

ContainerLINE

Understanding Container Atmosphere Control Technologies

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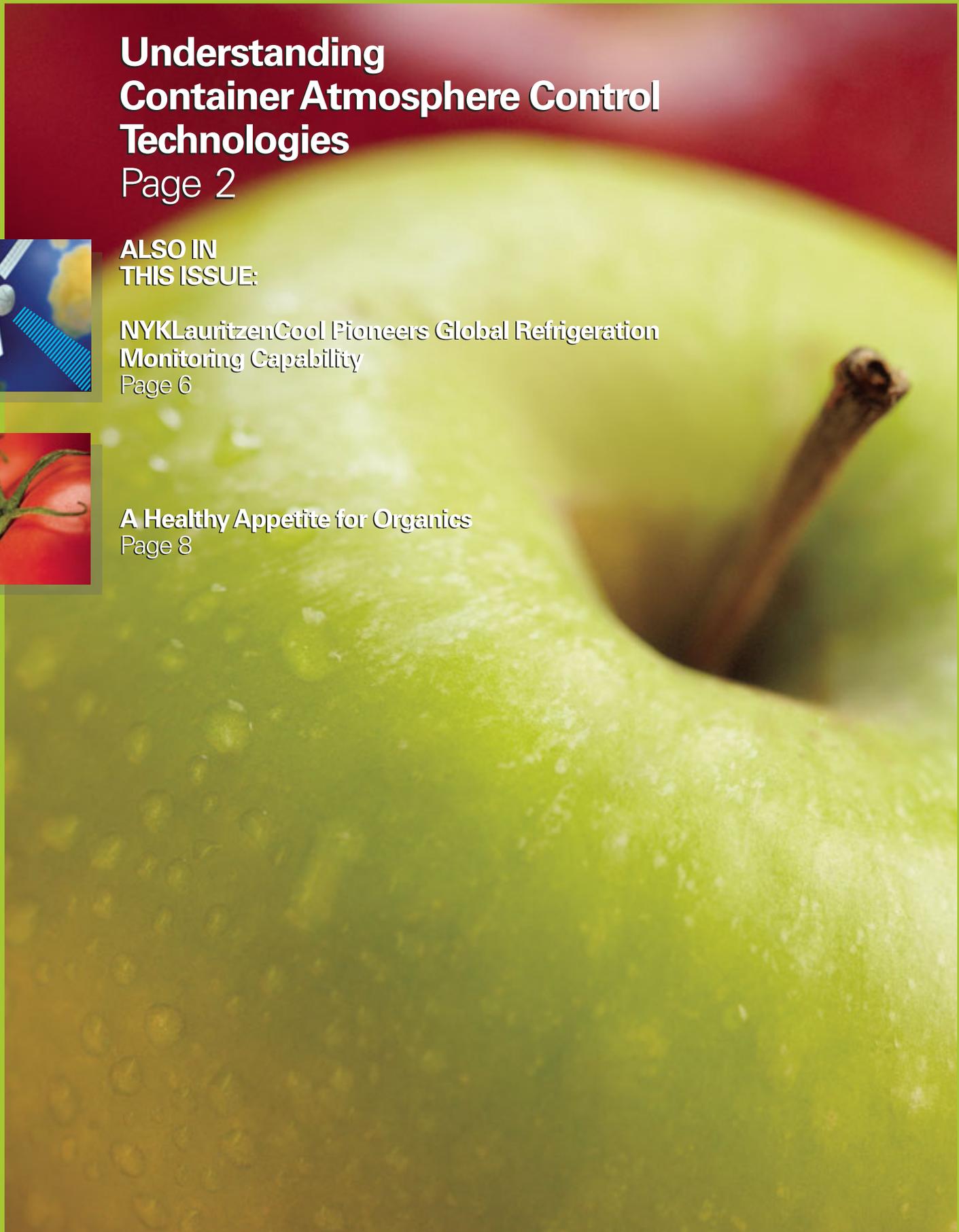
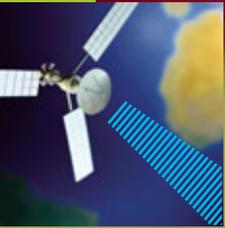
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Technology, Not for the Sake of Technology



If there's one thing that can be said about the world around us, it's that technology is constantly changing our lives. The key question is "when do we adopt new technology and why?"

If we look at our personal lives, we don't buy laptops, for example, because of their technology. We buy them for the benefits they provide – because they make us more efficient, flexible and enable us to do things

that we could never do before. The same could be said of iPods, GPS navigation systems, and HD televisions. The fact that they are new is irrelevant. The fact that they provide us useful features and benefits is.

The articles in this issue convey that theme, and we at Carrier are focused on helping you see and realize the benefits of technology, while not being deceived by useless new technology. We also work hard to ensure that technology obsolescence does not affect the use of your Carrier unit over its lifetime, which can be 15 to 20 years or more.

In this issue, we'll look at controlled atmosphere technology and how it has revolutionized the distribution of fruits and vegetables around the world, including the rapidly growing organics segment. We also examine competing technologies, how they differ, and the potential applications of each.

