Vol. 13 No. 4 November 2017 ₹ 100

Cooling India

India's foremost Monthly dedicated to the growth of HVACR Industry

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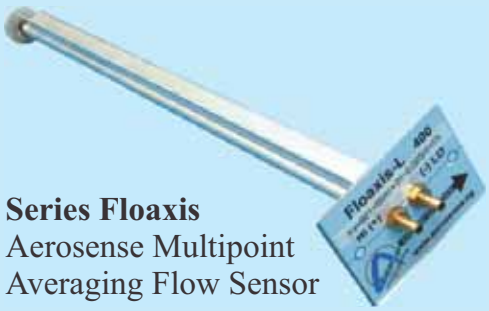

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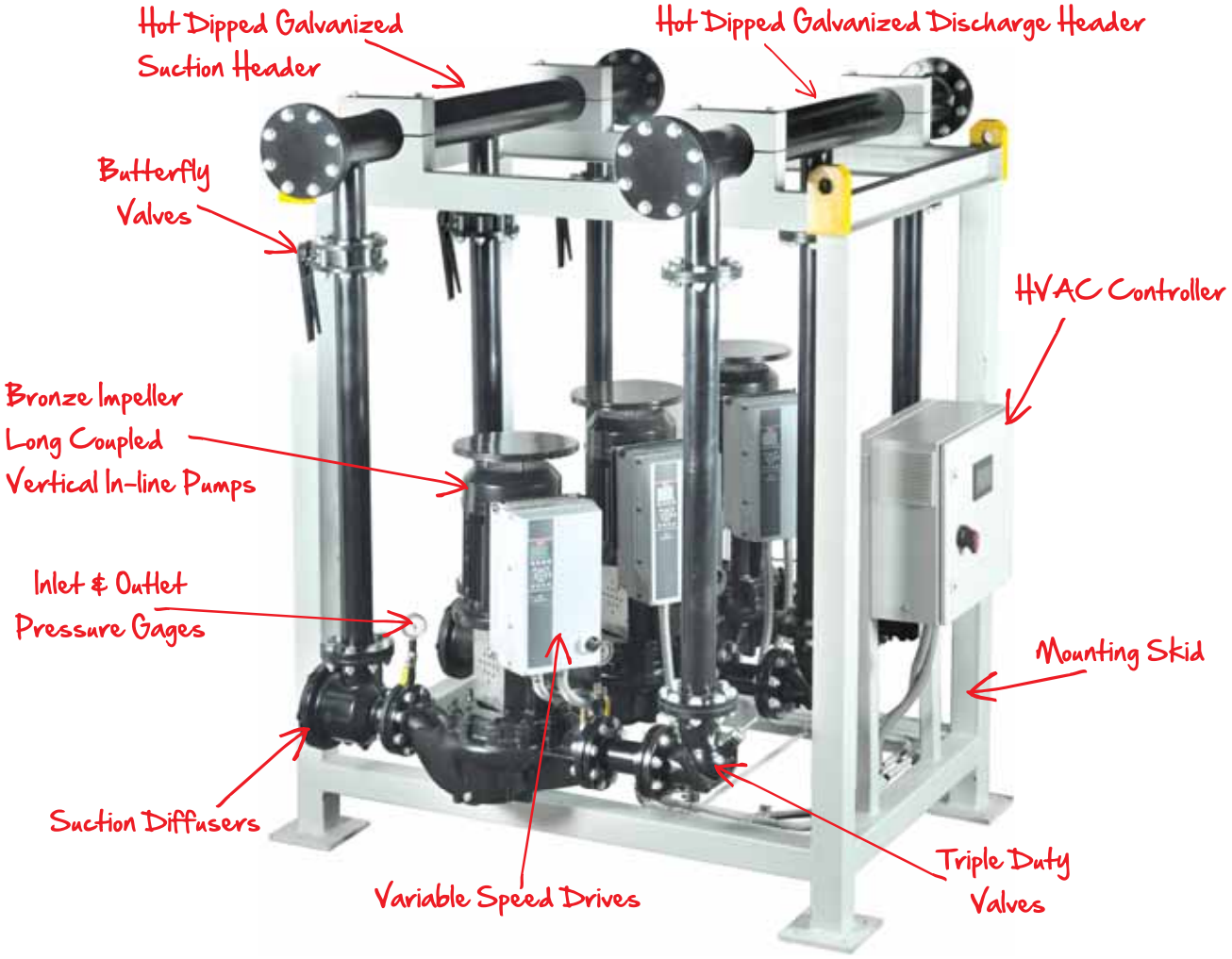

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Publisher's Letter

Hello and welcome once again to **Cooling India**, the country's only exclusive monthly magazine on the HVACR industry, now trending on top on the net. Over the past 150 years, after the invention of electricity, mankind has done every possible thing to cause maximum damage to the environment. Yes, due to the pressures of population and technology. We got too many new things in too little a time. This has been recognized, and governments have begun placing restraints on activities, causing excessive pollution.

The cooling industry added to the problem of pollution in the second half of the 21st century. Chlorofluorocarbons (CFCs), the main cause of pollution, were phased out by the Montreal Protocol. It was replaced by HCFs. Subsequently, the phase out of HCFs are underway and is being replaced by HFCs, which in-turn posed a new problem as they are potent greenhouse gases. This is going to be a never-ending problem. New products will be discovered for comfort and after some decades we may have to phase them out due to the damage that they cause to the environment.

So what is the solution? Whenever, we dispose of old regrigerators and ACs, we all should make sure that they are recycled properly This does not entirely solve the problem, but minimises to an extend. We could also choose refrigerators that use greenfreeze techonology and governments can also phase out HFCs as and when new alternatives are available.

There are many ways to reduce HFC leakage from existing ACs and refrigerators. New coolants are available that are both harmless to the ozone layer and don't warm the planet significantly. One promising class of alternatives are HFOs, or hydrofluoroolefins. Countries like the US and the European Union have come up with a number of regulations to seal the leaks from equipment and reduce HFC usage. We use cooling technology to reduce the heating. Just imagine, a 3°C rise in global average temperature will be good enough for our oceans to swallow many islands. Just 2°C increase will cause serious damage to our food supply. We need to do the balacing act of using technology and saving our planet. After all, there are huge benefits to lives from ACs and refrigeration. Modern world cannot even think of living without these. Environmental protection is everybody's responsibility at all national and international levels. It cannot only be decided at the Montreal Protocol. Hope you enjoy reading this issue. Do send in your suggestions or comments to me at pravita@charypublications.in.

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Contents

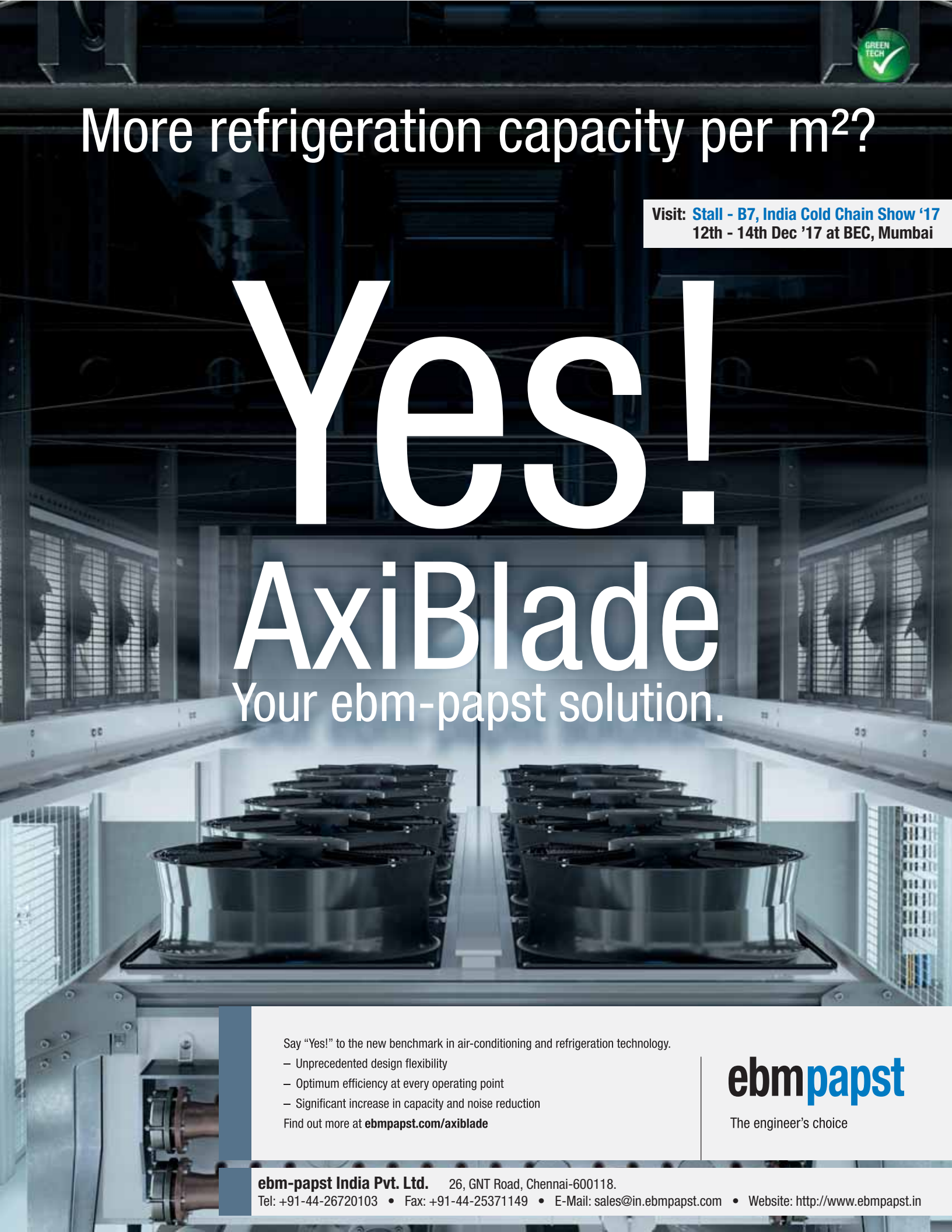
Vol. 13 No. 4 | November 2017

Articles

Features

Interviews

Departments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Ingersoll Rand to Acquire GPSi Holdings

Ingersoll-Rand, a world leader in creating comfortable, sustainable and efficient environments, announced that it has entered into an agreement to acquire GPSi Holdings, LLC from Falconhead Capital, LLC. This acquisition strengthens Ingersoll Rand's telematics portfolio, an important component of its connected technologies strategy. GPSi is a leading technology provider of cloud-based technology solutions for fleet managers in various transportation markets including education, golf and resorts. Its custom software solutions, combined with a high level of customer support, address diverse needs and are designed to increase productivity and maximize revenue opportunities for fleet owners. It

is headquartered in Sarasota, Fla. and has offices in Austin, Texas and East Sussex, England.

"As a leader in telematics, we are pleased to deepen our capabilities in delivering exceptional customer value and end user experience for Ingersoll Rand customers," said Dave Regnery, Executive Vice President of Ingersoll Rand. "With GPSi, we are well positioned to help customers maximize the value of their fleets, and to capitalize on the multi-billion dollar market for intelligent mobile assets across trucking, resort, golf, education, rental and other industries."

"We are proud of the growth and development of GPSi under our ownership," said David S Moross, Chairman and Chief Executive Officer of Falconhead Capital. ■

Blue Star Chooses PTC for Advanced Analytics

PTC announced that Blue Star Limited, India's leading air conditioning and commercial refrigeration company has selected the ThingWorx IoT Platform from PTC to monitor its factory operations to improve operational efficiency and factory quality. Blue Star Limited fulfills the cooling requirements of a large number of corporate, commercial as well as residential customers. The company also offers expertise in allied contracting activities such as electrical, plumbing, fire-fighting and industrial projects, in order to offer turnkey solutions apart from execution of specialized industrial projects.

The company's mainstay of product development and R&D has been energy efficiency coupled with eco-friendly and sustainable products. Blue Star was looking at improving its operational efficiency across its five modern manufacturing facilities in India. After an exhaustive due diligence process, during which various software vendors were evaluated, Blue Star Limited selected ThingWorx IoT Platform for its rapid application enablement, connectivity, machine learning capabilities, augmented reality, and integration with leading device cloud offerings. Speaking on the partnership with PTC, Suresh Iyer, Chief Information Officer, Blue Star Limited said, "We look forward to a long lasting partnership with PTC through implementation of PTC's ThingWorx IoT platform. We believe it will accelerate our transformation journey and improve operational efficiency of our factories in the country." Kalyan Sridhar, Country Manager, PTC India said, "Blue Star is constantly enhancing and transforming all its factories across India with latest technologies that improve various aspects of a manufacturing unit. We believe that the company will be able to utilize the latest Industry 4.0 technologies and significantly improve their productivity." ■

Chemours to Build Innovation Center at University of Delaware

The Chemours Company (Chemours) is pleased to announce it has entered into an agreement to build a state-of-the-art research and innovation facility on the University of Delaware's Science, Technology and Advanced Research (STAR) Campus. When fully operational, the project will establish a world-class innovation partnership and talent development pipeline between chemical industry leader Chemours and the University of Delaware. It will also keep 330 researcher and technician jobs in the Wilmington metro area. Construction on the new 312,000-square-foot facility, representing an investment of approximately USD 150 million, is expected to begin this year; plans call for it to be completed by early 2020. "Chemours wants to be the best in the world at using chemistry to develop products and applications that serve our customers' needs," said Chemours President and CEO Mark Vergnano, "and having a state-of-the-art innovation center and a long-term research partnership with the University of Delaware puts us in a stronger position to do just that."

"The University of Delaware is excited to welcome Chemours to the STAR Campus, where we are creating a bold future of innovation for our state and region," said UD President Dennis Assanis. "Not only will the University's students and faculty benefit from this vibrant new research partnership, but, together, we will be making our entire economy stronger and more resilient for years to come."

Delaware Governor John Carney was equally enthusiastic, "We work together well in Delaware, and this partnership between Chemours and our flagship university will help drive innovation in our state, prepare Delaware students to succeed, and pave the way for additional economic growth." ■

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Belimo HVAC sensors offer trusted reliability, easy installation, and seamless integration with major Building Automation Systems and are designed with an innovative screwless snap-on cover housing that allows for easy commissioning and provides NEMA 4X / IP65 protection. The new range includes accurate sensors for measuring temperature, humidity, pressure, CO_2, and VOC in pipe, duct, and outdoor applications. Belimo sensors provide the highest quality and are backed by world-class service and support.

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New Organizational Structure for Emerson

Emerson announced a new organizational structure for its Commercial & Residential Solutions business in Europe, designed to increase customer focus and support the company's transformation into a comprehensive global solution provider across all markets: from cold chain to residential and commercial buildings.

In 2015 Emerson started a strategic repositioning of its business by streamlining its five business platforms into two: Emerson

Automation Solutions and Emerson Commercial & Residential Solutions. With this repositioning, Emerson optimized its portfolio to focus on core business and competencies, thus enhancing growth and investment opportunities, and further strengthening its culture of innovation-driven product and solution development. "This organizational change is focused on aligning our European sales and marketing teams around core markets and channels," said Jean Janssen, President of Emerson Commercial & Residential Solutions Europe. "It keeps Emerson Commercial & Residential Solutions Europe consistent with Emerson's global strategic repositioning."

The new sales organization is led by Rainer Dietrich, Vice President of Sales for Europe, with the support of a team of long-time Emerson executives. ■

Panasonic Acquires Arimo

Panasonic announced that it has acquired Arimo, a Mountain View, California-based leader in deep learning and behavioral artificial intelligence (AI). Ranked among the ten most innovative companies in data science by Fast Company Magazine in 2016, Arimo is developing IoT-centric AI products for commercial and manufacturing applications, which supports Big Data and Deep Learning applications. Through this acquisition, Panasonic plans to leverage Arimo's data science expertise in solutions, it provides to its B2B customers (including manufacturers) as well as in the housing business.

Panasonic has developed the Panasonic Digital Platform, which aggregates and utilizes sensor data from factories, housing, cold-chain, and HVAC applications. By combining Arimo's strength in data science and especially predictive analytics, Panasonic plans to accelerate the growth of its AI/IoT-based solution business and further promote the company's digital transformation. "The acquisition of Arimo provides Panasonic with a much-needed core data science element that will greatly reinforce our efforts to continue developing further sophisticated AI-based solutions for our B2B customers," said Yoshiyuki Miyabe, Panasonic Corporation Chief Technology Officer. "We are very pleased to have Arimo founder Christopher Nguyen and his team of data scientists join us in this mission." ■

EVAPCO Acquires Alcoil to Create EVAPCO Alcoil

EVAPCO, an industry leading manufacturing company with global resources and solutions for worldwide heat transfer applications, announced that it has acquired Alcoil USA LLC, a York, Pennsylvania-based company that designs and manufactures micro-channel heat exchangers.

The newly formed EVAPCO Alcoil, Inc will pursue the same business that Alcoil has been pursuing and will operate from the existing Alcoil location. Alcoil has been dedicated to the manufacture, development, application and OEM support for brazed aluminum heat exchangers for the HVAC/R and industrial process industries worldwide. Heading up the newly formed company will be Vice President and General Manager John Kollasch. Kollasch is a 26-year EVAPCO employee with extensive coil experience in the HVAC and IR business segments. "I am excited to immediately infuse the talent that John can bring to EVAPCO Alcoil as we embark on the journey of transforming Alcoil into a manufacturing company with an 'Evapcoesque' level of lofty success," said EVAPCO President and CEO Bill Bartley. "Alcoil is an excellent strategic fit with the company and aligns well with our growth objectives. These heat exchangers are an essential part of our future growth profile and integrating this franchise into our portfolio will enable us to continue to innovate a full spectrum of global solutions worldwide."

EVAPCO provides a full spectrum of global product solutions for the commercial HVAC, industrial refrigeration, power generation and industrial process markets with 78 active patents on the market today. Headquartered in Taneytown, Maryland, EVAPCO products are engineered and manufactured in 24 locations in 10 countries and supplied through a sales network of more than 170 offices. ■

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Launch of Collaborative Clean Air Policy Centre

Along with its partners, TERI proudly announces the inception of Collaborative Clean Air Policy Centre (CCAPC), a new partnership among the Indian Institute of Technology Delhi, Sri Ramachandra University Chennai, University of California Berkeley, and The Energy and Resources Institute (TERI) Delhi.

UrbanEmissions.info, a credible information centre providing research, and analysis related to air pollution, serves as the Centre's knowledge partner. With its Secretariat housed at TERI, New Delhi, CCAPC will focus on comparing and evaluating policy options for dealing with India's health-damaging air pollution of all types, indoor, outdoor, rural, and urban. It will facilitate a platform for institutions to work together to make appropriate policy recommendations and provide actionable solutions to manage the problem.

By virtue of its nature of work, CCAPC will also work closely with but be independent of the Ministries of Health; Petroleum; New and Renewable Energy; and Environment, Forests and Climate Change, and Indian Council of Medical Research. Apart from publishing policy papers that will help enhance the understanding of air pollution management; the activities of CCAPC will also involve running a post-doctorate programme with mentorship across all four partner institutes. ■

SCHOTT Bags Gold in 2018 German Design Award

The hands-free glass door system SCHOTT Termofrost Smart Access has won over the judges for the 2018 German Design Award, an international competition run by the German Design Council, and received the Gold prize for its excellent product design in the 'Retail' category. Previously, at EuroShop in March 2017, SCHOTT was awarded the AIT (Architektur Innenarchitektur Technischer Ausbau) innovation award. Christian Köhler and Dietmar Nilles from SCHOTT are delighted to receive the award. Christian Köhler and Dietmar Nilles from SCHOTT are delighted to receive the award. Picture: SCHOTT

SCHOTT Termofrost® Smart Access doors for refrigerated cabinets open hands-free using motion detection sensors. Made entirely of glass with no frame, this virtually invisible door system provides shoppers a panoramic view of and easy access to products. In an effort to differentiate themselves from growing online retail outlets, supermarkets are investing in shop design concepts that create a feel-good atmosphere and provide exceptional customer experience. Product freshness and convenience are the two most important contributing factors, according to the EHI Retail Institute. Appealing product presentation in particular can set retail outlets apart from online retail.

With this in mind, SCHOTT and NOA Design developed a fridge door system of the future for the German supermarket chain REWE. "Our world is modernizing rapidly. Convenience, efficiency, customer experience and environmental friendliness all shape our day-to-day life, including how we shop", Michael Lammel, Managing Partner of NOA says. Christian Köhler from SCHOTT adds, "Unique store concepts help grocery store managers connect with their customers. Closed refrigerated cabinets will be an integral part of the food retail sector of the future since they save energy. Our automatic fridge door system goes even further. The added convenience and appealing design creates a new, positive customer experience." ■

Australia Ratifies Kigali

It becomes the 10th country to officially ratify the Amendment to the Montreal Protocol – half of what's needed for it to go into effect. Demonstrating continued early action by its government to commit to an HFC phase-down, Australia has become the 10th country to officially ratify the Kigali Amendment to the Montreal Protocol.

Australia's ratification status was confirmed by the Depositary at the United Nations Office of Legal Affairs, New York. This brings the global count halfway to the 20-country ratification minimum required for the Kigali Amendment to enter into force on 1 January, 2019. If that condition is not met by that date, the amendment will become effective on the 90th day following the date of ratification by the 20th party.

Last year, in October of 2016, Australia played a key role in co-chairing the negotiations for the Kigali Amendment. Since that time, Australia's government has been steadily moving forward with its own domestic HFC phase-down plan. On 30 March, the Government introduced a bill to amend the country's existing Ozone Protection and Synthetic Greenhouse Gas Management (OPSGGM) Act. The bill was passed on 19 June and requires Australia to begin phasing down HFC imports from 1 January 2018. The bill also brought the country's HFC phase-down schedule in line with the Kigali Amendment's phase-down steps and will allow Australia to achieve the Kigali target of an 85% reduction by 2036. No HFCs are manufactured in Australia itself. ■

THE EMERSON CUP 2017 — 10th ANNIVERSARY

CONGRATULATIONS
to all the Emerson Cup winners!

Thank you for making history with us.

The 10th year celebration of The Emerson Cup at Jaipur was truly historical. On display was a firebrand genre of creative excellence that won hearts all around. Also in evidence were the deep reservoirs of commitment and dedication that our supporters and well-wishers have bestowed on us, year after year.

We at The Emerson Cup, extend a heartfelt thank you to all – our participants, our judges, the industry, the people who have worked hard for making this journey memorable.

Most of all, a big thank you to our winners, who make The Emerson Cup what it is - a hub of creative brilliance.

