrier.

Many of the HFOs in use today have an impressive GWP of less than 2 and, as a drop-in solution, can keep efficiency losses in most applications down to a few percent. But that isn't true of every application. As pressure increases, the efficiency losses with HFOs can climb to upwards of 25%. When commercial chillers require a higher pressure compressor, HFOs cease to be the clear-cut winner in the category of best refrigerant replacement.

Natural Refrigerants

With their efficiency losses in higher pressure applications, HFOs aren't seen as the be-all and end-all when discussing the future of refrigerants. In the ongoing hunt for a low-GWP, high-efficiency refrigerant, some companies have begun exploring natural solutions, including propane and CO_2.

In fact, GWP itself is measured against CO_2. The EPA explains, "[GWP] is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2)." With this natural refrigerant as our benchmark for ideal environmental friendliness, it's no surprise that commercial chiller manufacturers are exploring CO_2 and other natural refrigerants.

What's more, other industries have driven the move to CO_2. The supermarket industry, in particular, has adopted CO_2 in its high-pressure food refrigeration applications. In fact, over 15,000 CO_2 refrigeration applications have been installed in Europe, where regulation is driving a faster move to low-GWP refrigerants and away from previously used HFCs like R-404A. This doesn't guarantee CO_2 will have widespread adoption in industrial applications, but it's a trend worth watching.

While natural refrigerants like CO_2 are environmentally ideal and can perform in high-pressure chiller and cooling applications, natural refrigerants bring a different concern with them. As Smith points out, "In the high-pressure range, all the potential replacements are flammable." Added to that is the issue of toxicity. So while natural refrigerants could be a path forward, they require the companies that use them to think about the safety of their facilities and, potentially, to make changes to ensure that any leaks don't create significant hazards.

The Efficiency/GWP Interchange

Clearly, the problem of finding a perfect refrigerant is complex. On top of environmental concerns, chiller manufacturers have to consider facility safety, compatibility with existing plant equipment, and efficiency preservation. The last, in particular, is doubly important as we consider the environmental ramifications of these new refrigerants.

"If you do anything with your refrigerant to reduce efficiency, you're increasing the carbon footprint significantly," Smith said. Even if a refrigerant has a lower GWP, if it reduces the efficiency of the chiller, the balance may still swing toward higher environmental impact because so much of the energy used by commercial chillers, especially in the United States, is still created by coal. (The United States Energy Information

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Administration reports that nearly a third of the U.S.'s energy is created in coal plants.) And, when considering the fact that – in an ideal situation – refrigerant is supposed to stay inside the chiller where it has no environmental impact, efficiency seems like the more pressing environmental concern.

That's why Smith of Johnson Controls said, "Our message and our position on our chiller products is a holistic view of the carbon footprint. Energy efficiency is really the big player. We need to do the right thing in terms of moving to these new fluids, but we need to consider the cost of energy efficiency."

Companies who want to take a holistic approach and optimize system efficiency can look to new technology. CAREL, for example, offers an evaporative cooler that can boost the cooling capacity of chillers by 30% or more. As Roberto Sandano, CAREL's Group Head of HVAC Marketing, said, "More and more, what matters is the complete architecture of the system rather than the efficiency of any single unit." Integrating new technology with new refrigerants can help companies drive efficiency.

Finding the Sweet Spot

Ultimately, every commercial chiller has different refrigeration technology that is ideal for optimizing its unique parameters in terms of efficiency, safety, and cost. Sandano said, "The main difficulty is that the current refrigerants cannot offer a solution for all applications. You need to have a specific approach."

Ultimately, there is no clear-cut winner in the hunt for an ideal low-GWP, high-efficiency, safe refrigerant. The industry will have to continue to fine-tune the solutions available today. And until an ideal refrigerant emerges, commercial chiller manufacturers and users need to stay informed so they can choose the best option based on the unique specifications of any given application. BP

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INDUSTRIAL COOLING SYSTEM INDUSTRY NEWS

CAREL To Expand Production Plant in Pennsylvania

CAREL, a leader in refrigeration and heating, as well as systems for humidification and evaporative cooling, recently held a groundbreaking ceremony to mark the expansion of its CAREL USA production plant in Manheim, Pennsylvania.