We highlight the application of wireless communication technology and the benefits it provides to NYKLauritzenCool. And finally, as Carrier units outlive multiple generations of parts, we examine how we at Carrier are committed to providing high quality replacement components to keep your fleet running.

We will continue to provide a fact-based view of benefits to your business as new technology is released, and please do not hesitate to "Turn to the Experts" at Carrier to provide solutions and answers to your questions.

Scott A. Pallotta
Director of Marketing

Understanding Container Atmosphere Control Technologies

By Jim Taeckens, Senior Product Manager

With container shipping of perishables, change is in the air!

And it's the air inside the container that's changing. Technologies that give shippers control of the atmosphere inside refrigerated containers are permitting fresh fruits and vegetables to arrive at their destinations in optimum condition as never before possible.

This new appeal for regulating the container environment comes at a time when produce trade is flourishing globally, with agricultural regions from around the world competing for consumer appetites by shipping produce over increasingly longer distances. The ability to deliver "freshness" by fine-tuning container atmosphere also translates into premiums reaped by the retailer, the shipper and even the grower.

How does it work? Varieties of fruits and vegetables all ripen according to their own individual biological clocks. Knowing the schedule for each and harvesting at just the right time – taking shipping distances into consideration – is key to assuring that consumers purchase produce of optimum quality, when the sugar levels and nutritional values are at their peak, and taste, color and texture are at their best.

Of course, refrigeration plays an important role in controlling on-board ripening. But the technique of adjusting the container's atmosphere can add days or even weeks to the potential storage and transit time, allowing produce to travel longer distances and bringing greater variety to consumers around the world.

As produce shippers know, atmospheric composition is important to fruits and vegetables, because they "breathe" or respire as they mature, consuming oxygen (O_2) and producing carbon dioxide (CO_2) and a hormone called ethylene. At a certain point in its maturity, the fruit undergoes an increase in respiration, after which it goes through a stage called senescence, softening very rapidly as it dies (See Fig. A).

Normal atmosphere consists of 78 percent nitrogen (N_2), about 21 percent O_2 and a miniscule 0.03 percent CO_2 . In the enclosed space of an unventilated container, fruits with rapid respiration rates – whether papaya, pear or plum – can rapidly change the atmosphere, reversing the normal levels of O_2 and CO_2 in only a day or so. That could be disastrous. Too little O_2 can lead to spoilage, just as too much can. That's where atmosphere control comes in.

Airing the Differences

Properly managing the O₂ and CO₂ concentrations through atmospheric control can actually retard produce respiration and delay ripening beyond what refrigeration alone can do. In some cases, adjusting the balance of O₂ and CO₂ can even be used to thwart the effects of post harvest pathogens, decay and insect infestation.

Technologies as Different as Apples and Oranges

More often than not, the term “controlled atmosphere” is erroneously used interchangeably to describe three different techniques to regulate the air inside a container. The truth is, these methods are as different as apples and oranges and avocados. While all three techniques aim to adjust the atmosphere, only true Controlled-Atmosphere systems provide real-time control capability covering the full range of possibilities.

With a basic understanding of the equipment differences, how do you select the most appropriate technology? It all depends on what is being transported and how many varieties will be shipped in the same containers. Shipping lines that want to maintain the greatest flexibility will choose solutions that can accommodate the widest variety of produce.

Modified-Atmosphere systems using gas injection have their place in applications where the transit time is relatively brief and products are not high-respiring. High-value and extremely perishable produce, such as white peaches, can benefit from the ability to achieve an atmosphere immediately. The problem with a gas-injected atmosphere is that it simply has

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The three key methods of altering container atmosphere during shipping are known as Controlled-Atmosphere, Modified-Atmosphere and Fresh-Air Exchange (also called Fresh-Air Management). Understanding their differences and limitations can help shippers make the best decisions for their applications.

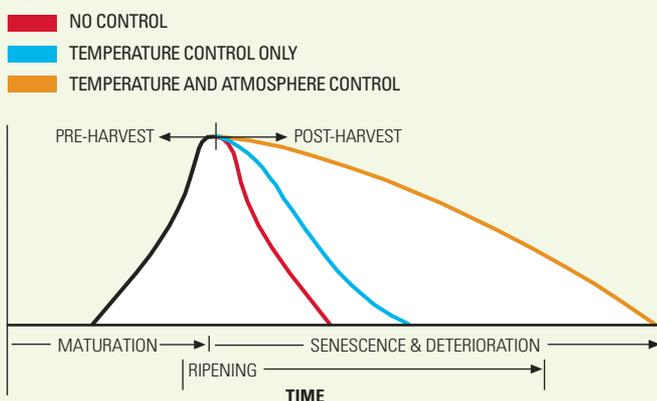
Controlled-Atmosphere – Built into the refrigeration unit, a Controlled-Atmosphere system draws outside air and also uses N₂ taken from it to fine-tune the balance of O₂ and CO₂ inside a container. By this definition, the leading Controlled-Atmosphere system in the industry is Carrier’s EverFresh™ system. The EverFresh system employs a unique “membrane separator,” which is a molecular filter that distills N₂ from everything else in the air – O₂, CO₂, water vapor and other gases. The captured high-purity N₂ is then used to displace O₂, CO₂ and other unwanted gases.