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eNow Powers 'Rayfrigeration' Zero Emissions TRU

eNow has demonstrated the effectiveness of its solar energy producing systems for transportation by powering the first zero-emissions commercial-use Transport Refrigeration Unit (TRU) on a truck making deliveries in an urban environment. The new zero-emissions TRU, branded 'Rayfrigeration,' has been undergoing real-world testing in California's San Joaquin Valley. In the first five months of testing, emission reductions of 98% nitrous oxide, 86% carbon dioxide, and 97% particulate matter were achieved. TRUs are refrigeration units mounted on trucks and are traditionally powered by high-polluting, small diesel engines to provide the needed cooling to transport chilled products.

The Rayfrigeration TRU is the first-to-market battery powered unit for commercial use and was tested on a Challenge Dairy Class 7 truck delivering fresh dairy products throughout Fresno, CA. Designed to support medium-temperature refrigeration applications, the Rayfrigeration system employs two forms of energy storage: eutectic medium (cold plates) and a high-capacity auxiliary battery system. The cold plates and auxiliary batteries are initially charged from utility power delivered to the vehicle when plugged in overnight. When the truck is operated on a delivery route, power is provided by eNow's solar photovoltaic (PV) panels mounted on the truck's roof. eNow joined Johnson Refrigerated Truck Bodies, Emerson, and Challenge Dairy Products, Inc. in the summer-long trial in California's San Joaquin Valley.

The eNow team calculated that an average emission of CO2 over a four-day week with an average delivery day of 7.7 hours was reduced from 2,525 lbs/week to 159 lbs. Nitrous Oxide emissions were reduced from 7162 grams to 1. This is after adjusting for the emissions from the power plant supplying grid electricity that was used overnight. (Emissions from solar are 0.) ■

Greenbuild International Conference to be Held in Europe in 2018

Today, US Green Building Council (USGBC), creators of the LEED green building rating system, and Green Business Certification Inc (GBCI), announced that Greenbuild, the world renowned green building conference will be held in Europe in April 2018. The event will be held at the Radisson Blu Hotel in Berlin from 17-18 April and the call for proposals is now open at greenbuild.usgbc.org/europe.

Founded in 2002, Greenbuild brings together industry leaders, experts and frontline professionals dedicated to sustainable building, making it the ideal space to learn about groundbreaking green building products, services and technologies. Greenbuild offers two groundbreaking days of US and international speakers, invaluable networking opportunities, industry showcases and workshops on the LEED green building program. "The green building movement is driven by passionate individuals who are dedicated to creating healthier, more sustainable communities," said Mahesh Ramanujam, President and CEO, USGBC and GBCI. "There is no better place than Greenbuild to bring these passionate green building leaders together. Greenbuild Europe is an opportunity for us to come together and explore new opportunities to create a more sustainable built environment throughout the region."

The 2017 Greenbuild conference will be held in Boston, Mass. with more than 20,000 attendees expected and 500 exhibiting companies. Greenbuild also expanded to India and China this year. ■

Beijer Ref Acquires Refrigeration Wholesaler in South Africa

Beijer Ref AB has entered into an agreement to acquire the business of Tecsa (Pty) Ltd and its assets. The acquisition broadens the base in Southern Africa. Tecsa Pty Ltd, controlled by Westbrooke Investments and trading as TecsaReco, is a South African wholesaler that offers a wide range of products and brands within commercial and domestic refrigeration, air conditioning, and spare parts for domestic appliances. Beijer Ref acquires the company for a purchase price amounting to between SEK 255 and 300 million. The variable portion of the purchase price is dependent on TecsaReco's performance in the current financial year ending 28 February 2018.

Tecsa was originally founded in 1965 as a wholesaler of parts and accessories for household appliances. In 2013, Tecsa acquired Reco, a refrigeration and air conditioning wholesaler that started its operations in 1947. The company's headquarters are located in Johannesburg and its products are distributed through a number of branches, of which one is located in Namibia and one in Botswana. In total, TecsaReco has more than 300 employees and gross sales in 2016 amounted to approximately SEK 435 million. The company has a good track record and is profitable. The business will continue to be operated as a standalone business in its current form. Beijer Ref is previously present in South Africa through the wholly owned refrigeration wholesalers Eurocool and Metraclark.

"The acquisition is positive for several reasons," said Per Bertland, CEO of Beijer Ref. "Our product range is strengthened with complementary segments and brands. We also access new and well-established sales channels. Above all, Beijer Ref acquires a stronger footprint in a growing market with a population that is gradually increasing its income and purchasing ability. The opportunities to reach out with our own manufactured and more environmentally friendly products also increase significantly." ■

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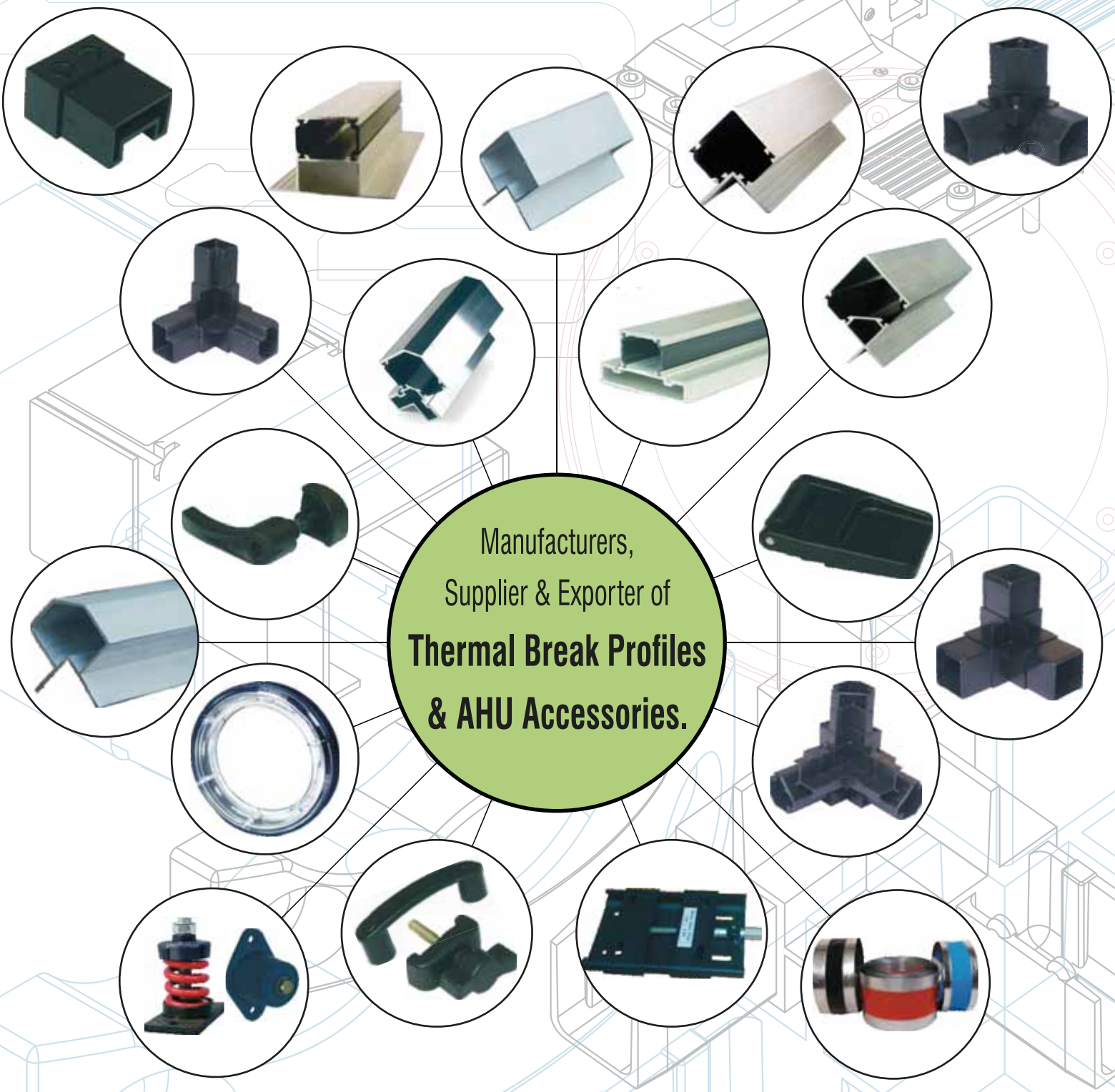

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Michael Anderton to head JC's Singapore Building Efficiency Division

Johnson Controls, the global leader in building technology and services, has appointed Michael Anderton to general manager and managing director of Building Efficiency in Singapore. A veteran with over 20 years of industry experience, Anderton will lead a team of over 600 professionals to deliver solutions for buildings to make them operationally and energy efficient, creating healthier and more productive environments.


Michael Anderton

As the industry's leading integrated smart green building systems, services and solutions provider, the Singapore operations under Anderton's leadership is able to provide a comprehensive life-cycle approach, spanning planning and design, installation, integration, optimization and maintenance. "With more than 100 years of track record in building technologies worldwide, Johnson Controls has become synonymous with smart green buildings. In line with the Singapore Government's vision to green 80 percent of all buildings by 2030, our Singapore team has been helping customers reduce energy consumption in buildings by up to 40 percent. This makes good financial sense too as payback is typically less than five years. At Johnson Controls Singapore, we will continue to build on our core competencies and innovate on two key areas to enhance the solutions we deliver for customers – integration of different building systems and more in-depth analytics of a building's operational and occupancy data. These will further improve building performance and energy efficiency," said Anderton. ■

AHRI Promotes Davidson Hood to General Counsel

The Air Conditioning, Heating, and Refrigeration Institute (AHRI) announced the promotion of Caroline Davidson-Hood to be the association's General Counsel, effective immediately.

Caroline joined AHRI in January 2015 as Associate General Counsel. Prior to joining AHRI, Caroline was an attorney at Washington law firm Patton Boggs from 2008 until 2013, when she joined Caterpillar, Inc as a Products Counsel.


Caroline Davidson-Hood

Prior to her work in the corporate world, Caroline spent a year as a wild land fire fighter in Lake Tahoe. "Our members and our industry have been well-served by Caroline's knowledge of the body of law associated with federal agencies and the legislative and regulatory processes, and we are happy to have the opportunity to recognize her substantial contributions with this promotion," said Stephen Yurek, AHRI President & CEO Caroline is a 2003 graduate of the University of California at Berkeley and a 2008 graduate of UC Berkeley School of Law. ■

Martin Lenz is Chairman of Eurovent's AHU Product Group

During their meeting of the Eurovent Association Product Group 'Air Handling Units' in Zoetermeer, Netherlands, members have elected Martin Lenz (TROX GmbH, Germany) as their Chairman and Andy Bijmans (Systemair B V, Netherlands) as their Vice-Chairman. The two take on their positions from Kees van Haperen (Rosenberg, Netherlands) and Gunnar Berg (Swegon, Sweden). Van Haperen had been leading the Product Group since 2002. Both of them had been active participants since the 1990s and now decided to pass their chairmanship on to a new generation. The Eurovent Product Group 'Air Handling Units' is the largest grouping in its product area worldwide, counting more than 100 manufacturers as members. The new Chairman, Martin Lenz, is Development Engineer at TROX GmbH and one of the Europe's leading experts in this product area. Andy Bijmans, the new Vice-Chairman, is Development Manager at Systemair B V Both look back at a long-term experience within the Product Group and Eurovent network as a whole. The outgoing Chairman, van


Incoming and outgoing (l to r): Kees van Haperen, Andy Bijmans, Martin Lenz and Gunnar Berg.

Haperen, told meeting participants, "It has been my honour leading this Product Group for close to 15 years, working together with all of you to making European AHU technology globally renowned in terms of quality, reliability and innovation. Over the years, we have achieved a lot and drafted widely applied standards and recommendations. Both Gunnar and myself are going to continue contributing to the Eurovent Product Group, now with focus on Life-Cycle Costs." ■

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Danfoss Recognizes Delfield with EnVisioneer of the Year Award

Danfoss has named Welbilt's brand Delfield, one of the largest custom stainless steel refrigeration equipment manufacturers in the world, the latest winner of its EnVisioneer of the Year award for its use of Danfoss controls to convert equipment to low-GWP, natural refrigerant while also significantly improving energy efficiency. Delfield offers a complete line-up of high-performance, high-quality refrigeration, fabrication, and serving systems for the food service industry. Its products ensure food safety and operational efficiency. Launched in 2010, the EnVisioneer of the Year award competition recognizes North American end users, municipalities, building owners, or original equipment manufacturers that have introduced a new product, opened a new facility, or invested in a building or system upgrade using Danfoss products or solutions to realize significant energy or environmental savings.

Delfield is utilizing Danfoss thermostatic expansion valves and electronic controls to optimize its foodservice refrigeration equipment. By integrating Danfoss technologies that enable more precise control and are approved for use with flammable refrigerants, Delfield recently converted its portfolio from R-404A, an HFC refrigerant, to R-290, a natural hydrocarbon

Delfield utilized Danfoss thermostatic expansion valves and refrigeration control technologies to re-engineer its equipment .

— reducing global warming potential by more than 99 percent, from 3,943 to 3. It also was able to lower refrigerant charge by 40-80 percent to reduce equipment footprint, and cut energy consumption by as much as 50 percent. "Danfoss applauds Delfield for its commitment to advancing the industry through environmentally-friendly, energy-efficient technologies," said John Galyen, president, Danfoss North America. The EnVisioneer of the Year award was presented on October 18 to Delfield's Darrel Walker, Vice President of Engineering; Jeremy Huhn, Staff Refrigeration Engineer; and Marcy Mathews, Director, Product Management, by Danfoss Sales Director John Carmack. ■

Trane Honors Crosstown Concourse with Energy Efficiency Leader Award

Trane, a leading global provider of indoor comfort systems, presented the Energy Efficiency Leader Award to Crosstown Concourse on October 9. The award recognizes the developers' outstanding commitment to best practices in energy efficiency and sustainability for the retrofit of a once-vacant 90-year-old former Sears building that is not only revitalizing the community around it, but reducing operational costs. For Crosstown Concourse, the driving force behind the project was creating a vertical urban village while improving operational sustainability and the financial performance of one of Memphis' most iconic properties. Crosstown Concourse is home to a collective of commercial, residential and retail partners including restaurants, health clinics, a charter high school, a contemporary art center, commercial offices and 265 residences.

"Crosstown Concourse represents the leadership in energy efficiency and sustainability that we recognize annually with the Energy Efficiency Leader Award," said Felix Wilson, Vice President at Trane. "By taking on what seemed to be an impossible task, the development underscores the impact that smart properties have in not only providing long term environmental, financial and facility benefits to those who live and work in the building, but the broader impact on Memphis and their commitment to communities." The Crosstown development team, with the support of multiple partners, approached the project with a vision to create opportunities to

Trane presented its Energy Efficiency Leader Award to Crosstown Concourse in recognition of developers for energy efficiency.

improve the overall efficiency of the building and the health and well-being of its inhabitants. The project exemplifies commitment to a sustainable future for Memphis. As a part of the ceremony, the company hosted a round table discussion with a variety of business leaders, all of whom had a hand in the redevelopment of Crosstown Concourse, including Commercial Advisors | Cushman & Wakefield, Crosstown Arts, Kemmons Wilson Companies, Looney Ricks Kiss, and OGCB, Inc.

The panelists discussed the vision for the community redevelopment initiative, the unique challenges of the project and best practices for implementing energy efficiency and sustainability when retrofitting older buildings. In addition to this discussion, Wilson presented the Energy Efficiency Leader Award to the companies mentioned above. Crosstown Concourse was selected as one of just three projects to receive the award in 2017. ■

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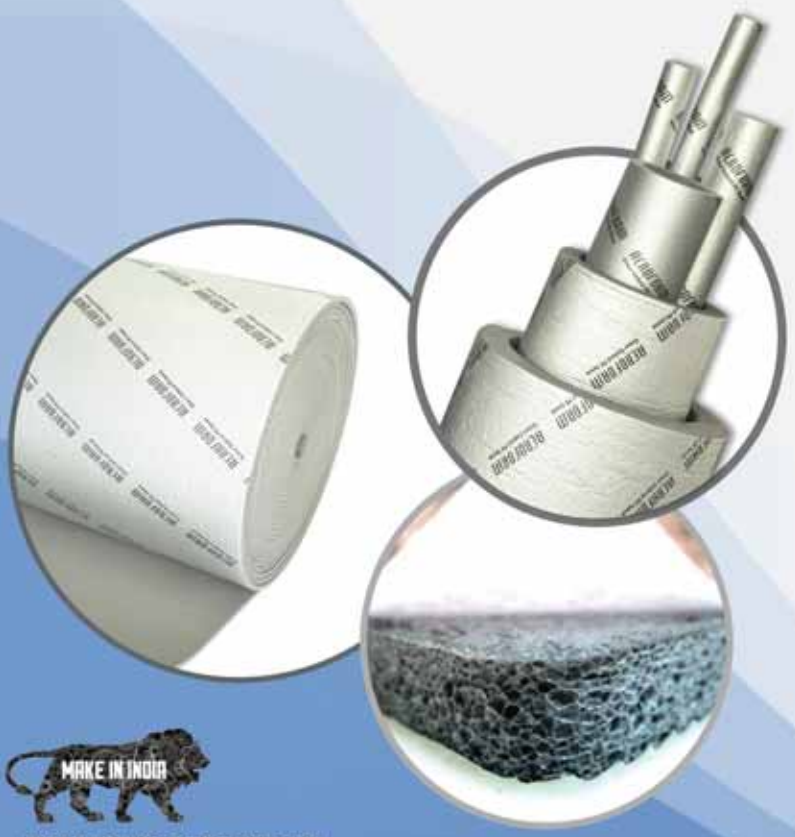

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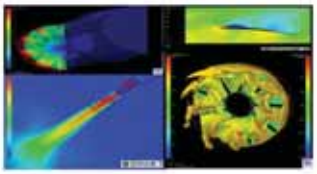

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Cold Chain Equipment Market to Reach $118.0 bn by 2020

According to Zion Market Research Report, global cold chain equipment market that was valued at USD 67 billion in 2014 is expected to reach USD 118 billion in 2020 and is anticipated to grow at a CAGR of 9.8% between 2015 and 2020...

Zion Market Research has published a new report titled 'Cold Chain Equipment Market (Storage and Transport) for Meat, Fish & Seafood, Dairy & Frozen Desserts, Vegetables & Fruits, Bakery & Confectionary and Others End-Uses: Global Industry Perspective, Comprehensive Analysis, Size, Share, Growth, Segment, Trends and Forecast, 2014 – 2020'. According to the report, global demand for cold chain equipment market was valued at USD 67 billion in 2014 is expected to reach USD 118 billion in 2020 and is anticipated to grow at a CAGR of 9.8% between 2015 and 2020.

The cold chain is an unbroken supply chain which exclusively serves storage and distribution facilities with a temperature-controlled range to extend and to help ensure the shelflife of products like vaccines, drugs, and chemicals. In cold chain process, the cold chain equipment is a vital entity of the supply chain. The cold chain equipment and vaccine carriers ensure the safety, efficiency or quality of the products distributed or transported.

The global cold chain market is primarily driven by the increased need to reduce food wastage across the globe. Secondly, the rapid growth of frozen food segment is expected to drive the cold chain equipment market. However, high installation cost coupled with stringent government policies and regulation is expected to hinder the growth of cold chain equipment market. Nonetheless, increased demand for food in emerging countries is likely to open new avenues for cold chain equipment market in near future. Storage equipment segment dominated the cold chain equipment market in 2014, which accounted for more than 50.0% share of the global market. Storage equipment is followed by transport equipment segment of the market in 2014. Moreover, storage equipment is expected to continue this trend during the coming years due to growing need of storage equipment to fulfill the increasing demand for food coupled with strong demand for frozen food across the globe.

Based on the end-uses segment, the global cold chain equipment market was dominated by meat, fish, and seafood segment. It accounted over 35 % share of the entire revenue generated in 2014. Furthermore, it is also expected to remain to prolong segment owing to the robust demand for meat, fish, and seafood on the global basis. Moreover, dairy and frozen dessert is another important outlet that is expected to witness the significant growth in near future.

Asia Pacific is expected to be one of the fastest growing regional markets for cold chain equipment market within the forecast period. This market growth is expected to be driven by the increase in the deployment of cold chain management in India and China. Thus, the increased demand for cold chain logistics in emerging economies is one of the major trends that are expected to contribute to the growth of the global cold chain market during the years to come. ■

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Reaching Sustainability Goals

Green Business Certification Inc partners with star communities to help cities, communities reach sustainability goals...

Green Business Certification (GBCI), the premier organization independently recognizing excellence in green business performance and practice globally, announced a new partnership with STAR Communities to address the needs of cities and communities around the world seeking a consistent framework for advancing sustainability. Modeled after LEED, the world's most widely used green building program, the STAR Community Rating System (STAR) was built by and for local governments and released as a pilot in 2012. Currently, there are nearly 70 communities across the US certified through the program, including large cities like Houston, Texas, Phoenix, Ariz, and Columbus, Ohio; and smaller places like Northampton, Mass., Monroe County, Fla., and Dubuque, Iowa. The goal is to integrate STAR into LEED for Communities and Cities in the near term to advance sustainable cities worldwide. LEED for Cities and LEED for Communities help communities and cities set goals, and implement sustainability strategies and plans to maintain and support these goals. The city or community then shares performance data to measure and track progress toward those goals.

"Local government leaders around the world have committed to pursuing strategies that have the ability to drive action and ensure a more sustainable future for us all," said Mahesh Ramanujam, President and CEO, GBCI and US Green Building Council (USGBC), the creators of LEED. "GBCI and STAR Communities are joining forces to deliver the most comprehensive program for cities and communities that will not only set them on a more sustainable path, but enable them to focus on and track performance and milestones."

"Over the past five years, we have worked closely with local leaders and sustainability practitioners to deliver a framework and certification program that drives more effective, inclusive decision-making and results in more livable, resilient and just communities," said Hilari Varnadore, Executive Director, STAR Communities. "The opportunity to work with GBCI and sister organizations USGBC and Arc will enable STAR to scale and serve as a catalyst and transformative tool toward more sustainable communities in the U.S. and beyond."

In partnership, the organizations will endeavor to accelerate adoption of standards, strategies, and performance metrics that help foster market transformation and enhance environmental, economic and social outcomes across global cities and communities. ■

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HVAC Requirements of NBC 2016

The NBC has been revised twice since it was introduced – first in 1983 and then in 2005. The latest revision NBC 2016 was released on 15 March 2017 and reflects the changes that the building sector has undergone since the last revision in 2005. There are a number of changes that have been incorporated in the NBC 2016 that are related to the HVAC sector and these are elaborated in this article...