The plant expansion, which will more than double the area devoted to production from 35,000 to 70,000 square feet, is part of a global geographic footprint expansion strategy, involving mainly the United States, Europe and China, serving the company's organic growth for the coming years. CAREL expects to complete the expansion in by the end of 2019 first semester.

"The extension of the plant follows the implementation, in the same plant, of the first U.S. programmable controller production line, completed last summer, and shows the interest of the group in the North American market. We expect it to represent a significant accelerator for CAREL's growth, which will be based on innovation, energy efficiency and customer care," said Francesco Nalini, the Group's Chief Executive Officer.

According to Nalini, expanding production capacity in the United States allows CAREL to be closer to its customers and meet their needs more promptly and effectively; moreover, it will be a fundamental step in increasing market share in the country, avoiding bottlenecks and improving logistics.

CAREL also expects positive impacts for the company will be accompanied by positive impacts for the local community, including the need for additional qualified workers in a sector and for a group in which environmental sustainability is a fundamental asset.

About CAREL

CAREL is one of the world leaders in control solutions for air-conditioning, refrigeration and heating, and systems for humidification and evaporative cooling. Our products are designed to bring energy savings and reduce the environmental impact of equipment and systems. Our solutions are used in commercial, industrial and residential applications. CAREL has 22 fully owned subsidiaries and seven production sites, as well as partners and distributors in a further 75 countries. For further information, visit www.carel.com.

CAREL's groundbreaking ceremony marked its plant expansion in Manheim, Pennsylvania.

Danfoss Acquires Industrial Refrigeration Technology Leader AAIM Controls

Danfoss has acquired AAIM Controls Inc., a specialized supplier of custom-designed regulation and control automation solutions, from motor starters to complete PLC systems. A leader in the North American industrial refrigeration market, AAIM Controls is located in Waynesboro, Pennsylvania.

With the acquisition, Danfoss moves to a strong and unique position as a systems provider within industrial refrigeration, according to Jürgen Fischer, President of Danfoss Cooling.

"We consistently look to strengthen our core businesses by partnering with other successful companies and acquiring technology that complements the solutions we offer our customers. By adding electronic regulation and control automation to our already-extensive portfolio of components for industrial refrigeration applications, we strengthen our global position by becoming a systems provider in the industrial refrigeration market," Fischer said.

With global megatrends like digitalization and combatting climate change driving the industrial refrigeration market forward, the demand is increasing for bundled solutions of products, as well as intelligent control and

INDUSTRIAL COOLING SYSTEM INDUSTRY NEWS

Front row (left to right): Brian Davis, Senior Director, Sales Development – Industrial Automation, North America, Danfoss Cooling; Kristian Strand, President – Refrigeration and A/C Controls, Danfoss Cooling; Arthur Marshall, Co-founder and President, AAIM Controls. Back row (left to right): Henrik Moller Henriksen, Director of Strategic Programs – Refrigeration and A/C controls, Danfoss Cooling; Pat Ocker, Power Engineering Manager, AAIM Controls; Craig Cordell, PLC Engineering Manager, AAIM Controls; Alan Izer, Co-founder and Vice President of Operations, AAIM Controls.

automation, that increase energy efficiency, ensure food safety, and help in the transition to alternative, climate-friendly refrigerants.

"In the industrial refrigeration market, controllers are often seen as the central part of a system offering. With the addition of AAIM's strong knowledge base and their highly specialized solutions, we gain a unique competitive advantage where we can better address these customer requirements," said Kristian Strand, President – Refrigeration and A/C controls, Danfoss Cooling.

Arthur Marshall, one of the founders of AAIM Controls, said, "Becoming part of the Danfoss family will give us great options for expanding into new areas, and I'm confident that the partnership with Danfoss will open up new business opportunities. Not only do we share the same ideas of how to develop the business, but we also have the same values when it comes to our people and how to drive growth."

About AAIM Controls

AAIM Controls Inc. was founded in 2003 by Art Marshall and Alan Izer, and employs 24 people within administration, engineering, and manufacturing in their 16,000-square-foot facility in Waynesboro. For more information, visit www.aaimcontrols.com.