A Controlled-Atmosphere system is the only one with the ability to control and maintain specific O₂ and CO₂ levels over a wide spectrum of potential settings. Ethylene absorbers can be used with extremely sensitive cargoes. If needed, supplemental CO₂ can be added.

Modified-Atmosphere – With this technique, before shipping, the container is injected with a specific composition of gases appropriate to the perishables inside. Then the container is sealed-off for shipping. During transit, the environment will change within the container due to off-gassing of the produce. To make a container suitable for Modified-Atmosphere use, it needs to be retrofitted with a “purge port” assembly. Additionally, the container must be very well sealed.

Fresh-Air Exchange – Like a Controlled-Atmosphere system, a Fresh-Air Exchange system invokes mechanical ventilation of the container to provide some level of control over CO₂ build-up, but to a lesser degree than Controlled-Atmosphere. For example, with Carrier’s eAutoFresh™ system, when the CO₂ level reaches a preset point, the system activates, drawing in outside air to add O₂ and ventilate excess CO₂. Because Fresh-Air Exchange systems rely on natural atmosphere, the interior of the container being ventilated will generally be approaching a 78 percent N₂ level, with O₂ and CO₂ in some combination making up the balance.

Fig. A – Ripening Control Comparisons



Finding the Right Solution



	Advantages	Disadvantages	Likely Applications
Controlled-Atmosphere	<p>Uses nitrogen to adjust atmosphere balance, so O₂ levels can be maintained at specific levels without increasing CO₂ levels</p> <p>Greater control provides best assurance against losses</p>	<p>Higher sophistication makes initial equipment investment greater than others although payback can occur relatively quickly</p>	<p>Virtually unlimited, because CO₂ and O₂ concentrations can be as low as 0 and as high as 21%</p>
Modified-Atmosphere	<p>Relatively simple</p> <p>Achieves atmosphere immediately</p> <p>Low capital investment for the shipper</p>	<p>Containers can leak and internal atmospheric composition changes during shipment</p> <p>No active, ongoing atmospheric control</p> <p>Requires qualified technicians to inject gasses in units</p> <p>Each use carries a cost factor, making it expensive for the customer</p>	<p>Short trips with products that are slow to respire</p> <p>High-value items such as white peaches, that can benefit from immediate atmosphere modification</p>
Fresh-Air Exchange	<p>Provides ability to modulate CO₂ levels by introducing fresh air during transit</p>	<p>Adding fresh air always adds O₂ component, limiting applications</p> <p>Initial equipment investment greater than Modified-Atmosphere solution</p>	<p>Cherries, strawberries, asparagus</p> <p>Suitable for anything where optimal combined CO₂ and O₂ concentrations can fall within a range of 19% to 21%</p>

(continued from page 3)

no ability to maintain a desired balance over a lengthy journey, which could lead to irregular ripening of fruits, off flavors and off odors. Also, while the initial investment for Modified-Atmosphere is the lowest, there is a built-in costly expense for gas injection with every shipment.

Deciding between the two mechanical methods, Fresh-Air Exchange and Controlled-Atmosphere, becomes a little more complex and requires analysis of the tolerances of the produce being shipped.

Figure B shows optimum O₂ and CO₂ ranges for various fruits and vegetables against the capable ranges of Fresh-Air Exchange systems and Controlled-Atmosphere systems. As shown, the Controlled-Atmosphere system covers a far wider range of possibilities (the entire field) than a Fresh-Air Exchange system (only commodities that cross or touch the gray diagonal band).

A Fresh-Air Exchange system is limited because it relies on outdoor air to supplement what is inside the container. The air introduced into the container will always have a composition of about 78 percent N₂, and the air inside will be some mix of O₂ and CO₂ that adds up to about 21 percent. In spite of its limitations, there are cases where it can meet the specifications of some produce. For example, a desired balance for strawberries of 6 percent O₂ and 18 percent CO₂ is certainly within the range of Fresh-Air Exchange.