The National Building Code (NBC) was first promulgated by the Bureau of India Standards in 1970. The NBC is for adoption by government and private sector and covers administrative regulations, controls rules and building guidelines. The NBC is typically known in the building services sector for the fire prevention and protection systems requirements listed out in Part IV – Fire and Life Safety. The NBC, however, covers the entire spectrum of building construction and operations through the 12 sections (11 Sections till NBC 2005) which are split into two volumes.

The NBC has been revised twice since it was introduced – first in 1983 and then in 2005. The latest revision NBC 2016 was released on 15 March 2017 and reflects the changes that the building sector has undergone since the last revision in 2005. There are a number of changes that have been incorporated in the NBC 2016 that are related to the HVAC sector and these are elaborated in this article.

Overview of the National Building Code

The NBC is divided into 12 sections, totaling into 33 chapters. Table 1 lists the sections and sub sections of NBC 2016. The code has linkages to the various Indian Standards and the sections are interlinked to provide a comprehensive approach to the various aspects of the building sector. The NBC has been designed in such a way as to

Table 1: Overview of NBC 2016 Sections

NBC Part	Area of coverage	Sub Sections
Volume 1		
Part 0	Integrated approach - a pre-requisite for applying the provisions of the code	
Part 1	Definations	
Part 2	Administration	
Part 3	Development controls rules and general building requirements	
Part 4	Fire and Life Safety	
Part 5	Building materials	
Part 6	Tructural design	Subsections on Loads, Design, different materials - Timber, Bamboo etc.
Volume 2		
Part 7	Construction management, practices and Safety	
Part 8	Building services	Covered in 6 sub sections. Sub section 3 relates to Air Conditioning, Heating and Mechanical Ventilation
Part 9	Plumbing services (including solid waste management)	Divided into 4 sub sections
Part 10	Landscape development, signs and outdoor display structures	2 sections, one for each area
Part 11	Approach to Sustainability	
Part 12	Asset and Facility Management	New Section in NBC 2016

be a single source of regulatory and good practices requirements which local municipal and government agencies can refer to as well as specify. There is a high focus on building for life safety of the occupants and public and specifies. Key sections that relate to HVAC in the code are:

– Part 8, Sub Section 3 which deals with air conditioning, heating and mechanical ventilation. This section covers various aspects, from design, noise and vibration, coverage of various types of air conditioning systems, energy conservation and installation or commissioning.
– Part 12 – Asset and Facility Management. This is a new section added that has been added to reflect the growing importance of this part in the overall building lifecycle.

Key Requirements of Part 8, Section 3 of NBC 2016

This section specifically deals with HVAC requirements of buildings. Table 2 lists the main areas that are addressed in this chapter of NBC. The various sections address design aspects, installation and operational aspects of air conditioning systems and components. The code lists the guidelines that the designers can use to develop optimal HVAC solutions. Different air conditioning equipment have different design requirements and the code addresses both unitary and central plant type of systems.

An important section that can greatly asset in the later life of the HVAC systems is the section on color codes and identification systems. Since the life of the plant is typically 10 – 15 years, if the original installation follows the color schemes and identification methodologies as listed down in the code, it will be relatively easier for the operations team to maintain the systems. Additionally, retrofits to the piping and pumping systems will be easier as system components are identified in a universal manner.

The section on installation, commissioning and testing is also an important one as it lays down steps to follow for new and retrofit installations. This is an area that is often neglected in commercial building applications as the full load is not available at the building go live stage. This section also lists down the approach to take for handing over of the plant to the O&M team.

Overview of Section 12 – Asset & Facility Management (FM)

NBC 2016 has introduced a new section on asset and facility management – Section 12. There has been an explosion of the building stock in India with nearly 500 million square feet of office grade A building already in existence. There is another 2 – 3 billion square feet of project space that is registered under various green rating systems which will come up for occupation in the next five – seven years. While the number of buildings has increased exponentially in the past decade or so, there has not been a high level of upkeep of the assets in the buildings as well as the building structure as a whole. Apart from a few large developers, most building owners are not investing enough for building upkeep, leading to in efficient systems and equipment's poor utilization of the assets and unsafe work spaces.

Even in the case of buildings that are designed and constructed to the highest standards, poor maintenance practices or lack of basic knowledge of maintenance reduces both life as well as returns on the building for the owners. Keeping these issues in mind, the NBC selection committee introduced the section on asset and facility maintenance. The section covers the following key areas:

- Scope and Terminology
- General aspects of asset, facility management, organizational structure for delivery, procurement of FM services
- Building component and systems maintenance
  – Fabric, Plumbing, HVAC, Firefighting, electrical systems, elevators, roads etc.

Table 2: Contents of Section 8, Sub Section 3

Sub Section	Contents
1	Scope
2	Terminology
3	Planning Design Criteria
4	Design of Air Conditioning
5	Noise and Vibration Control
6	Mechanical ventilation for non air-conditioned area ad evaporative cooling
7	Unitary Air conditioners
8	Split air conditioner
9	Packaged air conditioner
10	Heating
11	Symbols, Units Colour code and identification of services
12	Energy conservation, energy management, automatic controls and building management systems
13	Inseption, commissioning and testing

- Health and safety
- Soft Services
  - Landscaping, housekeeping, pest control, security etc.
- Solid waste management
- Building management systems

HVAC Requirements in Section 12

High level of HVAC system maintained is essential to enhance the life of the asset as well as to keep the operating costs associated with the air conditioning unit at an optimal level. Good operating practices help to improve the system performance and reduce breakdowns. The key components that the code covers are:

- Individual units
- Plants and Pumps
- Ducts, grills etc.
- Smoke extraction systems
- Fire dampers

Operation of Central Plants

The code specifies the sequence of starting the plants to obtain best efficiency – AHU, chilled water pump, cooling tower, condenser pumps and then the chiller. Chilled water set point should be as per design and can be increased by 1-3 degrees in winters or at night when loads are less. The code recommends room temperature to be set between 24 – 25.4 degree and provision of individual thermostat for local adjustments. The cooling tower water should have a hardness of below 500 ppm and the water quality shoulder be assessed by an external lab once a month.

Building Management Systems

Modern air conditioning plants have advanced chiller management software which is also integrated to the building management system for data management. Code advices that plant monitoring is undertaken through a building management system for continuous monitoring. The BMS system should be used to carry out quarterly and annual calibration of the system as well as to carry out measurement and verification of the plant's capacity and efficiency. Where the BMS system can log system parameters automatically, the O&M team should carry out a verification of data of the automated system with the manual readings at least one a month.

Conclusion

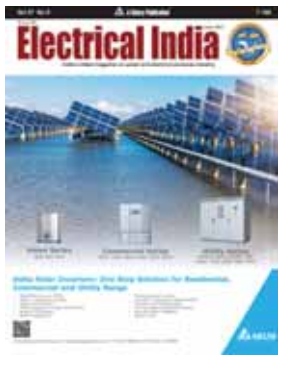
The National Building Code is a reference guide for both construction and operations and maintenance of buildings. The NBC has traditionally been seen as a document that gives guidelines on new construction and the design aspects of new buildings. There is, however, an important area that was left out in earlier version of the code - that of operations and maintenance of assets and the facility. Section 12 of NBC 2016 has been introduced to address this gap and has been developed by facility managers and building owners. This section has details of the design and structure of the asset and facility management organization in a building. HVAC is covered separately in Section 12 due to its criticality and functionality. It is expected that as the building services sector develops and develops, O&M and Asset or Facility management practices will also develop leading to better utilization of the assets and more efficient operations. ■

Aneesh Kadyan
Sr Director - Operations, for a leading real estate services firm, heads the operations of a large team of professionals in the building and facility management arena

Vinod Rekhi is New President of AIACRA

Vinod Rekhi has taken over as President of All India Air Conditioning & Refrigeration Association for the year 2017-19. AIACRA was incorporated in early Sixties, Ahmed Fazalbhoy being first president for 1961-63. AIACRA was started as all India body with regional associations at Mumbai, New Delhi, Chennai and Kolkata as part of the association to take care of interests of Indian HVAC&R industry. Later, TCRDA, Secunderabad also became member of AIACRA. In the past senior executives of leading companies like Voltas, Blue Star, Frick and Fedders Lloyd were holding the position of President of this association. AIACRA has MoU with world's many leading associations of HVAC&R industry including associations of China, Turkey, Korea and Australia.

From last many years, association is taking delegation to China Refrigeration Show in Shanghai or Beijing. Vinod Rekhi is 14th President of the association taking from Rajendra Mittal. Rekhi is Senior Consultant in India for Embraco, Brazil – World's number one company for FHP compressors, having plants in Brazil, Mexico, China, Italy and Slovakia. He is Director with Synergy Business Pvt Ltd and Managing Partner of Smart Marketing. During 40 years of his carrier in Indian HVAC&R industry, he was holding positions of Executive Directors with Danfoss (India) Ltd (Later Indfoss Industry) and Managing Director of Patton Refrigeration Indian Pvt Ltd. ■



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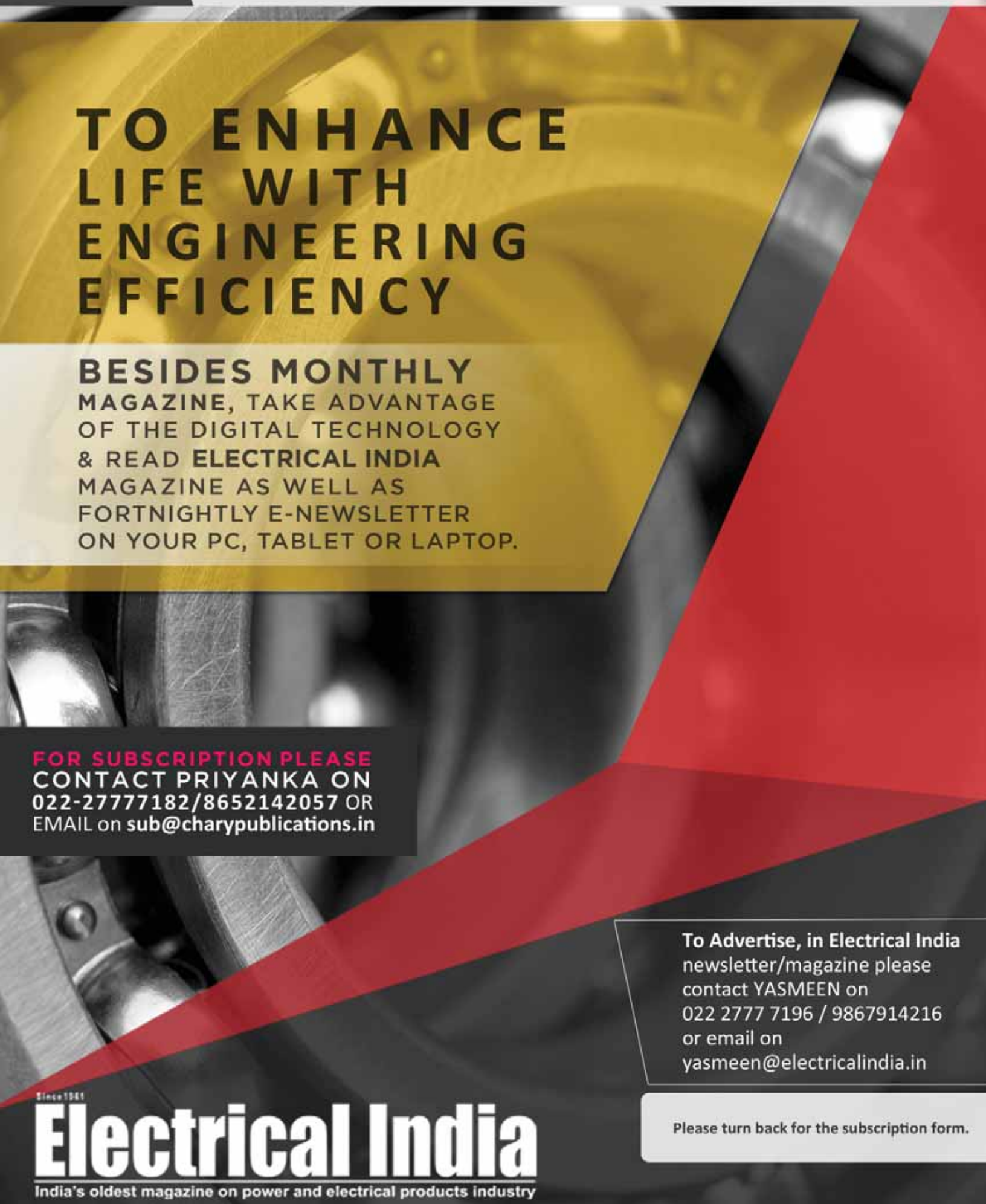

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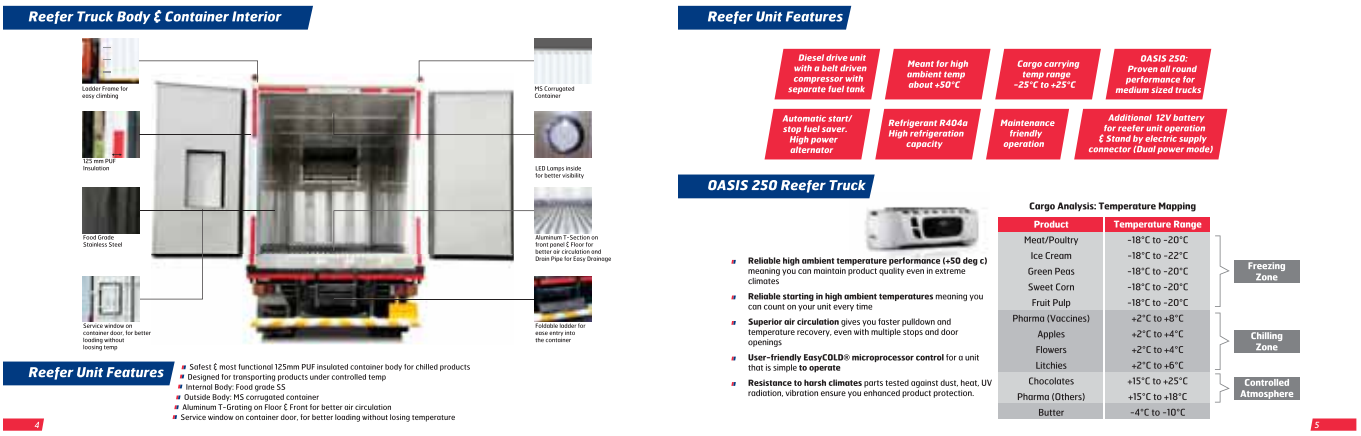
Please take us through on your reefer truck and container business.

With the ambition of strengthening our presence in the cold chain logistics segment, Eicher Trucks & Buses introduced next generation series of reefer trucks in the Pro 1000 and Pro 6000 category, which are amongst the most profitable products from the Eicher Pro range. These include - introduction of Pro 1059XP reefer, Pro1110XP reefer & Pro6025 reefer. With the launch of this series, Eicher is already providing fully built and ready to use solutions for cold chain logistics.

Eicher Pro refrigerated trucks are designed to keep the products fresh and can be used for varied applications. They have the highest rated payload in this category, robust and rugged aggregates that ensure high reliability, durability and cabin with superior driving comfort, while retaining best in class fuel efficiency, vehicle lifetime profitability & easy aftermarket support & warranty. Aptly known as the ‘Mileage Ka Badshah’, the Eicher Pro 1000 reefer series ensures high profitability and prosperity for its owner, with the benefits of earning from day one of the purchase. In this category, Eicher has Pro 1059XP reefer truck (7.2T GVW) and Pro 1110XP reefer truck (13T GVW). There is also the Eicher Pro 6000 reefer series, that includes Pro 6025 Reefer truck (25T GVW).

What are USPs of Eicher reefer containers?

The Eicher reefer trucks are India’s first highly fuel efficient Pro reefer truck series with best in class vehicle lifetime profitability and easy aftermarket support & warranty.



Following are its key USPs:

Technologically finest

- Light weight container: Safest & most functional 125mm PUF insulated container body for frozen & chilled products
- Longer temperature retention: Can carry between the temperature range of -25°C to +25°C at a high ambient temperature of +50°C
- Efficient oasis 250 reefer unit, renowned Surakasha P containers
- LED lamps inside the container for better visibility
- Foldable ladder for easy entry inside the container
- Drain pipe for easy drainage
- Service window on container door for better loading without losing the temperature
- Separate fuel tank for refrigeration unit – 60 litres, first in the industry

Easy aftermarket support and warranty

One stop warranty & service solution: 2 year warranty on reefer unit & 3 year warranty on reefer container

Easy Finance on completely built unit

Single Invoice and Easy finance on complete truck

Best in Class Vehicle lifetime Profitability

- Additional 12V battery for reefer unit operation & standby electric supply connector (Dual power mode)
- Low pull down time

OEM tested and OEM build quality

- ARAI regulated container from ISO certified vendor

What according to you are the key growth-drivers for the reefer segment?

- Improvement in road infrastructure and network will allow free movement of goods
- GST will smoothen logistics and overall transportation across the country leading to seamless and rapid movement of goods from the place of produce to the point of consumption (the classic "farm to fork" concept) with minimal wastage.
- Technological advancements to improve the cold chain supply chain of perishable food during transportation will drive demand for reefer trucks that can withstand more extreme temperatures.
- Increasing consumption of processed or frozen foods in more & more cities (with rising disposable incomes) besides a larger populace eating out at QSRs (Quick Service Restaurants) as well as rapid growth of organized retail or grocery chains.

What is the manufacturing capacity of reefer trucks, containers of Eicher? With the Government of India's initiative of 'Make in India', do you have expansion plans for the manufacturing of reefer trucks?

Eicher is committed to bring in products and fully built applications of relevant modernization in respect of reefers in the commercial vehicle industry. In keeping with this, Reefer trucks for a variety of industry segments like fruits & vegetables, ice cream, meat, pharma, processed food, dairy products and fish are part of our product plan. The reefers are developed and manufactured following a process of co-creation with customers and body building specialists.

Increasing consumption of processed or frozen foods in more & more cities (with rising disposable incomes) besides a larger populace eating out at QSRs (Quick Service Restaurants) as well as rapid growth of organized retail or grocery chains.

What government incentives and steps do you think are needed to improve cold chain transport in the country?

The government, both central and several state governments under the aegis of Ministry of Food Processing Industries have facilitated policies that encourages all stakeholders (farmers, processors & retailers) to come together and have addressed their key business drivers through capital investment subsidies for processing centers, reefer vehicles etc. A wider communication of this will help proliferation of reefer trucks. ■

Recent Trends in Cold Chain Logistics

Many innovative cold chain transportation solution, strengthened by cutting edge technology and a vast fleet of refrigerated vehicles equipped with advanced climate-control systems ensures that perishable products are delivered in a fresh, healthy and potent state to retailers and end consumers. These cold chain supplies specialize in frozen or chilled storages, transportation, warehousing, and distribution of logistics services for fresh reefer...

Advances in Cold Chain Transportation

A cold chain is a temperature-controlled and an uninterrupted supply of refrigerated production, storage and distribution activities, along with associated equipment and logistics, which maintain a desired low-temperature range. In India, there are a number of government and private run long, well tested or trusted and successful cold chain supplies in the cold chain distribution business all over the country for end-to-end cold chain solutions. These cold chains always offer customized solutions for temperature sensitive shipments including consumer foods, pharmaceuticals, retail and agri-food sectors. The product segments which are generally catered through cold chain transportation include ice-cream, dairy products including butter and cheese, poultry and meat, sea food, ready-to-eat or ready-to-cook food products, confectioneries including chocolate and baked products, fruits and vegetables, healthcare and pharmaceutical products and industrial products such as photo-imaging, films, rubber used for manufacturing of tyre.

Many innovative cold chain transportation solution, strengthened by cutting edge technology and a vast fleet of refrigerated vehicles equipped with advanced climate-control system ensures that perishable products are delivered in a fresh, healthy and potent state to retailers and end consumers. These cold chain supplies specialize in frozen or chilled storages, transportation, warehousing, and distribution of logistics services for fresh reefer commodities, offering worldwide ocean freight services providing secure, sanitary transport by the highest quality refrigerated or frozen carriers for timely deliveries and greater product safety along with shortened delivery times which increase product shelf life. To achieve all this, there is a need maintain high level of automation like data logger or sensors etc to ensure process follow up and managing crisis in well – defined manner alongwith services like

stock control, cold storage with palletizing, sorting, labeling and re-packing.

Cold chain transportation companies are serving the chemical, petrochemical, polymer, biofuels, life science and food ingredient sectors across commodity, intermediate, and specialty chemical supply chains. There is a need to understand the distribution environment first and then to identify which transport modes will deliver the products to their destination and determine the required regulatory steps. Cold chain logistics delivers integrated solutions to industries competing to thrive in today's global, rapidly evolving world where science and technology intersect. Shipping hazardous materials require more attention to detail than transporting regular goods, answering the unique challenges of these sectors is another required strength. Proper packaging is a key to the safe transport of hazardous materials. Leaking hazmat packages can pose serious risks to the safety of transportation workers and to the environment. Using suitable containers, sufficient cushioning, absorbent materials, and secure closures will keep hazmat where it belongs—inside the package. There is a need to pay special attention to the complex requirements which govern each transportation mode, and the rules may vary in different locations. Along with temperature controlled logistics services, there is a need towards an ability to service customers as:

1) Distribution Centers
   - Easy assembling and distributing to all outlets
2) Port Facilities
   - Network should include facilities near key port terminals
   - Offering storage and other value-added services at strategic locations
3) Customer Dedicated Facilities
   - Leadership in developing operations to manage complex distribution programs
   - Dedicated warehouse operations providing: capital management, labor, and systems for distribution needs
   - Multi-temperature ranges (ranging from ambient to chilled and frozen i.e. +20 ºC to -25 ºC)
   - Customer attached facilities that offer storage and service on-site

Recent Trends in Cold Chain Logistics

In delivering fresh food into communities all over the country, cold chain logistics are a big component of how food distributors provide services. Having the right technology and fleets of refrigerated and freezer trucks allow the central wholesalers to deliver all sorts of fresh foods to places that would otherwise have a lot less choice in what gets to the dinner table. These days, cold chain logistics is part of a dynamic industry. The work of bringing refrigerated and frozen foods to stores takes place amid many changes in consumer trends, as well as changes in how these processes are regulated and how market standards affect operations. In various ways, companies are figuring out how to more effectively control the product. In some cases, it starts with looking at how foods are sensitive to temperatures, and specifically how to handle a certain kind of food, whether it's fish, red meat, vegetables or processed entrées. Companies are innovating in their labeling processes, in quick shipping strategies, and in computer assisted distribution and market models that are helping them to keep sensitive foods at more consistent temperature levels and reduce transit times. That's all leading to a real sophistication and advanced method in which food distributors get the raw materials through the supply chain and to local stores.