About Danfoss

Danfoss engineers advanced technologies that enable us to build a better, smarter and more efficient tomorrow. In the world's growing cities, we ensure the supply of fresh food and optimal comfort in our homes and offices, while meeting the need for energy-efficient infrastructure, connected systems and integrated renewable energy. Our solutions are used in areas such as refrigeration, air conditioning, heating, motor control and mobile machinery. Our innovative engineering dates back to 1933 and today Danfoss holds market-leading positions, employing 27,000 and serving customers in more than 100 countries. Danfoss is privately held by the founding family. For more information, visit www.danfoss.com.

SPX Cooling Technologies Names Sales Rep Firm for Colorado and Wyoming

SPX Cooling Technologies has named Engineered Products, LLC, as its sales representative for Colorado and portions of Wyoming.

Together, SPX Cooling Technologies and Denver-based Engineered Products provide highly efficient and reliable evaporative cooling solutions for HVAC and light industrial applications, including Marley and Recold brand cooling towers, fluid coolers, evaporative condensers, and OEM components.

Engineered Products President Matthew Miceli founded Engineered Products in April 2018 with a vision to provide highly technical solutions, engineering expertise and outstanding customer service. Engineered Products had recently joined forces with Troy and Bob Gladstone of Midwest Machinery, which represents SPX Cooling Technologies in Kansas, Missouri and Oklahoma, to formally establish a sales rep firm for Marley and Recold products in Colorado and Wyoming.

With 18 years experience in the HVAC industry, Miceli and his team of engineers and project

Engineered Products President Matthew Miceli.

managers are armed with technical degrees and extensive HVAC backgrounds and strive to drive growth by providing value to engineers, contractors and owners. For more information, visit www.engineeredproducts.com.

About SPX Cooling Technologies, Inc.

SPX Cooling Technologies, Inc. is a leading global manufacturer of cooling towers, evaporative fluid coolers, evaporative condensers and air-cooled heat exchangers, providing full-service cooling solutions, components and technical support for HVAC, refrigeration, industrial and process cooling applications for nearly a century. SPX Cooling Technologies and its product brands are part of SPX Corporation. For more information, visit www.spxcooling.com and www.spx.com.

ASHRAE Wraps Up Successful 2019 Winter Conference, AHR Expo

Increased building activity, operational demands, changes in codes and design and new energy efficiency strategies were just some of the topic discussed among buildings professionals at the 2019 ASHRAE Winter Conference and AHR Expo.

The 2019 ASHRAE Winter Conference took place on January 12-16 in Atlanta, Ga., ASHRAE's headquarters city. More than 3,200 individuals registered for this year's Winter Conference.

The AHR Expo attracted HVACR professionals from around the globe and provided a forum for manufacturers to showcase the latest products and services. It drew more than 65,000 attendees, with 1,809 exhibitors total, 496 international exhibitors from 35 countries and 107 first-time exhibitors.

The Winter Conference technical program featured more than 300 presentations, with interest surrounding this year's new track, *Renewable and Natural Systems,* where session topics included exploring energy technologies, renewable energy sources and the future of the smart grid.

"The Winter Conference and AHR Expo provides an excellent setting for buildings professionals to collaborate on new ideas and share knowledge," said 2018-2019 ASHRAE President Sheila J. Hayter, P.E. "As we explore ways to incorporate renewable energy technologies into integrated building concepts, ASHRAE will take an even greater leadership role in defining the relationship between buildings and the power sector. The Winter Conference and AHR Expo continues to be one of the most important platforms through which this knowledge is shared."

At the conference, Hayter provided Society updates and initiatives related to the Society theme, *"Building Our New Energy Future."* She focused on how ASHRAE is preparing buildings professionals for the challenges and opportunities of designing efficient and grid-responsive buildings within the changing energy sector.

The 2019 ASHRAE Annual Conference will take place June 22-26, 2019 in Kansas City, with the 2020 Winter Conference February 1-5, 2020, and the AHR Expo, February 3-5, 2020, in Orlando, Fla.

About ASHRAE

ASHRAE, founded in 1894, is a global society advancing human well-being through sustainable technology for the built environment. The Society and its more than 56,000 members worldwide focus on building systems, energy efficiency, indoor air quality, refrigeration and sustainability. Through research, standards writing, publishing, certification and continuing education, ASHRAE shapes tomorrow's built environment today. For more information, visit ashrae.org

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