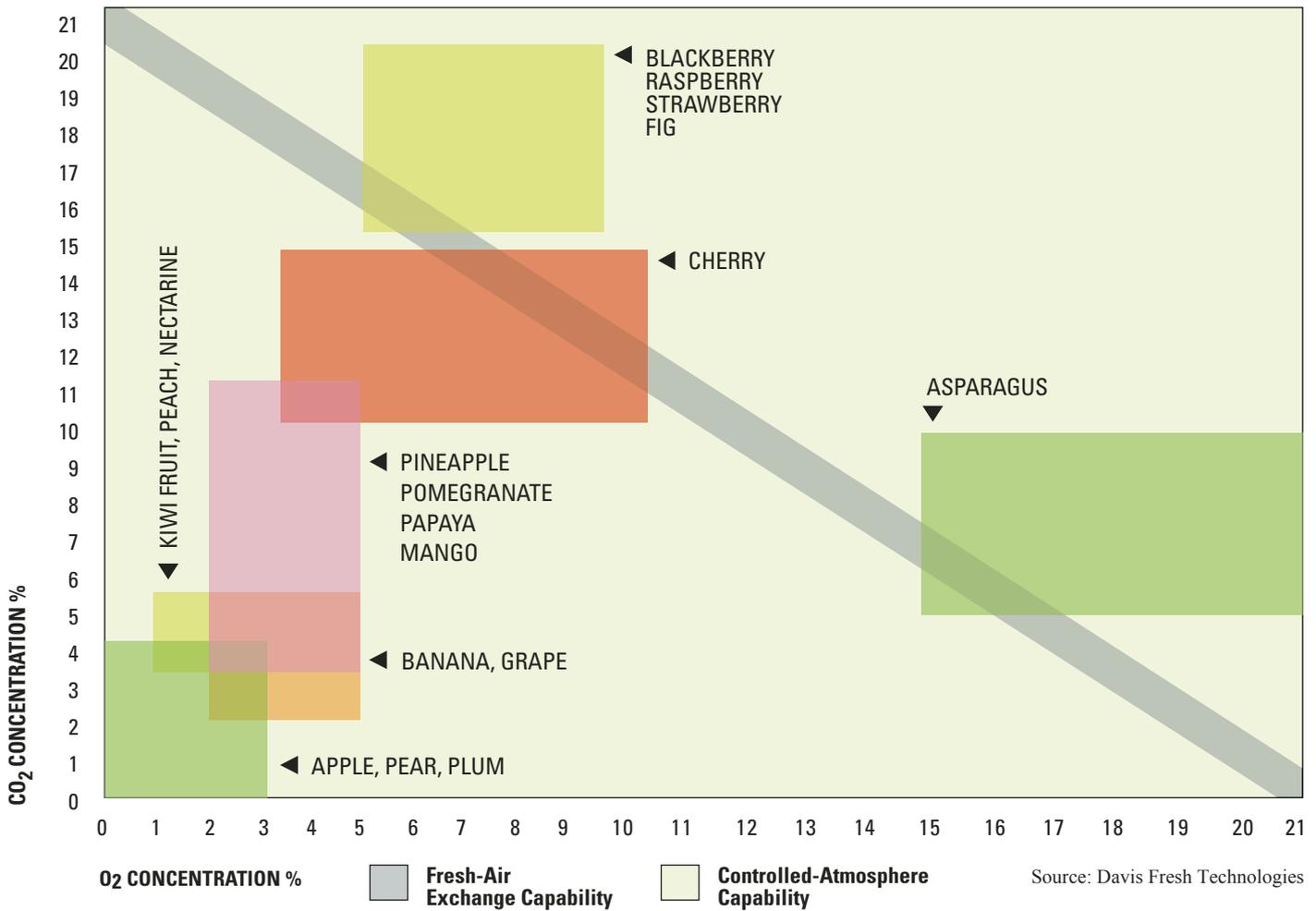
On the other hand, because Controlled-Atmosphere uses pure N₂ to adjust the environment, it handily accommodates produce such as mango, pineapple, cherimoya and sweetsop, which all have optimum O₂ ranges of less than 5 percent and CO₂ ranges of less than 10 percent. These ranges would be impossible with Fresh-Air Exchange.

In practicality, how wide of a range of atmosphere control does a shipper need? It all depends.

Shippers who deliver over the longest routes, or who need versatility to handle the widest variety of produce, will always find Controlled-Atmosphere systems to be the most accommodating.

If a shipper only handles a specific crop that can be accommodated by Modified-Atmosphere or Fresh-Air Exchange, then those methods may provide satisfactory results, although, as with any major capital purchase, a careful long-term cost/benefit analysis should always be done in advance.

Fig. B – Comparing Ranges of Controlled-Atmosphere and Fresh-Air Exchange Systems



Carrier Spreads the Word on CA to South America

With its growing agricultural export business, South America has taken a keen interest in Controlled-Atmosphere (CA) technology's ability to protect and preserve the quality of produce destined for overseas markets. Responding to this, Carrier recently sponsored two one-day CA seminars in Lima, Peru, and Santiago, Chile. Conducted by Davis Fresh Technologies, and attended by 116 representatives of shipping lines, shippers and growers, the sessions

offered an overview of post-harvest physiology and its effects on produce deterioration and shelf life, as well as presentations and discussion on the use of CA containers for long-distance transport of fresh fruits and vegetables.

Based on customer interest, Carrier is considering offering similar seminars in other regions. Contact your Carrier Transcold representative for more information.

NYKLauritzenCool Pioneers Global Refrigeration Monitoring Capability

These days there is more chatter than ever before aboard ships in NYKLauritzenCool AB's reefer fleet.

But we're not talking about human conversations.

In this case, scores of refrigerated containers and cargo holds are using the latest wireless telemetry to talk to the crew on the bridge of those ships. Operational status, temperatures and even alarm conditions are all being reported via radio in real time.