The primary transportation generally facilitates inter-city transport of products with services including door to door service and secondary transportation means the last mile distribution, supplying, amongst others, retail outlets, restaurants and the hotels. Each transportation vehicle should be equipped with a data logger to ensure continuous monitoring of temperature and global positioning system (GPS) enabled for real time tracking. The data logger and the GPS enable to provide customers with real-time information about the cargo even when in transit. Further, the data logger enables to ensure that the prescribed temperature is maintained to ensure that the quality of the temperature sensitive products is not compromised. In addition to the regular warehousing and distribution, there is a need to provide value added services to customers with value added services such as kitting, labelling, sorting, stuffing and de-stuffing of containers, repacking and bulk breaking. The heat is on food and pharma companies to keep refrigerated freight frosty. With its capital-intensive equipment, strict temperature requirements, and energy dependence, the cold chain has always been a demanding logistics segment. Now, the sector is grappling with additional challenges—from increases in the sensitivity, quality standards, and volume of many of its goods, to continually mounting regulations. The cold chain also faces many of the same issues challenging the entire supply chain: serving the global market, driving out costs, becoming more strategic, and addressing capacity and resource constraints, all while managing the exacting needs of the sector's precious cargo—primarily food and pharmaceutical products. Here are trends impacting the cold chain, and some strategies manufacturers and logistics service providers use to adapt and thrive.

Globalization of Cold Chains

Increasing interest in healthy food, and a growing middle class in different locations all over the world are pushing cold chains to globalize. Consumers now demand higher-end products that must travel extended distances and ship quickly to ensure freshness and quality. Food is traveling around the world as more manufacturers manage their supply chains globally. The manufacturing plants are becoming more specialized to a specific product or label, and they ship their goods more widely. Demand for fresh food is growing, and that requires increased innovation to overcome capacity and infrastructure constraints, and mitigate disruption risks to ensure quality delivery. Meeting these demands without driving up

inventory or cost places added pressure on each element of the supply chain. In pharmaceuticals, added product specialization and sensitivity means they are more often being shipped globally to reach their markets. Logistics practices must comply with each country's regulations and maintain the strictest requirements, driving many drug makers to raise practices across their supply chain with concerns about maintaining control of products in transit.

Focus on Quality and Product Sensitivity

In the food industry, the big trend is an increased focus on quality, health, and integrity. To win the repeat business of fickle and demanding consumers, manufacturers must ensure an optimal experience with the brand. For cold chain products, that means avoiding the changes in texture and taste that occur when a shipment strays outside recommended temperatures, as well as decreasing the amount of processing for proteins such as fish. More premium products are coming into the market with a shorter shelf life, greater sensitivity to temperature, and a much different level of demand. This intensified focus on quality and the consumer experience means refrigerated warehouses across the food cold chain must maintain as many as five different temperature zones. Pharmaceutical manufacturers, too, are dealing with more sensitive products, such as customized treatments for rare diseases. These products often include more high-value active ingredients that offer shorter shelf lives and carry strict temperature requirements. Many drugs must be maintained at temperatures lower than 77 degrees F, while some require 35 to 46 degree cold chain transportation. Another fast-growing drug category is controlled room temperature. These drugs are safe at room temperature, but must be maintained there during transport using temperature-assured containers such as reefers to avoid the spikes that can come in ambient containers.

Required Regulation

Globalization and an increase in the number of food safety and pharma counterfeit incidents are prompting governments to tighten regulations on production and supply chains. Establishing preventive measures and harmonizing regulations are major issues for the food and pharma industries. Products such as produce must be traceable all the way back to the point of origin. Recall systems must be reliable and efficient, not only to rapidly comply with more stringent regulations, but to limit the scope by isolating specific batches of product. Getting out ahead of such regulation is a common theme across cold chain logistics. Manufacturers are building more stringent practices into their requirements.

Cold Chain Efficiency

The need to operate a lean supply chain is even more acutely felt when every step faces the additional requirement of refrigeration and compliance. Driver shortages and capacity constraints are hitting the cold chain especially hard. Operating a refrigerated fleet requires significant capital investment, especially, trained drivers, increased liability, and a greater risk for close inspection. Cold chain operators are eager to find new strategies to reduce costs. In retail, requirements for smaller, more frequent orders are driving the use of multi-cell trailers—refrigerated trailers in which insulated curtains are hung at intervals to create different temperature zones. This approach enables a cold chain to include frozen and chilled goods in the same shipment. But consolidating into a multi-cell trailer isn't always possible. Because of the space and handling costs of managing the insulation, it works best for dedicated equipment rather than a common refrigerated carrier. Shipper demand for efficiency, visibility, and product freshness is driving cold chain 3PLs to add a wide range of value-added services.

Mode Shifting

Fuel price fluctuations and globalization have driven some cold chain operators to shift modes from truckload to inter modal, or from air to ocean. Other factors contributing to mode shift include truck driver and capacity shortages, and sustainability initiatives. But makers of chilled and frozen goods must balance the additional time these modes may take with speed-to-market requirements. While air is the predominant choice for pharma transport, some shippers have shifted to steamship as the ability to manage and track locations and temperatures in containers has improved.

Sustainability Initiatives

Cold chain operators are looking for new ways to balance the energy-intensive requirements of perishable products with the desire to reduce resource consumption. Many service providers are using electric vehicles, especially, for drayage. But refrigerant is a more challenging obstacle than fuel. In warehouses, operators have shifted from freon to ammonia, but the compound's volatile properties make it unsuitable for trailers. Using CNG on the trailer side is still in its infancy. Improvements in insulation are increasing

energy efficiency to some degree, but onboard fleet management systems may deliver even bigger savings. Drivers are no longer responsible for setting temperatures so conditions can be controlled remotely, that fuel utilization is much improved.

Packaging for New Needs

There has been considerable focus on the development of packaging equipment with improved properties over conventional insulated packages. Significant efforts have been made on improved vacuum insulated panels, on-demand systems that do not require pre-conditioning, as well as flexible, actively temperature managed solutions that are now emerging, each with their own strengths and weaknesses, as well as a shift away from outdated solutions such as dry ice toward cryogenic distribution. The common feature with many of these newly emerging technologies is the fact that these shipping systems are reusable and require well developed reverse logistics as well as cleaning procedures to ensure that there is no outside or cross-contamination which

poses its own challenges. Development of consistent, effective decontamination processes poses its own unique challenges. Each type of equipment has its own unique materials, which may be impacted negatively by different solvents commonly utilized in laboratory or clean room disinfection. Alternative, non-contact means of decontamination would be advantageous and could have utility across a wide range of packaging materials. One of these new technologies being developed within the transportation space is xenon-pulsed ultraviolet light disinfection. Pulsed xenon-based ultraviolet light no-touch disinfection systems are being increasingly used for hospital room disinfection after patient discharge. For pharmaceutical manufacturers, a big challenge comes in balancing packaging and transportation costs. For small parcels moving through the ambient supply chain, the 3PL can choose 24-, 48- or 72-hour packaging, but the more insulated the package, the

higher the cost. It's also essential-especially for international shipments-to have partners who can ensure shipments are re-iced if a delay occurs. Food manufacturers are turning to newer disposable packaging designs to ensure integrity for more sensitive products. Reusable containers are also seeing increased use in both food and pharmaceutical logistics to reduce waste, and some companies are embracing greener packaging materials.

Technology Trends

Like all others, cold chain operators must continually upgrade technology to ensure efficiency, integrity, and safety. This includes both back-end IT infrastructure and front-end devices to gather and report key shipment data in real time. Cold chain carriers have invested considerably in on-board equipment built into refrigeration units to track temperature and location, and to make this data available to 3PLs and shippers in real time, offering increased visibility and the opportunity to prevent or mitigate loss. Some shippers use removable sensors to independently track the temperature of their cold cargo, usually, for high-value goods and international shipments. Some food manufacturers have built this capability right into their packaging. Rise in demand for real-time temperature and location status is sharply driving demand for IT infrastructure that can analyze and deliver data where and when it's needed. That infrastructure will be further challenged in pharmaceutical logistics as serialization regulations take hold, requiring tracking of all serial numbers in a shipment down to the unit level. Advanced technologies for cold chain management to ensure drug safety and efficacy continue to grow in importance. The cold chain pharmaceutical market continues to be one garnering specific interest within the logistics space. New therapies such as regenerative therapies and gene therapies as well as a shift toward temperature-managed shipments are currently of significant focus. This is due to the fact that many of the most innovative therapeutics, like regenerative medicines and other advanced cell-based therapies, are close to commercial launch and need to be shipped under very exacting temperature conditions. This shift is contributing to the growth of temperature-controlled products at more than twice the rate of non-temperature-controlled products.

At the Hands of Customer

The biggest obstacle for many cold chain operators is the one part of the supply chain they don't control i.e., the moment products are placed in the consumer's shopping cart or tendered to a healthcare provider. Despite considerable expense and effort to move the item across hundreds of miles through multiple hand-offs, a product that sits too long in a cart, a hot car, or a poorly regulated freezer can degrade in quality, a condition that often gets blamed on the manufacturer. Ensuring pharmaceuticals, food, and other chilled goods retain their integrity and safety remains a moving target for cold chain operators, globalization, tightening regulation, and changing consumer demand continue to alter the scope of the task, while driving the need for technology, efficiency, and security.

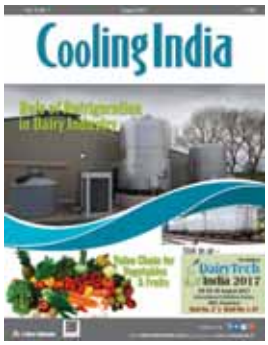
It has become clear that effective cold chain logistics management is vitally important to preserving the efficacy of valuable cold chain dependent medicines and for risk mitigation.

Informatics and Data Monitoring

It has become clear that effective cold chain logistics management is vitally important to preserving the efficacy of valuable cold chain dependent medicines and for risk mitigation. Unfortunately, most companies do not integrate logistics planning early enough in their clinical trial design; it is often an afterthought once the product is nearing commercialization. Adding complexity, such as adding more links to a supply chain as seen in regenerative therapy programs increases the steps and/or temperatures that must be controlled and increases risk of a temperature excursion. Next generation informatics systems must have the ability to not only collect location and handling information from infield scan codes and airline data, it needs to effectively manage the validation and qualification data for the packaging, as well as verify and control the performance, calibration, and reconditioning status of the packaging, collect and correlate real time data collected from data loggers in the field as well as assess performance and cost of selected logistics partners. In addition, the informatics systems that are required to manage an ever-increasing complex supply chain must have the ability to not only actively monitor the logistics conditions and considerations around any given product distribution, it must also be able to interpret the data coming in from the next generation data loggers in real time and assess risk intelligently. Next generation data loggers are now readily present and can track an entire range of specifications in near real time such as location, temperature (inside and out), shock, orientation, anti-tamper, humidity, and pressure.

Increased Patient-centric Approach within Pharma Industry

As biologic and specialty pharma continue to evolve and patients take more control of their treatments, we'll continue to see an increase in a patient-centric approach by the pharma industry. Sometimes, called "patient-centric treatments," this is the next step within biologics pharmaceutical development and these are primarily gene-based therapies, blood derivatives, etc. With many of these biologics requiring rigid or tight temperature control, expect to see increased consideration of the patient impacting all areas of treatment delivery, including logistics. The financial risks of mishandled shipments are fairly clear for commercial drugs that must remain temperature-controlled: lost sales and revenue, lost productivity, and lost opportunity to improve patient lives. The risks are no less



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severe on the clinical side, where transportation failures involving clinical product or patient samples could result in studies being compromised. Delays and other disruptions in trials impact the expected time to market for a product, potentially putting millions or billions of future revenue dollars at risk. As a first step, it is crucial for manufacturers to identify the needs for all of their shipped products, especially, those of high value. Meeting risk mitigation and quality objectives within the framework of an effective cost or performance strategy can be a simple matter of combining the right packaging fit with the right service fit for each individual application.

Future of the Cold Chain Industry

The use and understanding of leading cold chain technology are at the core of business and key to enhancing, differentiating and adding value to customers' supply chains. As customers and government regulations demand better quality and stricter compliance with global standards, there have been noticeable technology trends developing to meet these market needs. Demand for quick product recalls is leading to technological innovation. It seems we can't go a week without hearing about a new food recall in the news. While the reasons for food recalls are various and complex, they have collectively led to an increased demand on food manufacturers to put controls and measures in place to ensure the safe and quick recall of temperature controlled products. Both customers and legislators require the speedy removal of items from the market as soon as they are found to be unsafe or in violation of legislation. Companies have been forced to find answers and respond to these recalls with the help of recent advancements in inventory tracking. As regulations shift towards transparency and producer liability, it becomes more and more important that the cold chain has the right technology in place. As has always been the case, accurate record-keeping is essential to successful recall management. Human error, inefficiencies and other variables in this process have the potential to delay a recall, thereby, increasing the public's level of exposure to recalled products. Recent technology advances have limited these challenges by increasing accuracy and efficiency levels in a way that has been unprecedented. New technologies allow cold chain logistics firms to identify distribution pathways accurately, notify key parties about recall responsibilities, and enable quick understanding of where a quality control system may have broken down. As regulations shift towards transparency and producer liability, it becomes more and more important that the cold chain has the right technology in place. ■

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Adopting New Refrigeration Technologies

The vapour compression refrigeration system has caused huge damage to the environment. The Montreal protocol has already banned the CFCs and the HFCs which gave high COP to the VCR system. Now, to face this challenge there are two ways. First one is to opt for new refrigerants with zero ODP and very low GWP. The other way is to adopt new refrigeration technologies that are discussed in the article...

Refrigeration has become a part and parcel of human need and comfort. The vapour compression refrigeration is the most popular method of refrigeration. Unfortunately, the refrigerants used in vapour compression systems lead to severe ozone layer depletion and global warming problems. Thus, the refrigeration industry is now looking forward for new refrigerants and refrigeration technologies. Apart from the popular vapour compression refrigeration; there are many other ways to produce refrigeration. A look into the history of refrigeration shows that, the ice cooling and evaporative cooling were some of the refrigerating methods that were practiced till the development of mechanical refrigeration. Evaporative cooling was famous in ancient Egypt and India. Ice was mainly used for storing the food stuff and to keep them fresh. The source of ice, to achieve lower temperatures was only the natural ice, which was taken from lakes in winter. The natural snow was mixed with salt in order to reach lower temperatures. However, these methods were not able to meet the increasing demand in cooling load. Thus, over a period of time they have become obsolete.

In 1834, Jacobs Perkins proposed the first mechanical refrigeration machine with compression, which used ether as refrigerant. Then the first domestic refrigerator was built later in 1913. The invention of chlorofluorocarbons (CFCs) as refrigerants in 1929 became a remarkable event in the refrigeration and air-conditioning industry. Unfortunately, in 1973 scientists found out that the CFCs have high ozone layer depletion potential (ODP). Then came the hydro fluorocarbons (HFCs) which had zero ODP to replace CFCs; however, they have high global warming potential (GWP). Thus, the refrigerants used in the vapour compression refrigeration system (VCRS) have become a threat to the environment. The international regulations on various refrigerants used in VCRS provide a great opportunity for the emergence of new environmental friendly refrigerants and new refrigeration technologies. As a result, new family of refrigerants called hydro fluoro olefins (HFOs), which have zero ODP and very low GWP are now being studied. Also, the important refrigeration technologies which can replace vapour compressor technology are sorption refrigeration, thermal electric refrigeration, thermal acoustic refrigeration, calorific refrigeration, jet refrigeration and vortex tube refrigeration; the details of which are discussed below.

Vapour Compression Refrigeration

The vapour compression refrigeration is the most widely used kind of refrigeration technology for applications like domestic refrigerators, air-conditioning. It can produce higher coefficient of performance (COP) and has better flexibility and compactness in manufacturing and

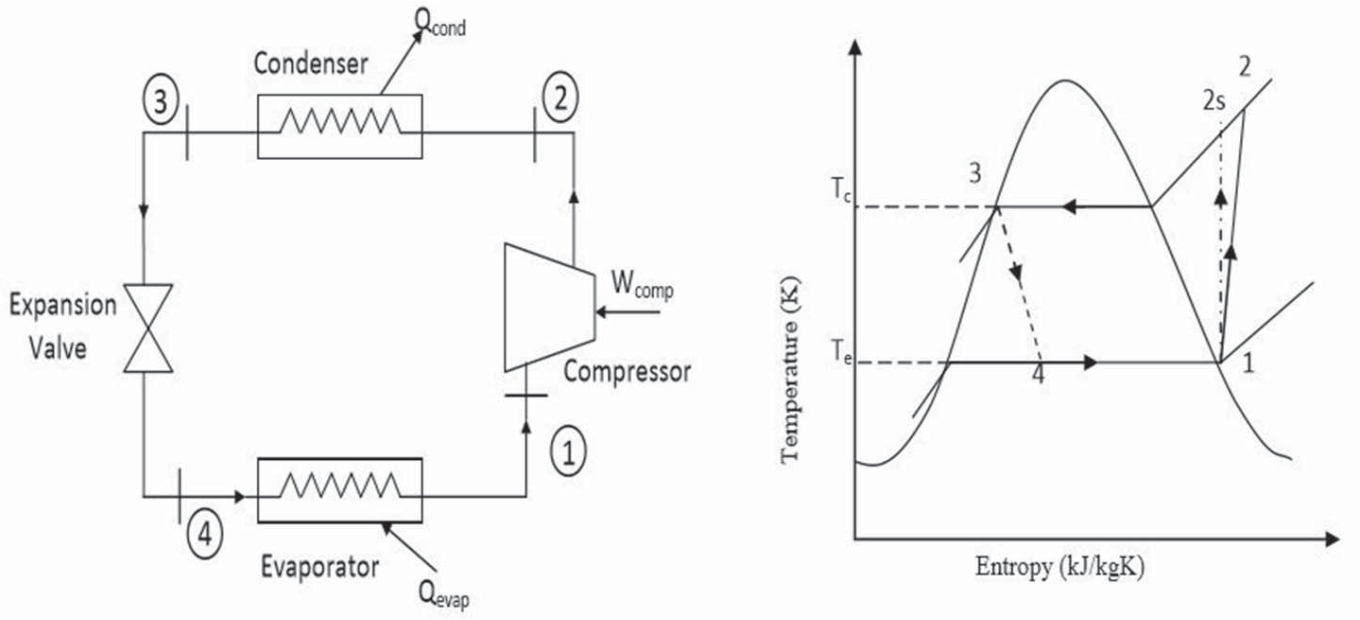
operation as compared to other refrigeration methods. The schematic of vapour compression refrigeration (VCR) system is shown in figure 1(a) and the corresponding T-s diagram is shown in figure 1(b). In this cycle, the refrigerant is passed through the space where cooling is required. The refrigerant then removes heat from the cooling space and gets evaporated. This gaseous refrigerant is then compressed to the condenser pressure where it rejects heat to the surroundings and liquefies. The liquefied refrigerant is now throttled to the evaporator pressure where it produces the refrigerating effect. The cycle is, thus, repeated for continuous running of the system. The mechanical work required to run the cycle is provided by an electric powered compressor. Thus, the vapour compression refrigerators with electric powered compressors are extremely reliable only when a reliable electricity supply exists. On the other hand, when there is a discontinuous power supply, the method of integrating a thermal storage system can be adopted to run the compressor. For off-grid systems, vapour compression solar refrigerators are powered by photovoltaic panels. This major cooling technology, with so many advantages is also characterized by low exergetic efficiency, especially, for small devices. As the system consists of moving parts like piston in the compressor, it creates great noise. Also, ensuring zero leakage of refrigerant is difficult. Thus, the VCR systems have high maintenance problems. Apart from these issues, the refrigerants used in VCR system have caused serious ozone depletion and global warming problems. Thus, there is great need to adopt newer technologies which can overcome the drawbacks of vapour compression refrigeration technology.

Sorption Refrigeration

The sorption refrigeration requires no compressors and the cooling effect is obtained by a heat-driven cycle, which can operate with relatively low-temperature heat sources. This method has lower efficiency in comparison with mechanical vapour compression systems, but can be powered by waste heat, solar thermal energy or traditional fuels. These systems are also simpler to control and produce no vibration or noise due to presence of few or no moving parts. The sorption technology is significantly attractive when a high amount of low temperature heat is available, such as solar energy. There are two main processes based on sorption: absorption and adsorption techniques.