It gets even wilder than that: these machine "voices" can be heard around the world. No matter where the ships are, reefer data is relayed to satellites and bounced back to a server in Scandinavia. From there, the information is logged for record keeping and access by NYKLauritzenCool management or even their customers via Web browser for review and analysis.

One of the world's largest operators of specialized reefer vessels, Stockholm-based NYKLauritzenCool initiated the project to bring a higher level of quality assurance to its customers, according to Ralph Mohlin, technical project manager for NYKLauritzenCool.

"Together with the customer we can prevent damage to the cargo, minimize losses and prevent claims," said Mohlin.

The program takes advantage of the ARTIQ^{COOL} System, developed by Norwegian instrumentation specialist Teck-Skotselv AS and its partner Arkub Telematic Systems of Sweden. The ARTIQ^{COOL} system is designed to provide surveillance, monitoring, reporting and control of refrigeration systems within the cold chain.

Begun in 2005 as a trial on NYKLauritzenCool's weekly route between Costa Rica and the United Kingdom and Belgium, the project now encompasses seven of the shipper's 70 vessels and 400 of NYKLauritzenCool's 3,000 reefer containers. The containers used in the project have Carrier refrigeration units, including 60 EverFresh Controlled-Atmosphere (CA) units. Also networked are the below-deck refrigeration systems and the 15 to 16 cargo decks within each of the participating ships, which include the Sevillan Reefer and other vessels in NYKLauritzenCool's Summer and Crown classes.

Each container's refrigeration unit is equipped with its own radio unit, as are the various cargo holds. Data is collected from the refrigeration system control unit and transmitted by the radio to a master node and computer located on the ship's bridge. There, operators get a comprehensive real-time view of all refrigeration systems and instant alerts if a problem develops.

"By being able to read this data at any time, we will be able to detect if something is going wrong much earlier," Mohlin said, adding that corrective steps can be taken immediately.

Radio-equipped refrigeration units stacked on this NYKLauritzenCool vessel transmit to the ship's master node, which bounces cargo data to a satellite for retrieval at a landside base.



Although remote monitoring of moving refrigeration systems is frequently done on land with rail systems, ocean crossing requires a different communications model. For one, land-based systems rely on cellular communications networks, which are nowhere to be found in the mid-Atlantic.

From the ship's bridge, an Iridium modem, GPS unit and antennas create a data link for long-distance monitoring. Back on land, the ARTIQ^{COOL} interface displays a comprehensive picture that includes a ship fleet overview, ship status overview, map presentation and route tracing, a container overview in both tabular and graphic form, an alarm overview and more.

Information can be accessed from any Internet-connected computer with a Web browser. Security protocols prevent use by non-authorized users.

One of the things that makes the monitoring system unique among data acquisition systems is that for every ocean crossing, the containers, like a deck of cards, get shuffled and regrouped, creating a new mix of about 70 to 80 reefers on the deck of each ship. Yet they all synchronize communications with the central station on the ship's bridge.

Getting all systems to talk together in the harsh oceanic environment was a key part of the job, according to Steinar Haugerud, managing director of Teck-Skotselv. "On a ship you have a very tough area, with wind, rain and saltwater, so it made for a very tough testing this last year," he said, adding, "It works very well."

A challenge for Teck-Skotselv was to find a suitable radio transmission frequency that could penetrate a ship's steel hull and also be permitted in all countries in which NYKLauritzenCool operates. Critical to success was development of a complicated wireless network, including repeaters under and on deck to extend coverage of the local radio network.

For its part, Carrier supplied the developers and NYKLauritzenCool with engineering support to get the refrigeration unit controls to talk to the radios.

"We received very good cooperation from Carrier on the interface and protocol for communicating with their MicroLinkTM units," Mohlin said.

As the program moves into new stages, additional data will be gathered from the CA units, Mohlin said, explaining, "We are in the process of extending the monitoring to read also CO₂, oxygen and relative humidity."

Giving customers the ability to control systems remotely will

eventually be added. But for the time being, the system is providing customers with transparency – the real-time assurance that their cargoes are being well protected every minute of the journey.

Said Mohlin, "The benefit is increased communication with the customer."

Thanks to those "talking" reefers!



INTERNET



A Healthy Appetite for Organics

The organic foods category barely existed a generation ago, but now it is considered one of the most profitable and rapidly growing niches in agriculture.

It's a worldwide phenomenon. The global organic market has been growing by 20 percent a year since the early 1990s. Today, organic farming is practiced in at least 100 countries, with more than 31 million hectares (76.6 million acres) under organic management, according to the 2007 edition of *The World of Organic Agriculture*.

Released in February at BioFach 2007 in Germany, the report indicates that the global appetite for organic products reached 25.5 billion euros in 2005, with North America and Europe still the primary markets for organic products. Australia leads the world in land committed to organic farming, followed by Argentina, China and the United States (see chart).

By continent, the most significant portions of global organic surface area devoted to organic agriculture are in Oceania (39 percent), followed by Europe (23 percent) and Latin America (19 percent). Although growth in the U.S. has been rapid, total land devoted to organic farming is a fraction of one percent. Leading in terms of largest portion of farmland certified for organic agriculture are the Alpine nations, such as Austria with more than 14 percent of its land certified as organic.