Absorption

In the absorption cycle a liquid refrigerant solution like Lithium Bromide/ Water, Water/Ammonia etc., is circulated in the system. The working of a simple absorption cycle using water/ammonia as liquid refrigerant solution is shown in figure 2. In this process certain liquids or saline solutions absorb the vapours of some refrigerants in large quantities. Later, the absorbed refrigerant is separated from the solution by heating. Thus, in the absorption cycle the compressor is replaced by the generator-absorber assembly and pump. Meanwhile, the evaporator, condenser, and the expansion valve play the same role as in the compression cycle. Here, the ammonia vapour at state 2 is separated from ammonia–water solution in state 1 by heating the solution in the generator. Then the ammonia vapours are condensed in a condenser, while the liquid ammonia at state 4 is expanded in the expansion valve. In the evaporator, the ammonia is evaporated performing the refrigerating effect. The ammonia, in the vapour state 6, is absorbed by the ammonia poor solution at state 10. The absorption reaction is exothermic and takes place in absorber, producing a solution rich in ammonia. The rich solution is then pumped by the liquid pump represented by 8 in the figure, through a heat exchanger and into the generator, completing the cycle. The poor



(a) (b)

Figure 1: (a) The schematic representation of VCR system (b) Temperature-Entropy diagram of VCR cycle

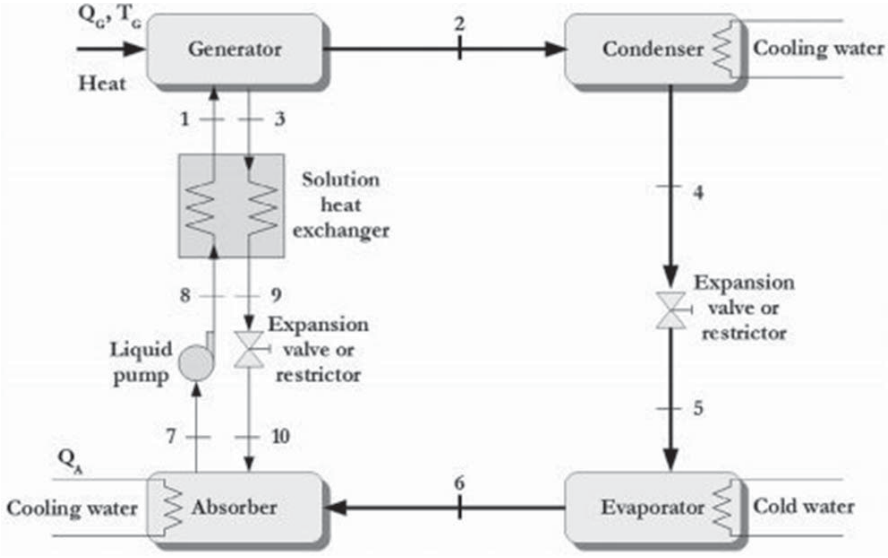


Figure 2: Working of simple absorption refrigerating system

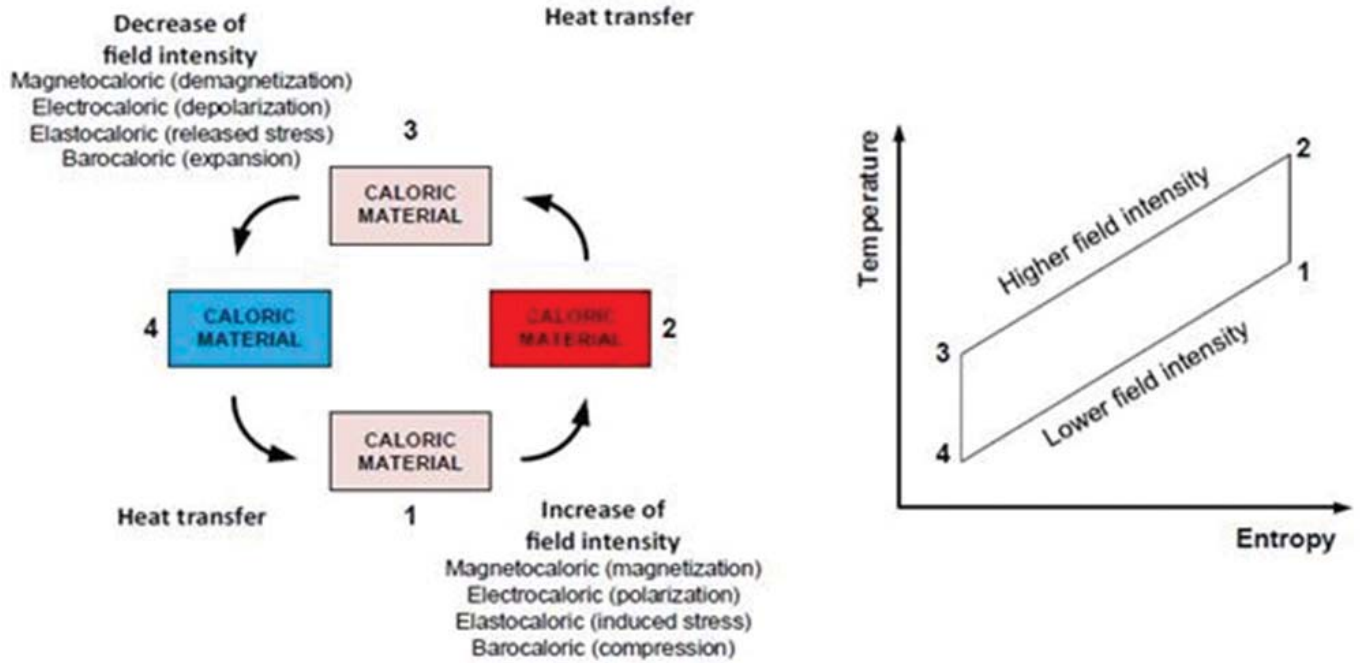
solution from the generator passes through a heat exchanger, pre-heating the rich solution, passes through an expansion valve to equalise the pressure with the ammonia vapour coming from the evaporator and enters the absorber.

Adsorption

An adsorption cycle is similar to that of absorption, but the sorbent is a solid, and physical or chemical adsorption can be considered. There is no circulation of the solid adsorbent in this cycle. Thus, various adsorption cycles are intermittent and operate with two components; an adsorber/desorber and a condenser/evaporator. In comparison with liquid absorption systems, adsorption systems can operate with lower temperatures and thus can be more easily coupled with low-temperature sources like solar thermal collectors. But they are larger in size and, therefore, are rarely applied in small-size refrigerators. For the same capacity, the physical dimensions of an absorption machine are smaller than those with adsorption cycle due to the high heat transfer coefficient of the absorbent.

Caloric Refrigeration

In recent years, technologies based on solid-state physics have been investigated to be alternatives for future refrigeration, heat pumping, air conditioning, or even power generation applications. These technologies use caloric energy conversion. They are baro caloric, electro caloric, magneto caloric, and elasto caloric technologies. These technologies suggest the possibility for improvements in energy efficiency, compactness, noise level, as well as a reduction in environmental impacts. The principles of operation for a thermodynamic refrigeration cycle in all the caloric technologies are shown in figure 3(a). The working material heats up by magnetization, polarization, stretching and pressing in magnetic refrigeration, electro caloric refrigeration, elasto caloric refrigeration and baro caloric refrigeration respectively. This process is similar to the compression process in VCR system. The heat generated due to the caloric effects needs to be rejected by the system. The expansion process of a gas refrigerant in VCR system is replaced by the demagnetization, depolarization, release, and expansion of the caloric material in magnetic refrigeration, electro caloric refrigeration, elasto caloric refrigeration



(a) (b)

Figure 3: (a). Representation of caloric energy conversion cycle. (b). Simple caloric brayton thermodynamic cycle.

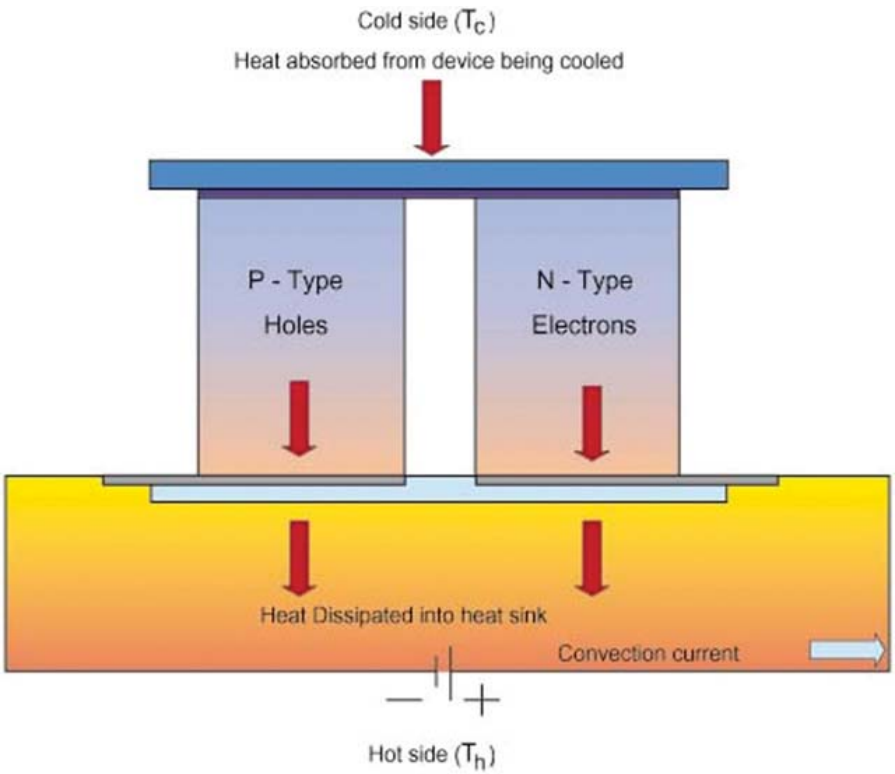


Figure 4: Simple representation of Peltier effect in Thermo electric refrigeration

and baro caloric refrigeration respectively and its temperature decreases. Now, the caloric material absorbs some heat from the space to be cooled. Therefore, in the final step, a heat-transfer process is required to transfer the heat from the heat source to the caloric material. In figure 3(b), the caloric Brayton thermodynamic cycle is shown.

Among different caloric refrigeration methods, the greatest progress has been observed in the field of magnetic refrigeration. However, in the recent few years, significant research efforts have also been made in the field of electro caloric and elasto caloric refrigeration. The reason for this is because the two domains, especially elasto caloric energy conversion, are at an early stage of research, where most of the devices represent experimental set-ups with a small portion for the characterization of the material's properties.

Magnetic Refrigeration

The Magneto caloric effect was first discovered by Warburg in 1881. In 1918 Weiss and Piccard explained the magneto caloric effect. Since the 1930s magnetic refrigeration has become a standard

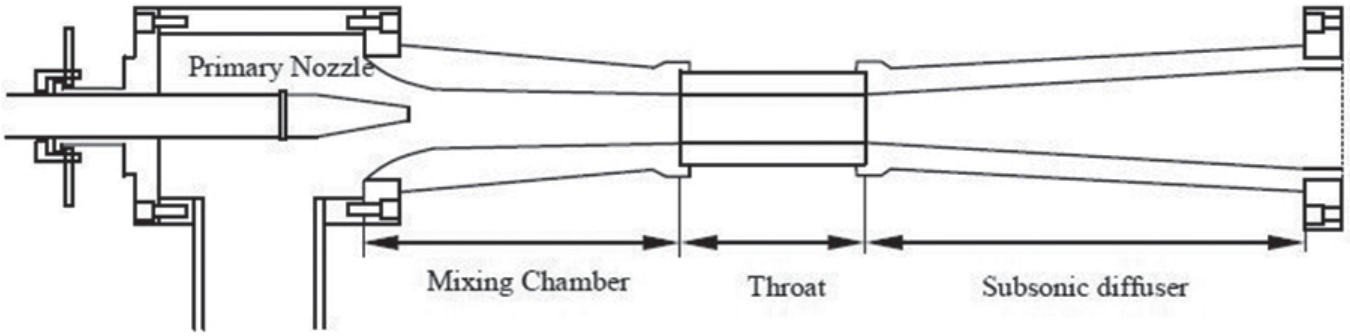


Figure 5: Different parts of a simple ejector

technique in low-temperature physics. In1976 Brown designed the first magnetic refrigerator working at room temperature. The main advantages of magneto caloric effect (MCE) principle as compared with classical VCRS are that it does not release any ozone layer depleting or global warming gases and possesses high energy efficiencies. The magneto caloric effect is an intrinsic property of specific magnetic materials characterised by a temperature change induced by a change in the strength of an external magnetic field. The magnetic materials are generally rare earth elements. Magnetic refrigeration requires the combination of a magnetic source of high strength and a material with sufficiently high refrigerant capacity.

Magnetic field sources

The external magnetic field strength is a key parameter of the magnetic cooling machine. The magnetic field generates the entropy change in the magneto caloric refrigerant. It is equivalent to the compressor in conventional systems. The higher the external field is the higher is the entropy and adiabatic temperature change of the functional materials. In this way, superconducting magnets can be used to build magnetic refrigerators with high level of magnetic field. The superconducting magnets can be utilized for industrial application, i.e., supermarket chillers, refrigeration plants and building climate control. On the other hand, the implementation of this kind of magnetic sources in domestic refrigerators is out of question since the superconducting magnets need liquid helium or a cryocooler to maintain the superconducting coil efficient i.e. around 4 K. For the commercialization of domestic and automotive devices, the development of performant magnetic sources based on permanent magnets is a crucial step.

Magneto caloric materials

As discussed above, magnetic refrigeration requires the combination of a relatively strong magnetic field and a material with a large magneto caloric effect. Now-a-days, the magneto caloric materials have become one of the critical parts for the research. The gadolinium metal (Gd) is the most used material in room temperature magnetic refrigerators. The discovery of the magneto caloric effect in compounds Gd5 (Ge1-xSix)4 was an important step for the development of magnetic refrigeration. But, Gd contributes additional costs due to manufacturing of the magnetic refrigerant. Instead, out of all the reported magneto caloric materials, LaFe13-xSix has been found to be the most promising alternative due to its large magneto caloric effect and low hysteresis. In addition, the low cost of the elements comprising the compounds like Fe makes this family of materials very interesting.

Thermoelectric Refrigeration

Thermoelectric refrigeration utilizes the Peltier effect. This effect occurs when a direct electrical current is passed through the junction of two dissimilar conducing materials. It causes one junction to cool down, to absorb heat and the other to heat up to reject heat. The thermo elements are doped semiconductors; one is an n-type

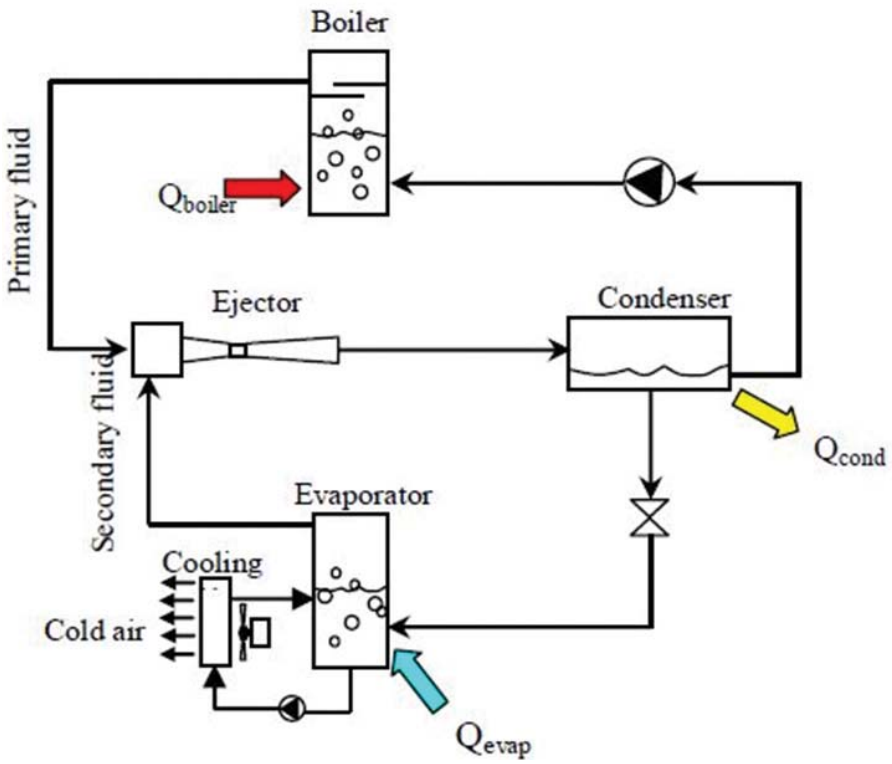


Figure 6: Schematic representation of steam jet refrigeration system

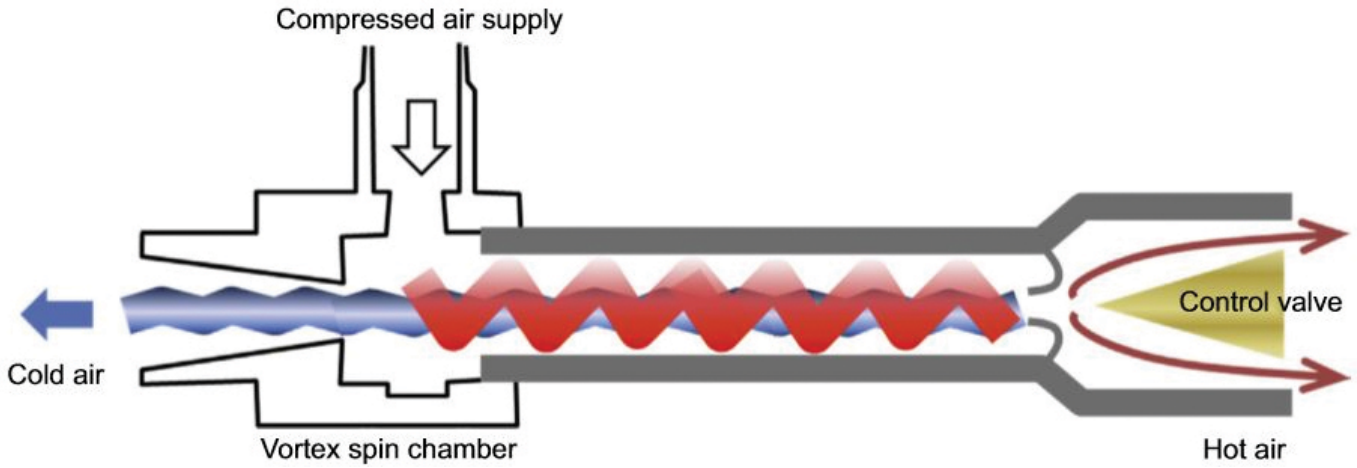


Figure 7: Working of a Vortex cooling tube

with mainly negatively charged carriers and the other a p-type with mainly positively charged carriers as shown in figure 4. Peltier coolers are commercially available and are mainly cut from bismuth telluride (Bi2Te3)-based materials. They have lower COPs than vapour compression refrigeration systems, and this limits their application. However, they can be cost-effective in small refrigeration systems such as wine coolers, small beverage coolers, or where noise is an issue. Thermoelectric power generation has also been suggested as a means to provide power on refrigerated transport vehicles. The major advantage of this system is that it does not have any moving parts and thus, there is no noise output.

Steam Jet Refrigeration

The steam jet refrigeration works on a heat-powered refrigeration cycle. A steam jet refrigerator was first developed by Le Blanc and Parson in early 1900. The importance of jet refrigeration is that it is relatively simple to design, easy to construct and operate compared to the other types of refrigeration systems. It can be used with water which is the most environment friendly refrigerant. The primary energy source used is the solar thermal energy. The primary fluid (high pressure steam) from the boiler passes through the primary nozzle in the ejector. The ejector in steam jet refrigeration is used to increase the pressure of the refrigerant to condenser pressure. Thus, an ejector does the work of a compressor as in vapour compression refrigeration system. The schematic of an ejector is shown in figure 5. Now a supersonic jet of the primary fluid is produced within the mixing chamber of the ejector. A very low pressure region at the mixing chamber is thus obtained. This low pressure region draws secondary fluid from the evaporator into the mixing chamber. Then the primary fluid and the secondary fluid mix together in the mixing chamber. The mixed stream is still in form of the supersonic flow. At the end of the throat section, the difference in pressure between mixed stream and back pressure (condenser pressure) increases. This gives rise to series of oblique shocks. The shock is that which causes a major compression effect to occur and flow form is suddenly changed from supersonic to subsonic. A further compression of the flow is achieved as it is brought to stagnation through a subsonic diffuser. The ejector is discharged at back pressure. Thus, an ejector entrains a low pressure saturated vapour from the evaporator, where the refrigeration effect is produced, as the secondary fluid. It uses a hot and high pressure vapour from the boiler as the primary fluid. The ejector discharges its exhaust to the condenser where the fluid is condensed to liquid by rejecting heat out to the surroundings. The schematic diagram of a jet refrigeration system is shown in fig.6.

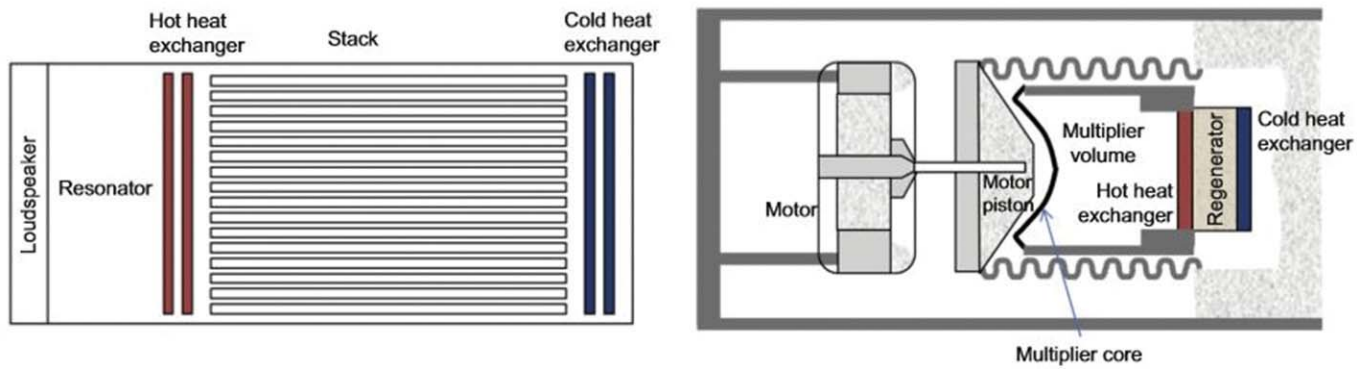
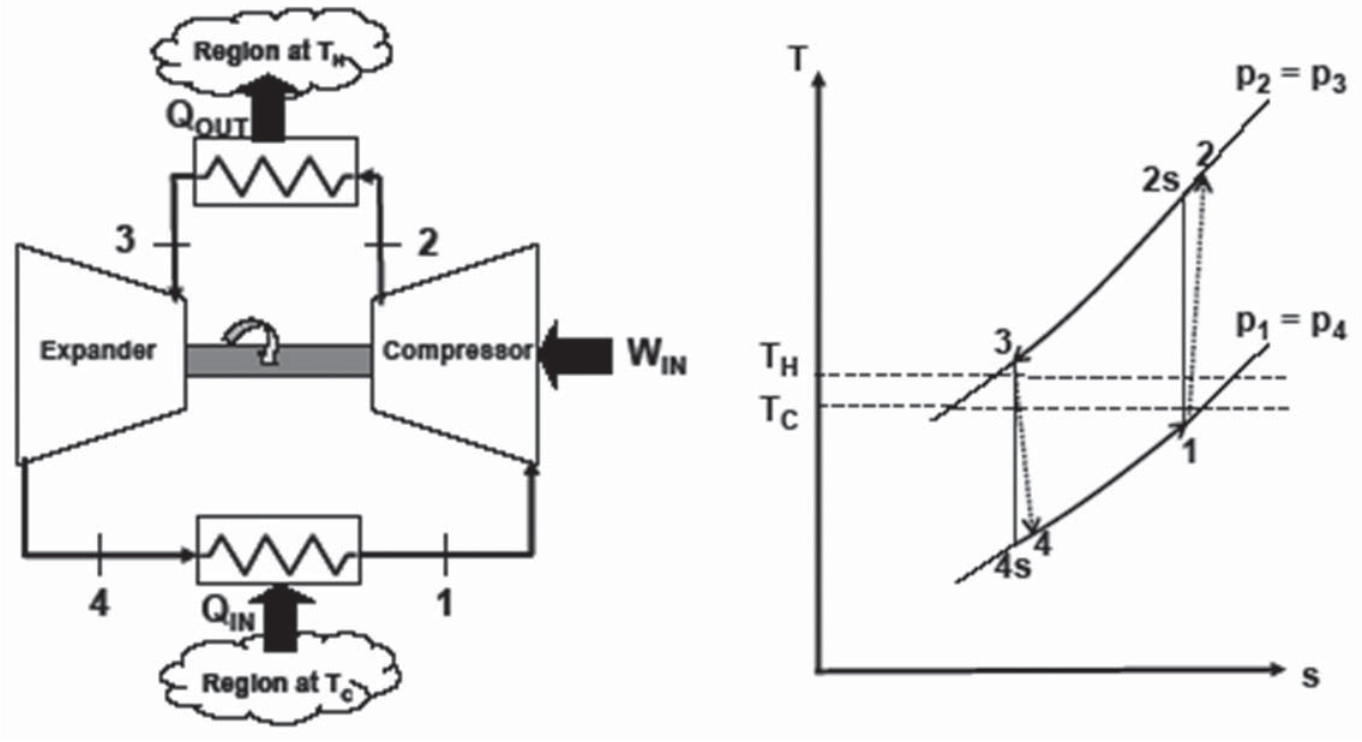


Figure 8: Representation of (a) Standing wave thermo acoustic refrigeration and (b) Travelling wave thermo acoustic refriration



(a) (b)

Figure 9: (a) Air cycle refrigeration arrangement (b) Air cycle refrigeration on T-s diagram

Vortex Tube Cooling

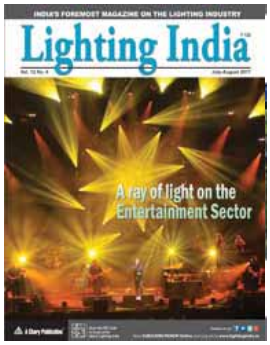
The vortex tube is device, which separates a high compressed flow into low pressure stream and high pressure stream of different energies. This results in a difference in temperatures. George Ranque, the French metallurgist and physicist, accidentally invented the first vortex tube in 1928. The documents and vortex tubes of another scientist Hilsch were found after the World War II. The vortex tubes are thus, generally referred to as Ranque-Hilsch vortex tube. The vortex tubes can be categorized into uni-flow vortex tube and counter-flow vortex tube. As the name implies, the warm and cold streams pass in the same direction in the uni-flow type. On the other hand, in the counter-flow vortex tube type the cold flow move in the opposite direction with respect to the hot stream. Generally, the counter flow is preferred over the uni-flow for its efficient energy separation. The compressed air is the working fluid in vortex tube cooling. Thus, it is environmentally harmless with zero global warming potential (GWP) and zero ozone depletion potential (ODP). The working of a vortex tube is shown in figure 7.

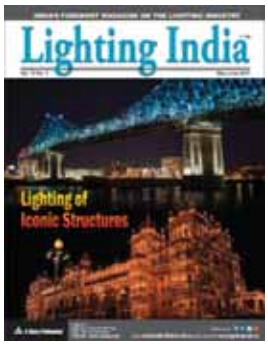
The compressed air injected into a swirl chamber exits as two streams namely hot stream and cold stream. The compressed air entering the swirl chamber is subjected to a high rate of rotation. The hot gas is allowed to escape via the conical nozzle. The remaining air returns through the centre of the vortex tube to exit as cold air. The pressure difference occurs through the gas due to the centrifugal force. Then compression at the walls, expansion at the centre, and heat transfer between the two streams within the vortex tube takes place resulting in the cold and hot air stream separation.

The vortex tubes are inexpensive and are used in nontoxic spot cooling. The availability of large amount of compressed air limits its use. There is initial energy cost of compressing the air involved in this type of cooling. Thus, a large amount of compressed air available as a waste or free energy source provides the scope for using this technology. In the absence of large amount compressed air, vortex tubes will only be suitable for spot cooling or where toxicity or flammability is a greater concern than energy.

Thermo Acoustic Refrigeration

Thermo acoustics is the science which deals with sound and thermal energy. Byron Higgins observed thermo acoustic phenomenon. Hofler built a first thermo acoustic cooler at Los Alamos National laboratory. The thermo acoustic refrigeration systems use sound waves to produce cooling effect. The cooling effect is achieved through compressing and expansion of an inert gas such as helium, argon, air or a mixture of gases in a resonator. The thermo acoustic devices are mainly divided into standing wave systems and traveling wave systems and are shown in figures 8(a) and 8(b) respectively. The main components in standing wave systems are a closed cylinder, an acoustic driver, a porous media called stack, and two heat exchangers. In standing wave system, a loudspeaker produces sound waves which are used to create a resonant standing wave inside the stack. A temperature difference along the length of the stack is produced as gas oscillates within the stack, due to expansion and compression by the sound wave. On the other hand for traveling wave system, the driver is a





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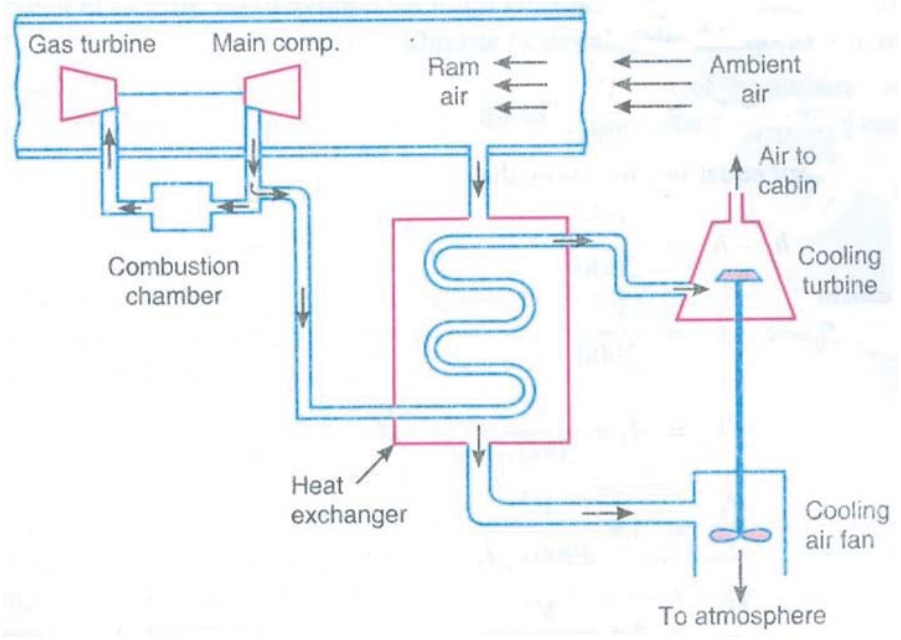

Figure 10: Simple aircraft air conditioning system

motor and piston. The temperature difference for this system occurs in a regenerator rather than a stack unlike in stand wave system. The regenerator consists of a matrix of small channels. As the pressure is increased and decreased, the air will oscillate between the hot and cold heat exchangers through the regenerator matrix. When the pressure is high, the gas moves towards the hot heat exchanger and when the pressure is low, it moves towards the cold exchanger, thereby transferring heat. The acoustic refrigeration technology is most suitable for low capacity equipment. The main benefit of the technology is that it uses environmentally safe, inert gases such as air, argon, and helium. The inefficiency of systems which have been already built and tested is a result of inadequate tolerances in assembled apparatus. Also, the heat exchangers were found to be the cause for high cost and complexity.

Air Cycle Refrigeration

Air cycle refrigeration is based on the reversed Joule (or Brayton) cycle. The ideal cycle considered for air refrigeration cycle is called Bell-Coleman cycle. The schematic diagram for the arrangement of different components of Bell-Coleman cycle has been shown in figure 9(a). The ideal cycle (1-2s-3-4s-1) and also the cycle considering the irreversibilities in the compressor and expander (1-2-3-4-1) have been shown on the temperature-entropy (T-s) diagram in figure 9(b). Air cycles can be classified as closed, open or semi-open/closed. Closed cycles are sealed systems and consequently there is no direct contact between the working fluid and the product being cooled. Open cycles can be open on either the low-pressure side or the high-pressure side of the cycle. Cold air leaving the system passes through the refrigerated space coming in direct contact with the product being cooled. Since air is used as cooling medium, no cost of refrigerant is involved thus making the system quite cheap. Also, as the main compressor is employed for the compressed air source, there is no problem for extra space, extra fixation of the compressor. Also there is no additional vibration. The chilled air is directly used for cooling; the costs of separate evaporator and its weight are eliminated. As the air is refrigerant, minor leakage of the same is tolerated vis-à-vis that of the costly refrigerant. There are no complicated parts involved rendering low maintaining cost. It is light weight per ton of refrigeration compared to other refrigeration system and thus it is used in aircraft refrigeration. On the contrary to the benefits discussed the system shows low COP. Also, there is only sensible cooling and no evaporation of the refrigerant.

Aircraft Refrigeration

The gas cycle or air cycle refrigeration is widely used for the air conditioning of different types of aircrafts. Although, the COP of this cycle is much less than that of vapour compression cycle, it is preferred for aircraft refrigeration system due to its less weight and other advantages. Normally, in an aircraft, a compressor is already present for the gas turbine power cycle. A part of the compressed air is used for air conditioning purpose as show in figure 10.

Of course, in an actual aircraft air conditioning, the above cycle is modified using the ram effect of high velocity air jet and more number of compressors and heat exchanger. The initial compression is done by using the ram effect of air entering into the high velocity aircraft. The scheme has been shown in figure 8 on the T-s diagram. Other improved systems used for

aircraft refrigeration after the modification of the basic systems include Bootstrap system, Regenerative system and reduced ambient system.

Conclusion

The vapour compression refrigeration system has caused huge damage to the environment. The Montreal protocol has already banned the CFCs and the HFCs which gave high COP to the VCR system. Now, to face this challenge there are two ways. First one is to opt for new refrigerants with zero ODP and very low GWP. The other way is to adopt new refrigeration technologies like the ones discussed above. The magnetic refrigeration has already gained importance and put into practice. The aircraft refrigeration and air refrigeration systems use air as refrigerant, which is very easily available and are being used in aircrafts. Likewise, focus should be laid on the other existing methods as they are simple and does not use harmful refrigerants as in VCR systems. These alternatives technologies are not all new and were used earlier. But due to the domination of VCR system, they were put aside. Now, the time has come for crucial research to be carried on these technologies, so that they can replace VCR technology. The aim for research should be to develop new refrigerants and new technologies to the meet the cooling demand of the world without effecting our environment. ■

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LG Electronics Commits to Sustainable Building Projects

LG Electronics USA Air Conditioning Technologies is debuting a new case study in the LG Project Profile Series, the unique LEED-certified renovation of Columbia Square, a mixed-use property in Hollywood, Calif. The project – spotlighted at the 2017 Greenbuild International Conference, showcasing LG's unique heating, ventilation and air conditioning (HVAC) technologies installed in a variety of commercial and residential environments.

LG's industry-leading Variable Refrigerant Flow (VRF) technology and duct-free solutions are making major inroads in the United States where the demand for high-performance, flexible HVAC technology continues to grow. LG's air conditioning systems are designed to minimize efficiency losses found in conventional HVAC systems, provide sustainable energy savings, and offer one of the lowest lifecycle costs of any system on the market today.

Columbia Square

Columbia Square previously housed the CBS Radio Network's West Coast facilities, as well as CBS's original Los Angeles television and radio stations. The large-scale, mixed-use project required a HVAC system that would combine an energy-efficient and cost-effective platform, as well as flexibility for a shell and core fit-out. The team looked for a system that was efficient, quiet, reliable, low maintenance, and easily configurable. The chosen LG VRF system was able to support building's numerous glass windows and open spaces while still delivering high energy efficiencies to achieve the esteemed LEED Gold certification.

Sharpe Building at The Foundry

The project team required an HVAC system that would both retain the Sharpe Building's unique architectural character while appealing to young professionals migrating to Providence's urban center who expect modern comfort and conveniences. The project team recommended installing the LG Multi V IV VRF heat recovery system, which would maintain the aesthetics of the historic building while addressing space considerations by running small refrigerant lines throughout the building without using bulky ductwork.

Smouse Elementary School

The school needed a versatile HVAC upgrade that balanced efficiency with the unique design needs of a historic building with several floors of varying environments. Most importantly, Smouse required a system that would provide an optimal comfort environment for its students while preserving the architectural integrity of the building. LG's VRF Multi V Water IV system was selected for its ability to deliver on all of Smouse's requirements and worked perfectly for the environment because it was able to hook into the adjacent school's central plant that already had a cooling tower and boiler to easily incorporate the LG water-cooled condensing units in the basement. From there, the refrigerant piping was routed to the varying zones established in the school.

The Mill at Dover-Foxcroft

On top of functioning in the extreme weather conditions, in order to achieve the desired net-zero impact, the HVAC system needed to be energy efficient, while still delivering on the specific comfort requirements of the varying businesses operating throughout the complex. All of this had to be achieved with minimal modification to the structure in order to preserve its historic nature. LG's robust solution featured 180 tons of LG Multi V Water IV Heat Recovery Units that tied into the geothermal well system and included a variety of indoor units, such as ceiling cassettes, wall mounts, high static ducted and floor standing indoor units. ■

ABB Equips Luxury Dubai Tower

ABB supplies smarter building system to improve energy efficiency by 30%...

ABB supplies Dubai's latest, exclusive residential building, Volante Tower, with a full building automation system, controlling everything from public areas to individual living spaces, together with systems integrator customer Ultimate Solutions. The Volante Tower was designed to serve the needs of discerning customers who seek a remarkable residence, boasting 35 floors comprising 45 exceptional apartments, all with sweeping waterfront views overlooking the Dubai canal and the Burj Khalifa.

The apartments include a combination of half floor two bedroom units at 5,000 sqft and whole floor five bedroom units at 10,000 sqft. The tower also boasts a Club where residents can enjoy a spa, gym, swimming pool, café and cinema.

The common areas, including corridors, are fitted with sensors in order to decrease wasted energy and improve efficiency up to 30%. Meanwhile, the apartments are individually kitted out with smart home management systems that offer full control of the AC, blinds, lights and music. Due to the prestigious nature of the residence, the developer wanted to offer its residents an original design in terms of aesthetics and functionality. ABB was, therefore, the partner of choice based on its bespoke glass keypads, with KNX technology. Glass material is often preferred in high-end residences as it gives an expensive and stylish look, yet offers practicality, while KNX is a standardized network communications protocol for building automation, designed to be independent of any hardware platform. ABB also supplied electrical protection DIN rail components.

"We are delighted with the great job done in Volante by our systems integrator, Ultimate Solutions." says Michael Lotfy, head of Building Automation, for AMEA at ABB. "Together we have managed to deliver a state of the art solution, that not only saves more than 30% of the energy consumption, but it also controls each apartment at the touch of a button: from the smart phone or the tablet, with maximum comfort, safety and luxury at the same time."

ABB previously worked with Ultimate Solutions on the world-renowned luxury apartment building in the Dubai Marina, Le Rêve. Managing Director of Ultimate Solutions, Jana Malhas adds: "I have worked with ABB on several projects in the past, so they were my natural choice for Volante, and I was not disappointed. Throughout the project they went out of their way to make sure that we received the highest level of support and bespoke solutions that please a very sophisticated client base. I look forward to many more projects with ABB in the future."

ABB is a pioneering technology leader in electrification products, robotics and motion, industrial automation and power grids, serving customers in utilities, industry and transport & infrastructure globally. Continuing more than a 125-year history of innovation, ABB today is writing the future of industrial digitalization and driving the Energy and Fourth Industrial Revolutions. ABB operates in more than 100 countries with about 136,000 employees. ■

"Need to modernize cold storage infrastructure"

The Federation of Cold Storage Associations of India (FCAOI) is an all India association with members in most of the states in the country. There is a huge need for cold storage facilities in India leading to the formation of state level associations who look after their concerns. I am looking for innovation in the field of colours of fruits and delay of ripening process as demanded by customers e.g. preference for red colour for apple and green colour for sweetlime, states **Ashish Guru, Senior Vice President, Federation of Cold Storage Associations Of India & President, Gujarat Cold Storage Association, Gujarat** in an interaction with **Cooling India**...

What are the trends in Indian Cold Storage industry?

First cold storage was installed in eighteenth century in Kolkata for storage of ice. Gradually, it has led to installation of storage of potato, milk and fish. Now-a-days, cluster based cold storages are setup at production center of apple and potato. In Tier I & II cities, multi-commodity cold storages are coming up, catering to the needs of online grocery and vegetable requirements of urban population. Rise in disposable income of middle class people has generated demand for value added, frozen and quick service snacks. As a result, cold storages for such produce have increased slowly in urban areas. Now, more and more commodities are stored in cold storages even cotton bales in Telangana and groundnut in Gujarat.

What are the services provided by Federation of Cold Storage Associations of India?

Federation is a parent body of state association representing issues being faced by state association to Central Government. The Federation collects the data of agricultural produce, statistics from state associations and publishes it in the association's monthly *Patrika.* It coordinates with members of different associations in different states through Ice Exhibition and India Cold Chain show, updating new technology among the members.

Indian consumer prefers fresh fruits and vegetables over frozen as compared to western countries resulting only in long-term storage of potatoes and apples. Still, there is a huge gap of storage between fruits & vegetables production & processing (frozen). This leads to reduction in prices of perishable agro commodities in season.

ICAR study has estimated that annual value of harvest and post-harvest losses of major agricultural produces at national level was of the order of Rs 92,651 crore calculated using production data of 2012-13 at 2014 wholesale prices. Looking at this scenario, where is Indian cold chain industry lacking? Do you think that Indian cold chain infrastructure is upto the mark to arrest these losses?

Cold storages are located in bulk numbers in UP, West Bengal, Bihar, Gujarat, Maharashtra, Rajasthan, Delhi, Haryana and other states. Indian consumer prefers fresh fruits and vegetables over frozen as compared to western countries, resulting only in long-term storage of potatoes and apples. Still, there is a huge gap of storage between fruits & vegetables production & processing (frozen). This leads to reduction in prices of perishable agro commodities in season. It makes farmers' economic position vulnerable. There is a need to modernize cold storage infrastructure as market are matured for frozen commodities, which may result in reduction in wastage of perishable agriculture produce.

What are technological innovations introduced by the federation in order to preserve fruits, vegetables or grains? What innovations would you like to bring in the industry in order make it globally competitive?

The Federation usually uses popular cost-effective technology available in different states through exhibitions, seminar and experts panel discussions. I am looking for innovation in the field of colors of fruits and delay of ripening process as demanded by customers e.g. preference for red color for apple and green colour for sweet lime.

What are the projects of cold storage under implementation?

Singapore is executing fourth generation cold storage as compared to second generation installations in India. Gujarat is witnessing modern cold storages set up at Mehsana and Himmatnagar storing lime, onion, exotic fruits and vegetable.

What are the regulatory initiatives takes by the government to promote Indian Cold Chain industry?

Central Government through National Horticulture mission and National Horticulture Board assists cold storages by capital investment subsidy of 35% as prescribed by National Cold Chain Development, New Delhi. States like Gujarat, MP, Bihar give additional subsidy of 15%. The Government also helps for setting up C.A. storage, PLC, alterative energy. To bail out present cold storages in the situation of heavy potato storage and poor demand, the Government of Gujarat has announced liberal freight subsidy program for inter-state and exports. Refrigeration van is a key factor in cold chain. The Central Government also gives subsidy for two reefer vehicles. Interest rate has also been reduced by nationalized banks to promote cold storage infrastructure.

What is your outlook for the in 2017-18?

My outlook for 2017-18 is bullish due to good monsoon season, booming economy, lower interest rate, and proactive government policy and rising population of India. ■

Export Marketing of Kinnow Fruits

Kinnow is a good source of vitamin-C, pectin and anti-oxidants etc and therefore, it is in high demand in both Indian markets as well as export markets. During last two years, successful efforts were made by some progressive farmers from Abohar to export Kinnow fruits to Russia, Ukraine, Middle East countries etc...

Present Set Up Of Post-Harvest Infrastructure in Punjab for Export of Kinnow

The following post-harvest infrastructure has been established by Punjab Government for post-harvest handling and marketing of Kinnow fruits.

- Six washing, grading, waxing plants at Hoshiarpur, Fazilka and Muktsar
- Two processing units for processing of kinnow juice at Hoshiarpur and Abohar.
- Five citrus estates Hoshiarpur (Chhauni Kalan and Bhunga), Fazilka (Abohar and Jattan Tahliwala) and Muktsar (Badal).
- One pack house equipped with cold rooms and pre-cooling unit at Badal
- Some progressive farmers have established their own waxing and grading lines and cold chain solutions such as cold stores, preccling units and refrigerated vehicles at Abohar and adjoining area.

Important Guidelines for Export Marketing

Harvesting

The best period for harvesting of Kinnow fruit is from mid-January to mid-February. The fruits should be cut with clippers, close to the peel of the fruits retaining shortest stalk and green button. The later is taken as sign of freshness as naturally dropped fruits don't retain the green button. All necessary precautions should be taken to prevent injuries, any contamination or cross contamination of the product after picking.

Waxing

World over, citrus fruits are waxed with edible coating. During mechanical sorting and washing brushes removes natural waxes from the peel surface, leading to faster rate of water loss and shriveling and

The fruits should be cut with clippers, close to the peel of the fruits retaining shortest stalk and green button

these natural waxes are replaced with coatings, primarily of plant origin. The coatings, primarily based on Shellac, Carnauba and bees wax have been approved by Food Safety and Standard Authority of India (FSSAI). Use only those waxes, which are safe and approved by CODEX and regulatory authorities. The wax coating helps in checking the water loss from fruit surface, thereby, preventing the aging of fruits during transportation and marketing. It also imparts fresh glossy appearance, which enhances the market value. The waxing of fruits can be done either mechanically (spray brush or spray nozzle type application) or manually (with foam pad, mist spray or dip method). After waxing, the fruits are again dried at temperature of 30-35°C. The washing and waxing should preferably be done before fruits are sent to market.

The wax coating helps in checking the water loss from fruit surface, thereby, preventing the aging of fruits during transportation and marketing.

Grading

For getting premium price and assuring quality to consumers, the fruits are graded for different sizes. The various grades recommended for Kinnow fruits by APEDA are as under:

	Size range (mm diameter)	**No of fruits** in 10 Kg pack
a	60-64	84
b	65-69	72
c	70-72	60
d	72-74	54
e	75-79	51
f	80-85	45

For getting premium price and assuring quality to consumers, the fruits are graded for different sizes.

Packaging

The fruits should be packed in corrugated fibre board boxes, having 10

A divider having ventilation holes is inserted in between layers, which will act as cushioning material.

The fruits should be transported from packhouse to sea port in refrigerated maintained at 5-7°C.

It must be ensured that temperature of the cold store should not fall below 5°C otherwise it can result into chilling injury.

kg capacity. Usually two pieces, telescopic, CFB boxes of five ply with waterproof coating to tolerate high humidity during shipment are preferred. Normally, a box of size 45 cm x 24 cm x 18 cm having 10 kg capacity is very common and acceptable for export marketing. The box must have 5% area punched as holes for ventilation. A divider having ventilation holes is inserted in between layers, which will act as cushioning material. It has been seen that 10 Kg boxes containing 45-60 Kinnow fetch maximum price in markets.