What is Organic Farming?

Generally speaking, organic food crops are grown without pesticides, artificial fertilizers or sewage sludge. In the case of processed food, it is produced without ionizing, radiation or food additives. For livestock, it means it was reared without routine use of antibiotics and without the use of growth hormones.

The organic movement traces its roots to the 1950s with the promotion of organic gardening. In the '60s and '70s, it started to gain traction with grassroots concerns over environmental issues. The 1980s saw the emergence of private-sector organic certification and initiation of government regulations around the world. This led to legislated organic certification, beginning in the 1990s with the European Union's (EU) standards and followed in 2002 by the U.S. Department of Agriculture's National Organic Program certification standard. Additionally, many single-country standards now exist or are underway around the world.

Historically, organic farms were small family-run businesses, which is why organic food was once only available in small stores or farmers' markets. Now, organic foods are mainstream, with products produced on one continent shipped to another for consumption.

Currently, because of the higher prices commanded for organic food and beverages, most are sold in industrialized countries like the United States, where there is a sizeable and well-educated middle class. The Nutrition Business Journal reported that between 1997 and 2003, annual sales of organic foods in the United States tripled to \$10.4 billion, or 1.8 percent of total domestic food sales.

The largest portion of that – about 40 percent – is produce, and 93 percent of the organic produce is fresh produce. However, organic fresh fruit and vegetable sales still accounted for less than 5 percent of total fresh produce sales. By 2010, sales of organic foods in the United States are estimated to hit \$23.8 billion or 3.5 percent of the total retail food market.

As countries develop economically and their populations become more educated and affluent, demand for organic products increases, as is starting to occur in China, Brazil and South Africa.

An Incentive to Export

The global increase in organic farmland, particularly in non-industrialized countries, is spurred on by farmers lured to the financial benefits of selling their organic goods elsewhere. For example, nearly all organically grown bananas, tropical fruits, citrus and grapes from

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Africa are destined for markets in the EU. Most organic production in Asian countries – primarily fresh produce – is also for export.

Latin America, with the second largest amount of organic farmland in the world, has only a small domestic market for organic products. About 90 percent of its organic crop – largely high quality fresh produce – is exported to North America and Europe.

In Australia, cattle farmers use much of the organic farmland as pasture, so organic beef as well as fruit and vegetables are largely exported. New Zealand is also export oriented, with 5 percent of its kiwi and about 10 percent of its apples and pears certified organic.

Healthy growth rates are expected to continue in the coming years, according to the International Federation of Organic Agriculture Movements, which suggests that the ever-growing demand for organic products offers attractive opportunities for producers – especially those in developing countries.

A Role for CA in Organics

Organic foods command premium pricing through each step of the food chain, resulting in greater profits for the grower, wholesaler and retailer, and higher prices for the consumer.

In a supermarket in the United States in February, organic bananas sold for \$1.79 a pound alongside regular bananas selling at \$0.49 a pound. Despite these higher prices, the number of people who purchase organic produce is growing and becoming more diverse, with consumers citing factors such as health, nutrition and support for the environment as reasons to buy.

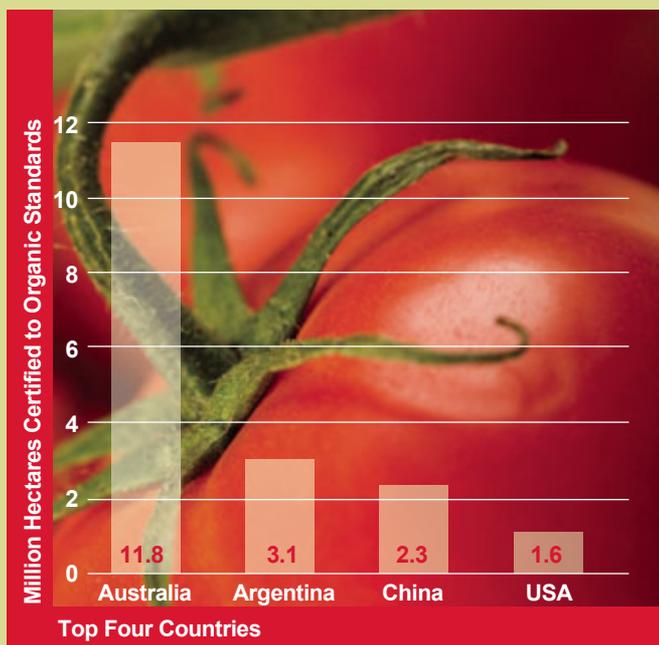
The appearance of fresh produce also matters to consumers, with the number of cosmetic defects affecting the likelihood of an organic product being purchased.

That creates a role for Controlled-Atmosphere (CA) refrigeration for the transport of organic cargoes, as it can slow down deterioration of appearance and flavor quality of fresh produce.