Pre-cooling

After packaging the fruits should be kept in precooling units at 6-8°C and 90-95% RH for 6-8 hours in order to achieve the desired temperature of fruits before transportation under refrigerated conditions.

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Transportation

The fruits should be transported from packhouse to sea port in refrigerated maintained at 5-7°C and thereafter in ship; it should be transported to destination markets under same temperature.

Storage

The fruits should be stored in cold store at 5-7°C and 90-95% RH. It must be ensured that temperature of the cold store should not fall below 5°C otherwise it can result into chilling injury. Unbruised and mature Kinnows can be stored up to 45 days at 5-7°C and 90-95% RH with acceptable quality.

Marketing

The farmers and entrepreneurs are advised to make their own association for marketing their quality produce by creating the post-harvest infrastructure. It will help in minimizing their exploitation in the hands of traders. Many agencies like APEDA and Punjab Agro Industrial Corporation (PAIC) are promoting and facilitating distant marketing of Kinnow. The desirous farmers should contact these agencies and Department of Horticulture of Punjab and PAU, Ludhiana for help and guidance. Various schemes are available for creation of post-harvest infrastructure under national Horticulture Mission programme. The farmers and traders can contact or visit the offices of Punjab State Department of Horticulture at block or district level for further information and guidance.

The cold chain infrastructure is helping the Punjab horticulturists in the export of kinnow fruit. This cold chain needs to be maintained properly for long economical and efficient operation.

Especially, the refrigeration equipment needs to be serviced periodically to repair faults and maintained to prevent faults before they happen. Appropriate plant maintenance will save money through reduced energy bills, reduced service costs and less plant downtime. Appointing a good maintenance contractor is the key to achieving these savings.

Good Maintenance Saves Money

- Maximizing plant efficiency and therefore, reducing electricity costs
- Reducing equipment failure and the costs associated with plant downtime and stock or product loss

The cost of a suitable maintenance contract depends on the complexity and size of the system. Typically, the annual maintenance cost is between 2% and 5% of the original capital cost of the plant, but you're likely to save up to 10 times the maintenance cost through greater energy efficiency. In addition, you can also reduce service costs and lost production costs.

Cleaning condensers and evaporator can reduce energy consumption by up to 10%; Finding and repairing leak and correcting the refrigerant charge can reduce energy use by up to 15%. ■

Export Marketing of Kinnow

Harvesting
↓
Sorting
↓
Washing & Waxing
↓
Grading
↓
Packaging
↓
Precooling
↓
Transportation in Refer Vans
↓
Storage
↓
Marketing

BVC Mahajan
Punjab Horticultural Postharvest Technology Centre, P A U Ludhiana

Mahesh Kumar
Punjab Horticultural Postharvest Technology Centre, P A U Ludhiana

Swati
Punjab Horticultural Postharvest Technology Centre, P A U Ludhiana

PronGO® for Temperature Sensitive Transportation

PronGO® provides logistic solution which can fill in the empty places created by the unavailability of the reefer based transportation system. PronGO® logistics solution identifies need of temperature maintenance at every step of the cold chain logistics infrastructure. It's a complete temperature controlled logistic solution for every kind of distribution be it from manufacturing facility to distributor to retailer or to the consumer...

One of the greatest challenges the transportation industry has ever seen is transportation of temperature sensitive products. Balancing between maintaining the precise temperature and cost associated with it has baffled the industry to implement the cost-effective strategies for streamlining global demand of temperature controlled logistics. In the meantime, the industry has to ensure that the international regulations and guidelines are not compromised. In case of breach of regulations, heavy fines are implemented and the prestigious reputation of the company is at stake.

In 2015, India's infrastructure gap in reefer transport was assessed at 52,826 units; the country is estimated to have only 9000-10000 long haul reefer trucks and zero reefer containers in use [1]. Figure 1 identifies that how transportation is an integral part of the logistic industry.

PronGO® provides logistic solution which can fill in the empty places created by the unavailability of the reefer based transportation system. PronGO® logistics solution identifies need of temperature maintenance at every step of the cold chain logistics infrastructure. It's a complete temperature controlled logistic solution for every kind of distribution be it from manufacturing facility to distributor to retailer or to the consumer. Being versatile in nature, it can be easily customized and

Supply / Procurement	→	Transportation	→	Storage	→	Transportation	→	End Consumer
• Precooling Systems • Farms (Rural Market) • Manufacturers		• Reefer Trucks • Refrigerated Railway Wagons • Reefer Containers		• Cold Storages • Warehouses • Perishable Holding Centers		• Reefer Trucks • Refrigerated Railway Wagon • Reefer Containers		• Retail • Terminal • Markets • Factory • Ports • Airport

Figure 1: Cold Chain Logistics Infrastructure

Table 1: Ranges and Specification: PronGO Logistics Solution

Sr. No.	Model No. PronGo®	External Dimension (mm)	Box Volume (l)	Average Payload Volume with PCM (l)	Backup Duration (nrs)	Temprature Range
1	50 LHC	565 x 400 x 370	50	27	16	-25°C to -20°C
2	100 LHC	775 x 550 x 405	100	75	16	-25°C to -20°C
3	150 LHC	845 x 600 x 480	150	120	16	-25°C to -20°C
4	50 LHC	565 x 400 x 370	50	31	48	2°C to 8°C
5	100 LHC	775 xx 550 x 405	100	75	48	2°C to 8°C
6	150 LHC	845 x 600 x 480	150	120	48	2°C to 8°C

fits in the operational requirement of every individual; it is cost-effective and easy to maintain and operate.

Component 1 PCM (Phase Changing Materials)

A phase change material absorbs energy, stores it in the form of latent heat and utilizes wherever necessary. They maintain constant temperature while changing their physical form i.e. from liquid to solid or vice versa. Phase changing being a reversible process, the high energy density behaves as a thermal reservoir which can be used repeatedly.

Component 2 Roto-Molded Insulated Container

Any PCM without a good insulation lacks in its performance. Roto-molded Insulated containers have at least 25 mm PUF insulation, which acts the first shield between varying temperatures (i.e. internal and ambient). Insulation, therefore, increases the efficiency of the PCM, thus resulting in longer retention time i.e. increased distribution radius.

Component 3 PronGO® Charging Station

A charged PCM utilizes its latent heat of phase change which is approximately 100 times higher than its sensible heat. Therefore for deriving the best performance a PCM has to be completely solidified before using it. For complete and effective charging, it is preferred to use a Plate freezer.

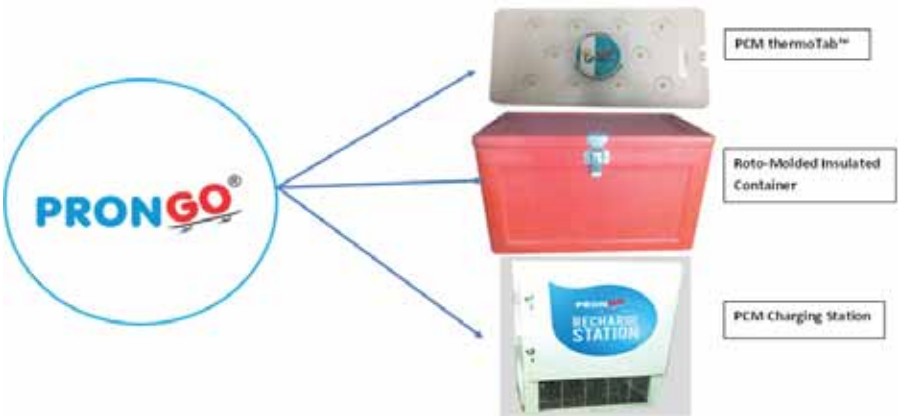

Figure 2: Three components of PronGO® logistics Solution

PronGo® Logistics solution is easy to assemble and assures perfect temperature maintenance during the claimed retention time. Currently, PronGo® Logistics solution is capable of maintaining temperature in 2 ranges:

1) **Frozen Application (-15 to -25 Deg C)**
2) **Chilled Application (2 to 8 Deg C)**

Case Study 1:

A 50 liter roto-molded box was taken and experimented upon with the under-written parameters. The main objective of the experiment was to determine the number of retention hours obtained with the current placement of the thermoTab™ containing a suitable PCM solution at -20 Deg C.

- Internal Capacity: 50 liters
- Insulation Type and Thickness: PUF and 25mm
- Temperature to be maintained: -20 Deg C
- Volume of PCM: 23 liters
- Payload Volume: 27 liters
- Retention hours obtained: 16 hours

Case Study 2:

A 50 liter roto-molded box was taken and experimented upon. The main objective of the experiment was to

Figure 3: variable temperature maintenance for different products

Frozen -25 to -15 Deg C
• Meat , Fish and Poultry • Frozen Fruits and vegetables • Ice-cream

Chilled 2 to 8 Deg C
• Fresh Fruits and vegetables • Milk and Dairy Products • Flowers and Eggs • Insulin

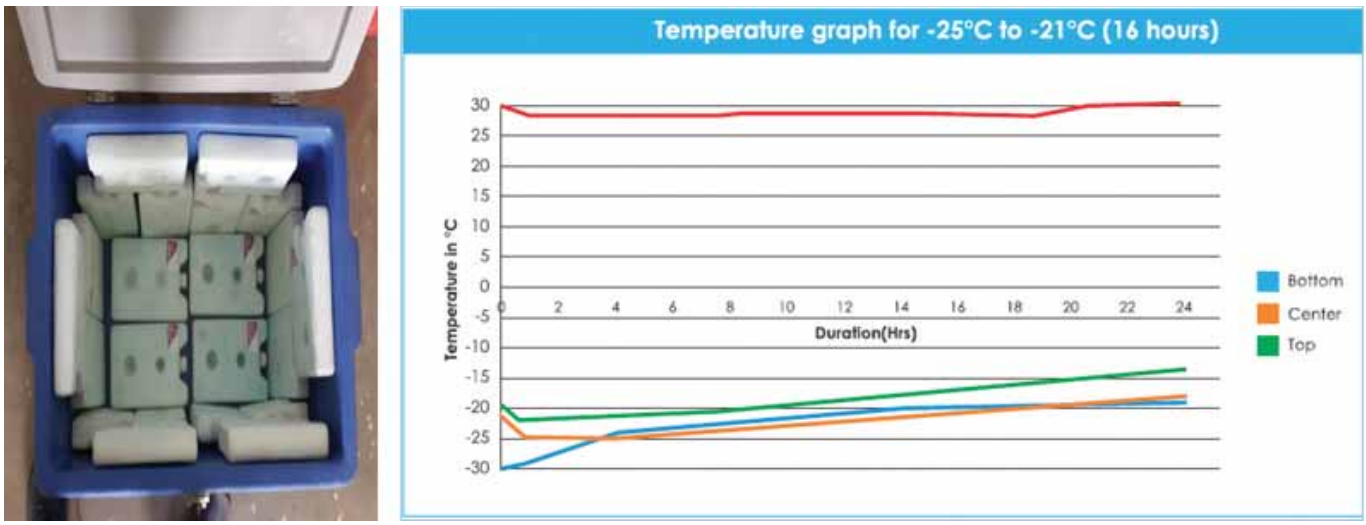

Figure 4: Thermotab™ placement and temperature validation

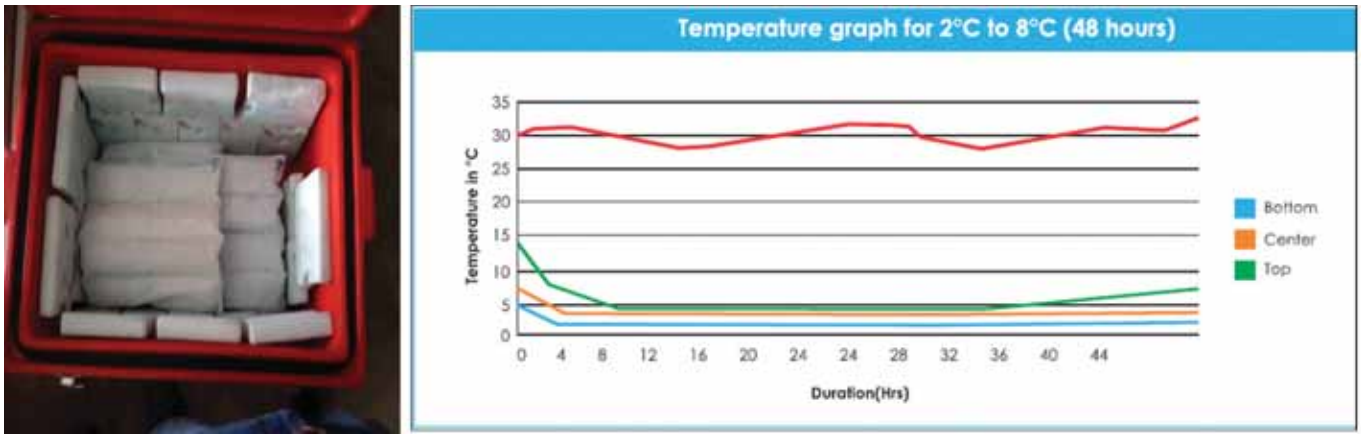

Figure 5: Thermotab™ placement and temperature validation

determine the number of retention hours obtained with the current placement of the thermoTab™ containing a suitable PCM solution between 2 to 8 Deg C.

- Internal Capacity: 50 liter
- Insulation Type and Thickness: PUF and 25mm
- Temperature to be maintained: 2 to 8 Deg C
- Volume of PCM: 19 liters
- Payload Volume: 31 liters
- Retention hours obtained: 48 hours

Conclusion

Use of PCM as the temperature specific logistics solution provides the following advantages:

a) **Precise Temperature Backup**: Greatly increases the available protection against adverse low and high environmental temperatures.

b) **More Payload:** Without affecting the thermal performance, we can increase the payload, thanks to PCM technology.

c) **Low Shipment/Consignment Weight**: Similar to payload volume, a reduction in total system weight could be achieved by using PCM, while maintaining thermal performance.

d) **Easy to Use:** There are only two component to be placed i.e. the roto-molded insulated box and the PCM thermotab, making assembly simpler and faster.

e) **Lower Cost:** With a payback of less than two years and remaining years of saving is achieved as the operating cost of PCM is very less as compared to other conventional solutions.

f) **Increased Distribution Radius:** Greater retention is a virtue of high latent heat of the PCM.

g) **Decreased Wastage:** With precise temperature maintenance, no perishable item is wasted. ■

Devakar Dhingra
Senior Associate,
International Business
Development, PCM

Showcasing Cutting-edge Technologies

After five successful years, the 6th Cold Chain Conference with a new theme "Tapping the Unexplored Opportunities in Cold Chain Business in India" would definitely open new horizons in the growing cold chain industry. Taking place on 12th & 13th December 2017, the conference will draw together world's brightest innovators to network, expand their market coverage and forecast future market targets...

Sixth edition of India Cold Chain Show will open in Mumbai and is set to be the biggest of all previous editions. The industry has seen the rise of ICCS and it evolution as the power center of Indian cold chain industry. India Cold Chain show is taking place from 12-13-14 December 2017 at Bombay Exhibition Centre, Goregaon (E), Mumbai. Encompassing commercial collaboration across the cold supply chain industry, ICCS is an event set explicitly to highlight creativity and innovation with a specific focus on business and investment on regional and international scale.

"In every edition, the show broke new ground by pulling together exhibitors and visitors across the world to display technologies that can fulfill the requirement of the industry. To live up to the mark, this year ICCS has launched "Cold Chain Tour," where we already concluded 210 meetings with 92 companies and invited 35 new food based associations. The cold chain team visited some key regions in India including Himachal Pradesh, Karnataka, Tamil Nadu, Rajasthan, Agra, Lucknow, Madhya Pradesh, Telangana, Andhra Pradesh and Assam which will deliver potential buyers to the exhibitors who require cold chain products and solutions," said Anuj Mathur, Managing Director, Reed Manch Exhibitions. We have also launched a new business matchmaking app GoConnect where we can get a chance to meet registered visitors, VIPs, conference delegates, overseas suppliers in a one-on-one basis. We believe it will help to build solid foundation for exhibitors as well as for visitors for fruitful business tie-ups," added Mathur.

Spread in an area of 4500 sqm, the show aimed to bring together more than 220 exhibitors from 12 countries showcasing cutting-edge technologies in cold storage, cold rooms, refrigeration & air-conditioning, logistics solutions, food-processing etc. A number of product launches from leading brands will also be beneficial for the industry. ICCS 2017 signed a contract with Dutch Distribution Centre where 12 companies will come together to create a One Stop Shop where they will showcase the latest technologies and cold chain solutions for the first time in India. It will also enable exhibitors to expand their horizons in the Indian markets.

"This year our top priority is on dairy, pharma, fruits & vegetable, seafood companies, ice-cream manufacturers and seed industry to get buyers from these sectors. To add value to this, we got several new industry associations support including The Agricultural and Processed Food Products Export Development Authority (APEDA), Association of Ammonia Refrigeration (AAR), Federation of Cold Storages Association (FCAOI), Indian Industries Association (IIA), National Horticulture Board (NHB), The Refrigeration & Air-Conditioning Trades Association Ltd. (RATA), Maharashtra Rajya Sahakari Dudh Mahasangh Maryadit (MRSDMM), National Seed Association of India (NSAI), Strawberry Growers Association of India, Maharashtra Chamber of Commerce, Industry & Agriculture (MACCIA) and Confederation of Indian Horticulture (CIH). Leading brands have parked their trust by continuing their association with the show like Pluss Advanced Technologies Pvt. Ltd.is our Conference Partner, Geetee Carriers Pvt Ltd is sponsoring our Lanyard Partner and IK Industries as a registration partner.

After five successful years, the 6th Cold Chain Conference with a new theme 'Tapping the Unexplored Opportunities in Cold Chain Business in India'would definitely open new horizons in the growing cold chain industry. Taking place on 12th & 13th December 2017, the conference will draw together world's brightest innovators to network, expand their market coverage and forecast future market targets.

"ICCS 2017 is not only about exhibiting and visiting but also a unique opportunity to be in front of key players of the industry. Adding to this, our VIP Buyers Programme will assemble India's well-known entrepreneurs and thought leaders to have insightful discussions to improve company's efficiency while learning about modern techniques and developing new business relationship, concluded Mathur.

There are enough reasons for everyone in the industry to plan their visit and attend the most promising event on cold chain sector in India. ■

Minimalistic Design, Maximum Information

To make the task of climate monitoring easy, wireless & aesthetically soothing, Testo has now introduced its new range of data loggers for building climate monitoring, named as TESTO 160...

Need for Climate Monitoring Systems

A better understanding of indoor climate in industries and its impact has become crucial to define and implement appropriate mitigation and adaptation policies, including investment policies for large infrastructure with long lifecycles. This in turn, has hiked the demand for climate monitoring systems considerably over the recent decades, which further increases the fundamental need for authoritative climate information and services upon which to base strategic plans, investments and day-to-day decisions. To make this task of climate monitoring easy, wireless & aesthetically soothing, Testo has now introduced its new range of data loggers for building climate monitoring, named as TESTO 160. This new range of data loggers from Testo with its five different models, help you keep your monitored locations aesthetically perfect, thanks to its small size and deco covers which helps it to blend with the surroundings.

Comprehensive and Wireless: Technology

The monitoring system Testo 160 measures, monitors and documents temperature, humidity, light intensity, UV radiation, CO_2 concentration, atmospheric pressure, continuously, precisely and automatically. This serves ambient climate monitoring and also preservation of valuable objects or systems.

The data loggers transfer the measurement values by wireless LAN to an online store, the Testo Cloud. From there, they can be called up by PC/tablet/smartphone from any place with internet access. If individually defined upper or lower limit values are exceeded, an alarm notification gets activated. For light intensity, an alarm can also be triggered if the accumulated light quantity within a day, a week or a month exceeds a limit value.

Unobtrusive and Individual: Product Design

The data loggers are specially designed such that they present

themselves discreetly and inconspicuously. Thanks to the deco-cover, they also blend in with any background. These optionally available housing covers can be individually painted or decorated. Just as the respective background requires.

The loggers have internal and external sensors. The latter are, thanks to their design and size, ideal for monitoring in small glass cases, in which otherwise a data logger cannot be placed.

Application Areas

Testo 160 climate monitoring system finds applications in:

- Facility Management
- HVAC Maintenance
- Malls & Offices
- Hotels & Airports
- Cold Storages & Warehouses

And find special applications in:

- Showcases & Display Spaces
- Museums & Archives
- Libraries & Archives

Choose model

The Testo 160 climate monitoring system consists of five different models that suits your application and measurement needs.

- **Testo 160 TH**

WiFi data logger Testo 160 TH is an easy-to-use data logger for monitoring temperature and humidity with an integrated temperature and humidity sensor.

- **Testo 160 THE**

WiFi data logger Testo 160 THE is an easy-to-use data logger for monitoring temperature and humidity with an integrated temperature and humidity sensor. It also has an option to connect up to two additional probes (ordered separately) for temperature, humidity, lux or lux and UV radiation.

- **Testo 160 THL**

WiFi data logger Testo 160 THL is more than just an easy-to-use climate logger for humidity and temperature monitoring. Thanks to additional integrated sensors for lux and UV radiation, it provides accurate information about the light conditions.

- **Testo 160 E**

WiFi data logger Testo 160 E adapts perfectly to your climate monitoring requirements. It offers 2 connection options for probes for temperature, humidity, lux or lux and UV radiation.

- **Testo 160 IAQ**

The easy-to-use WiFi data logger Testo 160 IAQ is ideal for monitoring indoor air quality. Thanks to its integrated sensors for temperature, humidity, CO_2 and atmospheric pressure, it accurately determines the climatic conditions in rooms. It can also perform long-term measurements without any difficulty.

Testo is recognized as the leading worldwide manufacturer of portable measuring instruments for various parameters. We aim to provide the best quality, service and value in the industry and thus, are committed to satisfy our customer needs for precise measurement and monitoring by offering them the best technological advancements in the industry for their daily measurement needs. ■

Write back to us at info@testo.in to know more about Testo 160-Building Climate Monitoring Systems.

Supporting Cause of Excellence, Innovation & Energy Efficiency

The Emerson Cup 2017

The Emerson Cup completed a major landmark in its eventful saga, with the competition completing 10 years, since its inception in 2008. Over the years, The Emerson Cup has received hundreds of nominations, and is one of the first competitions to celebrate the entire spectrum of design-technology, energy efficiency, architecture, human comfort, and more in the heating, ventilation, air conditioning & refrigeration (HVACR) industry.

The award is recognized as one of the most prestigious, marquee competitions of the Indian HVACR industry and a platform for showcasing emerging trends and practices amongst its professionals. The 10th Anniversary celebration held at Jaipur in conjunction with the India Green Building Council (IGBC) was historic and memorable with crème dela crème of the HVACR industry in attendance, together as one to recognize and reward talent.

The Emerson Cup 2017 *had five award categories this year:*

- IGBC Green New Buildings- Owner Occupied
- IGBC Green New Buildings -Tenant Occupied
- IGBC Green Existing Buildings
- IGBC Green Healthcare Facilities
- IGBC Green Mass Rapid Transit System (MRTS)

Speaking on the occasion Shirish Adi, Vice President & Managing Director, India, Emerson's Commercial & Residential platform said, "It is a momentous occasion with The Emerson Cup completing 10 years. Over the years, the award has evolved and grown with the changes in the HVACR industry and set benchmarks that fulfill our mission of improving human comfort, safeguarding food, saving energy and protecting the environment." He went on to add, "We are truly honored to host The Emerson cup each year in conjunction with the IGBC program and doing our bit to create a sustainable future."

The awards were selected by an experienced and distinguished panel of judges who have won acclaim within the industry for their contributions and achievements.

The first category of the evening, the IGBC Green New Buildings-Owner Occupied was conferred on Infosys Ltd, for the Infosys SDB 2&3 Pocharam, Hyderabad campus & ITC Ltd for their Hotel Grand Chola, Chennai.

While the excellence award for the IGBC Green New Buildings-Owner Occupied category was awarded to Godrej Properties Ltd and SM Sehgal Foundation for their outstanding projects Godrej One, Mumbai and SM Sehgal Foundation Phase 2, Gurgaon respectively.

The award in IGBC Green Existing Buildings Category was won by Mumbai International Airport Pvt Ltd for their Terminal 2 & Mindtree for their East Campus at Bengaluru. Keeping into account the quality of entries and recognizing the close competition, the jury decided to give Commendation Awards in the Existing Buildings category to Delhi International Airport (P) Ltd & Tata Sons-The Associated Building Co Ltd for their projects Terminal 3 of the Indira Gandhi International Airport Delhi & Tata Bombay House, Mumbai respectively.

In the newly introduced IGBC Green Healthcare category, Reliance Foundation won the excellence award for their Sir HN Reliance Foundation Hospital, Mumbai along with Max Healthcare Institute Ltd for their Max Super Specialty Hospital, Bhatinda.

In the other new category of IGBC Green Mass Rapid Transit System (MRTS), the award was won by Delhi Metro Rail Corporation Ltd for their work on 15 stations of the Delhi-Faridabad corridor.

The Emerson Cup 2017 raised the bar further in terms of new technology and professional practices. What's more, the Cup also turned the spotlight on new talent and aspirations. ■

Innovative New Generation Air Curtain from VTS

VTS, the leading global manufacturer of HVAC equipment, sets a benchmark on the Indian market with its innovations. WING made by VTS redefines the Air Curtains category, offering investors a product with ultra-modern design that meets the latest trends and parameters that are suited for every interior...

VTS engineers, taking advantage of their experience gained over the years of manufacturing and operating, have developed a new, innovative design of the WING curtain, which combines both functional and aesthetic qualities as well as meets the current requirements for acoustics and energy saving. The quietest curtain currently available on the market will be now available on Indian market. Owing to special solutions reducing air flow resistance and application of EC motors as well as a precisely developed rotor and air structuring device blades, the electricity consumption has been successfully reduced along with obtaining the required air stream range and the outstandingly short start-up time to full performance. The innovative and aesthetic shape of the WING curtain complements its unrivalled perfection.

Due to the quality of applied solutions, a lifetime warranty on the housing and a five-year warranty on the final product can be granted. Air Curtain WING from VTS, which has been the leading global manufacturer of air curtains for years, redefines the air curtains category, providing investors with a product whose design meets the latest trends and whose parameters are suited for every interior.

The entry zone in contemporary construction has not only functional, but also representative importance. The aesthetics of the interior and the comfort of persons present in the entrance hall of the modern office building, bank, apartment block, office or other public utility facility are one of the most important features of this part of the building. A major issue of the entry zone is the external doors which are opened frequently, thus, causing energy losses and drafts which bother the persons present inside. The vestibules which have been used for years eliminate these inconveniences, but they are not popular among the architects, since they prevent the architects from using this visiting space in an optimum manner.

Air curtains are an alternative for vestibules that complies with good practice and applicable legal provisions. However, they should also match the representative character of the space in which they are installed, apart from providing effective reduction of heat exchange through open doors and low exploitation costs expected by the user. Thus, the aesthetic values and silent operation (apart from effectiveness of operation and power efficiency) are the most important features of these devices that are an important element of technical and aesthetic fitting of a contemporary building.

Air curtains reduce air exchange through the open external doors, thus, protecting the interiors of the building against the inflow of cold air in the winter and hot air in the summer,

as well as the entry of insects and contamination. The principle of operation is simple. The curtain within the whole door or gate surface creates an intensive air stream, which is directed vertically or horizontally, tangentially in relation to the surface air of the door opening.

Today, the greatest advantage in the scope of functionality, aesthetics and power efficiency is offered by innovation. The design is one of the best tools for providing innovative solutions that place the users' needs in the centre. WING air curtain was created from passion for design and on the basis of a dream to achieve exceptional results; it combines an unpretentious form and master execution. Streamlined WING topped up with the side cover with a diamond shape which is nearly invisible is the fruit of the engineering idea, which led to designing the device structure in a manner that ensures subtlety that ideally matches any interiors in functional and aesthetic terms. Transforming ideas of a designer into reality has resulted in a product which is a real luxury on the mass market, due to its unique concept. Having smart form, it is characterized by intuitive operation and easy installation.

Sizes of Offered Curtains

In order to obtain a required efficiency of an air curtain, it should cover the entire door opening area. The WING curtains are available in lengths of 100, 150 and 200 cm.

In the case of larger openings, more than one of the curtains next to each other should be used. All WING curtain are suitable for vertical and horizontal installation, both individually and as a group.

EC motors in combination with the modern fan design in WING curtain ensure up to 40% of electric energy saving, when compared with traditional solutions.

The representative character of the entrance zone of contemporary building imposes high and strict requirements onto all the elements mounted on it. The air curtains, mounted in the entrance zone, should – beside functional performance – meet

UP TO 8 AIR CURTAINS WITH ONE CONTROLLER

The possibility of connecting 8 devices to one WING EC controller reduces also investment costs. The investor uses one conveniently located controller to manage up to 8 units.

high aesthetic standards and be characterised by low noise emission. The significant features of modern machinery include energy cost-effectiveness, i.e. a minimal energy consumption at required operational parameters, as well as a possibility of dynamic support of the room air-condition system, started automatically when needs occur. All these criteria are fulfilled by the WING EC curtain of VTS, offering – at a very attractive price – the standard which has, so far, been reserved for premium class devices only.

A still better effect of electric energy saving, as well as of heat and cooling saving, can be achieved when the fan is activated only when the door is open. However, technical solutions are needed that enable the start-up of the device with full capacity in a fraction of a second upon door opening. It is possible with the special design of the fan rotor, made of composite materials, which, despite its high performance levels, is characterised by an exceptionally low moment of inertia. The activation of this function in WING EC curtains is carried out by an additionally mounted open door sensor, combined with the Wing EC controller.

The application of microprocessor technology to control the WING EC curtain enables, beside performance changes, the control of many other working parameters, tailored to customer's needs. It also provides a convenient display of parameter settings and measured values. The main functions, supported by the WING EC controller, include:

- infinitely variable or manual fan performance control
- temperature control,
- support of an optional, external temperature sensor at a given room,
- support of a door opening sensor,
- support of a weekly program of curtain operation time points for working and weekend days,
- support of BMS systems.

Summary

WING is a new generation device, created because of a passion for the distinguished form and technological advancement-which are characteristic for gliders. A minimalist housing with a streamlined form of a wing seems to float in the air. The housing topped up with a diamond that hides excellent components in an innovative curtain body sets new standards for the category of curtains. WING combines unique design and excellent efficiency and therefore it completely redefines the air curtain image. ■

List of Approved Cold Chain Projects in Gujarat & Maharashtra as on 31.08.2017

S. No.	Project	Sector	District	Date of Approval	Project cost (Rs. In Crore)	Amount of grant released (Rs. In Crore)	Physical Progress
(1)	(2)	(4)	(5)	(7)	(10)	(13)	(31)
Gujarat Total 20, completed 8, ongoing 12							
1	Asandas & Sons	F&V	Mehsana	20.09.2013	46.12	7.67	Production started
2	Gayatri Dairy Products Pvt. Ltd	Dairy	Mehsana	04.07.2012	15.15	4.50	Production started
3	Hi-Tech Frozen Facilities Pvt Ltd.	F&V	Palsana, Surat	27.03.2009	16.83	7.19	Production started
4	Himalaya International Ltd.	Mixed (Dairy, F&V)	Mehsana	04.10.2013	130.00	7.50	Reported completion of project
5	Innovative Cuisine Pvt. Ltd.	F&V	Baroda	20.09.2013	20.72	7.46	Production started
6	Natural Frozen & Dehydrated Foods	F&V	Bhavnagar	26.05.2011	12.50	2.90	Production started
7	Panchmahal Dist Co-Operative Milk Producers' Union Ltd.	Dairy	Panchmhal	04.10.2013	28.80	8.12	Production started
8	Sabarkantha Dist. Co-op Society	Dairy	Sabarkantha	25.05.2011	23.80	5.72	Production started
9	Vimal Dairy Pvt. Ltd	Dairy	Surat	22.05.2015	28.86	2.50	Reported 75% progress
10	Banaskantha Dist. Coop. Milk Producers Union Ltd.	Dairy	Banaskantha	17.04.2017	58.46		Under implementation
11	Global Gourmet Pvt Ltd	F&V	Vadodara	17.04.2017	38.00		Under implementation
12	Desai Brothers Ltd	F&V	Anand	17.04.2017	24.85		Under implementation
13	Mehsana Dairy & Food Products Ltd	Dairy	Mehsana	17.04.2017	29.46		Under implementation
14	HMP Agro Green Pvt Ltd.	F&V	Banaskantha	17.04.2017	25.38		Under implementation
15	Kitchen Xpress Overseas Ltd.	RTE/RTC	Ahmedabad	17.04.2017	25.18		Under implementation
16	Ahmedabad District Co – operative Milk Producer's Union Limited	Dairy	Ahmedabad	20.04.2017	176.74		under implementation
17	Sabarkantha District Co-operative Milk Producers' Union Limited	Dairy	Sabarkantha	17.04.2017	41.83		Under implementation
18	Saraf Foods Ltd	F&V	Vadodara	25.04.2017	35.00		Under implementation
19	Teknofine Foods Pvt Ltd	F&V	Banaskantha	26.04.2017	46.00		Under implementation
20	Wholesome Foods	F&V	Kheda	27.04.2017	32.85		Reported 25% progress
Total					856.52	53.56	
Maharashtra Total 49, completed 26, ongoing 23							
1	B. Y. Agro & Infra Pvt. Ltd.	Mixed (Dairy, F&V)	Nagpur	05.07.2012	34.94	7.25	Production started
2	Blue Fin Frozen Pvt. Ltd.	Fishery	Raigad	04.07.2012	25.46	6.16	Production started
3	Baramati Agro Limited	Meat & Poultry	Pune	20.09.2013	9.11	3.89	Production started
4	Cold Star Logistics Pvt. Ltd.	F&V	Raigad	05.09.2012	23.26	9.24	Production started
5	D.J. Exports Pvt.Ltd.	F&V	Thane, Pune	04.10.2013	18.31	5.19	Production started
6	Elaf Cold Storage	Mixed (Meat, F&V)	Raigad	20.09.2013	17.56	7.16	Production started
7	Forstar Frozen Food Pvt. Ltd.	Fishery	Navi Mumbai	04.10.2013	36.68	10.00	Production started
8	Freshtrop Fruits Ltd.	F&V	Nashik	27.03.2009	32.75	8.47	Production started
9	Global Foods	Pulses, F&V, Spices	Nagpur	04.10.2013	24.28	7.26	Reported completion of project
10	Gonglu Agro Pvt Ltd	F&V	Nashik	22.05.2015	25.20	2.50	Reported 75% progress

11	Haldiram Foods Intl. Limited	F&V	Nagpur	28.08.2012	28.00	6.11	Production started
12	I.G. International	F&V	Chennai, Amravati	25.05.2011	22.25	8.96	Production started
13	Indapur Dairy & Milk Products Ltd	Dairy	Pune	20.09.2013	16.03	7.07	Production started
14	Mhetre Foods Pvt. Ltd	F&V	Pune	20.09.2013	12.51	4.78	Production started
15	Omni Fresh Agro	F&V	Nashik	20.09.2013	19.63	5.65	Production started
16	Saastha Warehousing Ltd	F&V	Raigad	25.05.2011	42.81	9.21	Production started
17	Savla Foods & Cold Storage Pvt Ltd	F&V	Mumbai	25.05.2011	27.00	7.20	Production started
18	Saikrupa Industries	Dairy	Nashik	20.09.2013	5.44	2.06	Production started
19	Satec Envir Engineering (I) Pvt. Ltd	F&V	Nashik	20.09.2013	22.62	5.47	Reported completion of project
20	Shivtirth Dairy & Agro Producers Company Ltd	Dairy	Sangli	20.09.2013	8.20	2.45	Production started
21	Sunfresh Agro Industries Pvt. Ltd	Dairy	Ahmednagar	20.09.2013	46.18	9.55	Production started
22	Swaraj India Industries Ltd.	Dairy	Satara	20.11.2013	26.21	7.50	Reported completion of project
23	Tirupati Balaji Agro Products Pvt. Ltd.	F&V	Pune	20.09.2013	50.41	5.93	Reported completion of project
24	VaishVik Foods Pvt. Ltd.	F&V	Satara	04.10.2013	26.53	7.39	Reported completion of project
25	Warana Dairy & Agro Industries Ltd,	Dairy	Sholapur	01.06.2011	43.31	9.15	Production started
26	Western Hill Foods Ltd.	F&V	Pune	31.07.2012	20.96	7.42	Production started
27	Western Superfresh Corporation	Meat, Poultry & Dairy	Raigad	22.05.2015	38.70	8.46	Production started
28	Rishi Ice and Cold Storage Pvt. Ltd.	F&V	Navi Mumbai	30.09.2016	24.87	2.07	25% progress
29	Farmico Cold Storage Pvt. Ltd.	F&V	Nagpur	17.04.2017	31.29		Under implementation
30	Balmer Lawrie & Co. Ltd.	F&V	Raigad	19.04.2017	57.27		Under implementation
31	Ananth Dudh Pvt Ltd.	Dairy	Pune	17.04.2017	27.41		Under implementation
32	S. R. Thorat Milk Products Pvt. Ltd.	Dairy	Ahmednagar	17.04.2017	27.00		Under implementation
33	RGA Fresh Fruits Pvt. Ltd.	F&V	Thane	25.04.2017	35.74		Under implementation
34	Prabhat Dairy Ltd.	Dairy	Srirampur	17.04.2017	26.48		Under implementation
35	Kool Solutions India Pvt. Ltd.	Mixed	Mumbai	20.04.2017	63.30		Reported 25% progress
36	Kaira District Co-operative Milk Producers' Union Ltd.	Dairy	Pune	02.05.2017	80.78		Under implementation
37	P.D. Shah and Sons Cold Storage Pvt. Ltd.	F&V	Satara	17.04.2017	22.79		Under implementation
38	Manganga Dairy Industries	Dairy	Solapur	17.04.2017	5.31		Under implementation
39	Kisan Mitra Cold Storage Pvt. Ltd.	F&V	Latur	17.04.2017	17.45		Under implementation
40	Nature Delight Dairy & Dairy Products Private Limited	Dairy	Pune	20.04.2017	33.74		Under implementation
41	Vaishno Devi Food Products Pvt Ltd	Dairy	Osmanabad	19.04.2017	23.80		Under implementation
42	Seasaga Enterprises Pvt. Ltd	Marine	Raigad	19.04.2017	48.08		Reported 25% progress
43	Siva Sai Exports	F&V	Nashik	25.04.2017	23.38		Under implementation
44	Swapnapurti Food Products Pvt. Ltd.	Dairy	Chandrapur	19.04.2017	4.68		Under implementation
45	Vaishnavi Grape & Pomegranate Processing Pvt Ltd.	F&V	Solapur	03.05.2017	24.32		Under implementation
46	Royal Cold Chain	F&V	Solapur	25.04.2017	27.49		Under implementation
47	Sri Sri Milk and Food Product	Dairy	Pune	19.04.2017	12.88		Under implementation
48	Varun Agro Processing Foods Private Limited	F&V	Nashik	25.04.2017	28.35		Under implementation
49	Bharti Global Food Products Pvt. Ltd.	Dairy	Beed	04.08.2017	22.98		Under implementation
Total					1373.73	183.56	

BELIMO's Sensors Complement to Actuators & Valves

To achieve a good room climate and energy efficiency in heating, ventilation and air conditioning plants reliable field devices such as actuators, control valves, and sensors are required. While actuators and valves control flows of air and water, sensors measure temperature, humidity, pressure, air quality or flows. They are installed in rooms, air ducts or pipes.

Sensible expansion of our range

Belimo has many years of experience in developing high-quality sensors for the HVAC industry that assure the reliable recording of information and guarantee the best possible data quality. We are expanding our core business of components with integrated sensors by adding autonomous sensors that can be applied to any system design. Belimo is launching a complete product range of sensors optimally tailored to Belimo actuators and valves that can be seamlessly integrated into existing or new building automation systems. ■

Email: info.india@belimo.ch

Carrier Launches New Digital Solutions

Carrier is introducing a suite of digital solutions that will improve engagement and remote management of commercial heating, ventilating and air conditioning (HVAC) systems. Customers with Carrier® SMART Service will now have visibility into their system's performance and energy usage through a new equipment dashboard and mobile application.

In addition, they will have access to an online community portal to help them manage the service and maintenance activity on their HVAC assets. With greater connectivity and system insight, building owners and facility managers can be more proactive about increasing the performance, efficiency and uptime of their systems.

Carrier, a world leader in high-technology heating, air-conditioning and refrigeration solutions, is a part of UTC Climate, Controls & Security, unit of United Technologies Corporation. Leveraging the rapidly expanding capabilities of the internet of things (IoT) and cloud-based applications and data management, Carrier has designed these tools to enable mobile-first, on-demand customer engagement.

A new equipment dashboard connects customers with their complete portfolio of Carrier SMART Service-enabled equipment, providing real-time visualization of vital system and component level health measures and deeper insight into operating performance and efficiency. Information can be analyzed remotely, so that service technicians can deliver faster, more accurate diagnosis of equipment issues on site. Customers can also get connected via the Carrier SMART Service mobile app now available for iOS and Android devices. With its simple and intuitive interface, users can remotely monitor the health of their portfolio of chillers in real-time and have oversight of key operating parameters, recent energy consumption trends, as well as weather forecasts to help predict future usage. ■

Email: www.carrier.com

Forthcoming Events At A Glance

India Cold Chain Show 2017
Venue: Bombay Exhibition Centre, Goregaon, Mumbai
Date: 12th to 14th December 2017
Website: www.indiacoldchainshow.com

ACREX 2018
Venue: BIEC, Bengaluru
Date: 22nd to 24th February 2018
Website: www.acrex.in

Global Logistics show
Venue: Bombay Exhibition Centre, Mumbai
Date: 22nd to 24th February 2018
Website: http://globallogisticsshow.com

ISK-SODEX Istanbul
Venue: TÜYAP Fair Convention and Congress Cente
Date: 7th to 10th February 2018
Website: http://www.sodex.com.tr

FoodTech Pune 2018
Venue: Pune
Date: 23rd to 25th February 2018
Website: http://foodtechpune.com

Indoor Air 2018
Venue: The Pennsylvania Convention Center, Philadelphia
Date: 22nd to 27th July 2018
Website: http://mms.isiaq.org

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GVK MIAL Bags Prestigious Green Award

GVK Mumbai International Airport Private Limited (MIAL), the company that administers Chhatrapati Shivaji International Airport (CSIA), was awarded the prestigious "Natural Capital Award -2017"in the Eco Corporate (Services) category under the 'YES BANK Natural Capital Awards' program. As a part of the award felicitation, MIAL has also been honored with plantation of 500 trees at Sitamata wildlife Sanctuary, Rajasthan. The accolade was bestowed to GVK MIAL for consistently achieving and implementing various environmental and social programs that corroborated well with 'Natural Capital', a term used to describe the value of the resources and ecosystems endowed by mother earth, essential for economic growth. Sustainability is at the helm of all projects and initiatives that are undertaken at GVK MIAL. An overwhelming achievement, this award is a testament of the unswerving commitment shown by the company on the path towards the ideology of holistic and sustainable development. ■

World's First LEED Platinum Certified Pharmaceutical Factory

Johnson Controls, a leader in creating intelligent buildings and efficient energy solutions to deliver on the promise of smart cities and communities, announced its instrumental role in helping Pfizer build its first LEED-NC Platinum certified pharmaceutical factory in the world. This follows an expansion project at Pfizer's factory in Dalian, China. As the chosen strategic partner for this project, Johnson Controls provided lifecycle green building certification consulting services, alongside building controls systems and other related products to help Pfizer successfully meet energy efficiency challenges in the pharmaceutical industry. As a result, a significant improvement in energy efficiency was recorded, including savings in water (45 percent), energy (35 percent) and cost (28 percent), according to the standards of ASHRAE90.1-2007. The factory in Dalian is

Pfizer's first production base in China. The expansion project, which is an aseptic workshop for cephalosporin products, is a key step in Pfizer's efforts to expand investment and capabilities in China. Covering an area of about 13,000 square meters, the expanded area was constructed in 2014 and completed in April 2017. Johnson Controls was involved throughout the full design and construction process of the area. ■

Double LEED Platinum Convention Center in World

The Vancouver Convention Centre was awarded LEED Platinum certification (version 4) for Existing Buildings: Operations and Maintenance this year. Coupled with its 2010 Platinum certification for New Construction, the Convention Centre is the first double LEED Platinum convention centre in the world. The Vancouver Convention Centre has been constructed to the highest environmental standard with features like our six-acre living roof and impressive green technology.

Platinum is the highest level of LEED (Leadership in Energy and Environmental Design). Version 4 is the newest version of the rating system. Vancouver Convention Centre has raised its benchmark in sustainability realm.

The already greener-than-green convention center's West building was awarded LEED (Leadership in Energy and Environmental Design) Platinum certification (version 4) for

Existing Buildings: Operations and Maintenance by the Canada Green Building Council. Coupled with its 2010 LEED Platinum certification for New Construction, the VCC now owns the bragging rights for being the only double LEED Platinum convention center in the world. ■

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