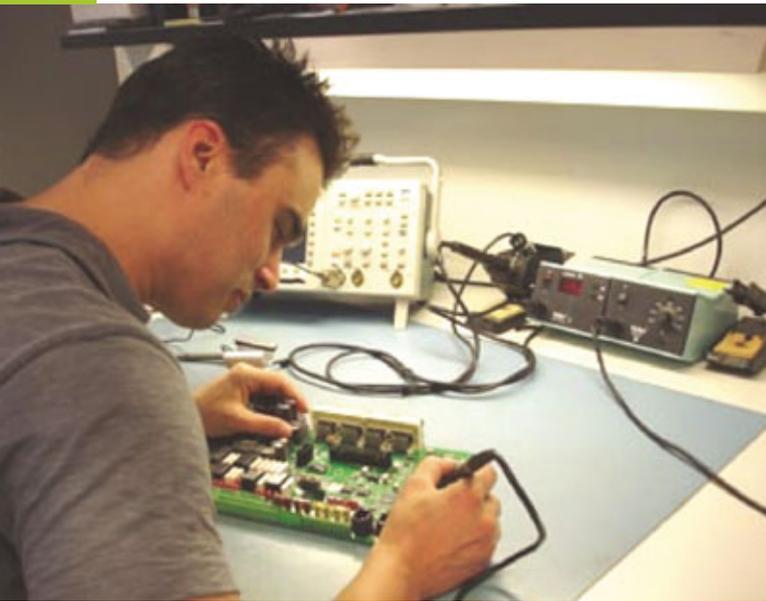
Helping organic produce to retain its chemical-free nature, CA can replace the need for certain post-harvest chemicals used for control of some physiological disorders, such as scald on apples, and eliminate the use of post-harvest fungicides and insecticides.

With so much at stake in terms of pricing premiums, CA can play a major role in assuring profitability of organic produce sales.

Land Committed to Organic Farming



Carrier Expands Electronics Services for Worldwide Coverage



You can never have too much of a good thing. That's certainly true with Carrier's Electronics Repair Operations.

The original world-class electronics repair and remanufacturing business, established only eight years ago as a single location in Rotterdam, The Netherlands, has expanded into three more strategic markets, and another is coming soon.

Started with a team of five technicians, the Rotterdam operation brought a higher standard of diagnostics and repair services for complex refrigeration unit controls. Integral to this, a "rebuild operation" enabled the creation of a substantial inventory of highly reliable refurbished boards, available at substantially lower prices than new.

The success of the operation necessitated expansion to support the global installed base through Carrier's worldwide parts depots and Carrier-authorized service centers. Since 2004, operations based on the successful European model were created in the United States, Brazil and Uruguay, supporting parts depots in North and South America. A future location in Asia will improve support to Pacific Rim ports and parts depots.

"Our customers' needs are global, so we've responded in a way that provides consistency of response worldwide," said Boudewijn Ligterink, Carrier's global manager of Electronics Repair Operations, who established the processes and practices for Rotterdam and has overseen the expansion.

"When we start a new facility like we did in Brazil, we copied the Rotterdam operation," he said, explaining that the paralleling of capabilities enables

consistent high standards wherever controls are serviced. "Everything is the same: the testing devices, tools, procedures, technology. Even the technicians are sent to Rotterdam for training. It's a duplicate."

From five in 1999 to 35 today, Carrier's repair technicians are among the most talented electronics engineers in the industry, according to Ligterink. Beyond their base education, technicians receive ongoing training into the diagnostics and repair of both Carrier's and competitive controllers, which are also serviced by Carrier.

As Good as the Original

For the highest level of reliability when it comes to replacing electronic components, Ligterink recommends that customers specify genuine Carrier rebuilt parts, which are easily identified by a special seal bearing the Carrier logo.

"No one knows our equipment better than we do. We have to make sure that it will run for many, many more years," he emphasized.

Ligterink notes that there is a significant difference between a part that has been repaired at a third-party facility and one that has been rebuilt through Carrier. When a part comes in to Carrier, a technician conducts a visual inspection for corrosion, cracks, and burn spots, and then cleans the board and replaces affected parts. But, unlike a third-party repair facility, Carrier also conducts a comprehensive diagnostic test of each electronic component on a controller – the microprocessor, relays, capacitors and all other components.

"In all cases we test using equipment of our own design," Ligterink said, adding that the testing needs to be more comprehensive than what is done for newly manufactured units. "We replace weak components and others that, based on repair histories, we know could cause a problem at some point in the future, even though they are performing adequately at the time. Hardware and software is brought up to OEM specifications. Most third-party repair shops simply aren't equipped to do that."

Because of the thorough work that goes into each rebuild, the reliability factor is as high as for new components, Ligterink explained. This is why Carrier's warranties for rebuilt and new are the same.

And, like the rebuilt components that come from them, each of Carrier's worldwide electronics repair centers is designed to perform just like the original.

Turn to the Expert Jeff Neuss

Performance Parts, Americas

No one understands the importance of using genuine Carrier Transicold replacement parts for Carrier equipment better than Jeff Neuss.

You would expect that from the Performance Parts Groups' business development manager for the Americas. However, his appreciation of quality components goes back to his earliest days with Carrier 25 years ago. Then, as a design draftsman, he helped bring parts off the drawing board and into reality.

For a time, he specialized as a design draftsman for Carrier Transicold's large bus products, but soon he moved into the field as a customer service manager/applications engineer. Eventually he became a field service engineer for Carrier's North American Intercity Bus business.

Building on his knowledge of product design and penchant for customer service, Neuss then became an instructor with Carrier's Customer Training team in 1999, teaching service technicians about maintaining the complete line of Carrier Transicold products, whether container, truck/trailer or bus.

Parts again became his focus in 2005, when he joined the Performance Parts organization as business development manager for the U.S. Northeast and Canada, a role that was expanded a year ago to include all of the Americas, but focused primarily on container products.

"This is a good fit for my background," Neuss added. "I know every product technically, plus I was out and about with our whole network of service centers and end-user customers for quite a few years."

From home base in Syracuse, N.Y., where he lives with his wife of 19 years and son, 14, and daughter, 12, he keeps track of parts depots in Oakland, Calif.; Panama; Santos, Brazil; Montevideo, Uruguay and San Antonio, Chile. While Performance Parts has over 50,000 components in the system, about 20,000 distinct parts are continuously replenished for container products, according to Neuss.

"For container products, I make sure the parts depots have the products to distribute," Neuss said, adding that he also manages relationships with major customers who maintain their own parts inventories. "The most important function that I have is ensuring that Carrier parts are available and being used on Carrier units," Neuss said.

"My technical background gives me an advantage over someone that might be a sales person at heart,



because I understand the parts and the market. I understand how parts are made. I can review processes that we use to rebuild or repair, and can give my input to the customer."

The explosive growth of the container industry, he noted, has led to new influences on the equipment owner. There has been a change in what customers look for in parts, frequently opting for readily available, lower-cost and often unproven gray-market replacement parts as a means of holding down maintenance and repair costs.

"Every company is looking very closely at their maintenance and repair costs. We understand that," he said. "The quality of our components is still superior. Carrier puts a lot of effort into qualifying our vendors and our parts to ensure that they are the highest quality.

"The Container business is a global industry, so we need to provide what customers want, whenever and wherever they need it. That's why we have so many parts depots and service centers. We're almost everywhere.

"Because of Carrier, I've seen 30 countries and have met many fantastic people around the world," he said. "I wouldn't have had that experience with any other company I considered when coming out of college."



Marcelo Gama, left, and two of his students.

In Brazil: Teaching the Next Generation of Refrigeration Specialists

Brazil's National Service of Industrial Learning is a unique network of trade and technical schools with a 65-years-long commitment to teaching.

Known locally as Servio Nacional de Aprendizagem Industrial or SENAI, this not-for-profit program helps develop and hone skills of the current and next generation of workers. Its diverse curriculum encompasses construction, mechanics, electronics, food and beverage, fashion and textiles, transportation and many other trades and professions. And, with Carrier's support, students at SENAI schools in the port city of Santos and the state capital, Sao Paulo, have access to hands-on training in basic refrigeration mechanics and refrigerated container operation.

Carrier's involvement began in 1997 with the donation of ThinLINE units to SENAI's Sao Paulo and Santos schools, which let SENAI broaden its mechanical refrigeration offerings to include container refrigeration.

Thanks to Carrier's continuing support and the dedication of SENAI instructors like Marcelo Gama, 1,000 students have completed the refrigeration programs over the past ten years, with no letup in sight. Enrollments for the courses remain full, due to Brazil's burgeoning export business.

"The growth expectation for refrigerated cargo exports is a minimum of 20 percent per year over the next four to five years," said Gama, himself a technician of 15 years who earned top honors studying container refrigeration through Carrier's training program. "In the local market,

there is a shortage of qualified refrigeration engineers, so we are helping to meet that need. It's a big job."

A Visionary Program

Since its founding in 1942, SENAI has taught more than 40 million students and has served as model for the creation of similar institutions in Venezuela, Chile, Argentina and Peru.

SENAI is organized and managed by industrial entrepreneurs through the Brazilian Confederation of Industry and state federations. There are more than 400 SENAI schools and another 300 mobile units offering 1,800 classes, serving a combined enrollment greater than 2.3 million a year.

As a private-public partnership, SENAI is financed by both tax revenue and the industrial sector, which also supplies products for study and practice. Courses are offered free of charge or at nominal rates and vary from a week, to several months to up to two years, depending on the nature of the program. Typically, students spend half their day in the SENAI classroom and half working as apprentices.

"It's a very well organized program," said Niels van den Bergh, Carrier's business development manager in Santos. "It's a give-and-take between industry and the students," he noted, explaining that industry reaps the benefit of employing SENAI apprentices. Carrier's Santos operation employs two electronic repair engineers and a warehouse manager who came via the SENAI program.

Refrigeration courses are scheduled every two months and consist of 30 hours of instruction covering principles of refrigeration, basics of electricity, reefer operational modes, humidification and dehumidification, controlled and modified atmosphere, and troubleshooting.

SENAI is broadening horizons for the workforce of Brazil, and with Carrier, it's broadening horizons for the refrigerated container shipping industry too!

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